

A circular inset image showing industrial machinery, possibly a paper mill or textile loom, with large spools and mechanical components. A semi-transparent globe with a grid pattern is overlaid on the left side of the circle. The background of the entire page is black, with a red vertical bar on the right side.

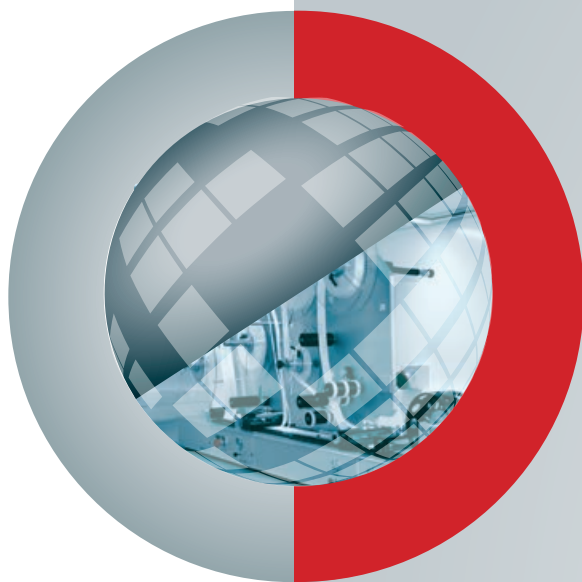
2017 ANNUAL INTERGRATED REPORT

YOUR PARTNER IN UNLOCKING MINERAL WEALTH

As a global leader in minerals and metallurgical innovation, Mintek provides world-class Research and Development (R&D) expertise, testwork, and process optimisation for all mineral sectors at local and international level.

The activities range from initial bench-top investigations to full process flowsheet development, pilot- and demonstration plant design and optimisation of industrial plants. Mintek employs about 650 staff, which include qualified and experienced engineers and scientists who are leaders in their fields of specialisation.





CONTENTS

1. Introduction

Common Vision, Shared Values and Culture	06
Corporate Profile and Organisational Structure	07
Mintek's Integrated Value Chain	08

2. Strategic Performance

Chairperson's Overview	12
Chief Executive Officer's Review	14
Mintek Strategic Objectives	17
Strategic Performance Report	18

3. Governance & Remuneration

Board Matters	28
The Mintek Board of Directors	28
Executive Members	31
Corporate Governance Report	32
Remuneration Report	39

4. Operational Performance

Energy Minerals	42
Base Metals	42
Ferrous Minerals	43
Technology Metals	44
Industrial Minerals	45
Precious Metals	45
Eco Efficiency and Environmental Protection	47
Advanced Metal Applications	50
Small Business Development	52
Process Monitoring and Control	54
Collaborations and Science Promotion	56

5. Sustainable Development

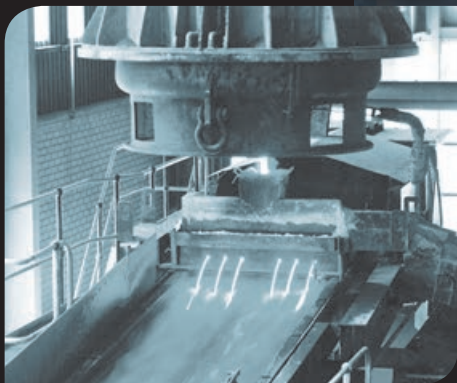
Performance Against Mintek's Sustainability Focus Areas	62
Investing in Mintek's People	66
Recognition and Excellence Awards	68
Safety, Health and Wellbeing of Mintek's People	71
Protection of the Environment	72
Quality of Mintek's Work	75
Corporate Social Responsibility	76

6. Financial Performance

Chief Financial Officer's Review	80
Audit and Risk Committee Report	83
Directors' Responsibilities and Approval	85
Directors' Report	86
Report of the Auditor-General South Africa	86
Annexure to the Report of the Auditor-General South Africa	91
Audited Financial Statements	92
Consolidated Statements of Financial Position	92
Consolidated Statements of Comprehensive Income	93
Consolidated Statements of Changes In Equity	94
Consolidated Statements of Cash Flows	95
Accounting Policies	96
Notes to the Consolidated Financial Statements	101
Audited Financial Statements (Mindev)	117
Mindev (Pty) Ltd Statement of Financial Position	117
Mindev (Pty) Ltd Statement of Changes in Equity	117
Mindev (Pty) Ltd Accounting Policies	118
Mindev (Pty) Ltd Notes to the Financial Statements	119

7. Research Outputs

Poster Presentations	122
Oral Presentations	123
Conference Papers	129
Book Chapters	132
Journal Articles	132
Glossary	134



*Pyrometallurgy Services at Mintek.
From top to bottom: Top-
Blown Rotary Converter
(TBRO), Generic Granulation
and Smelting & Furnace
Optimisation.*





1

Introduction

Common Vision and Shared Values	06
Corporate Profile and Organisational Structure	07
Mintek's Intergrated Value Chain	08

1.1

Common Vision and Shared Values and Culture

Mintek's **mandate** is to serve the national interest through research, development, technology transfer, to promote mineral technology, as well as foster the establishment and expansion of industries in the field of minerals and products derived therefrom.

Mintek's **vision** is to be a global leader in mineral and metallurgical innovation.

The **mission** is to serve our stakeholders by adding value to the mineral sector through research,

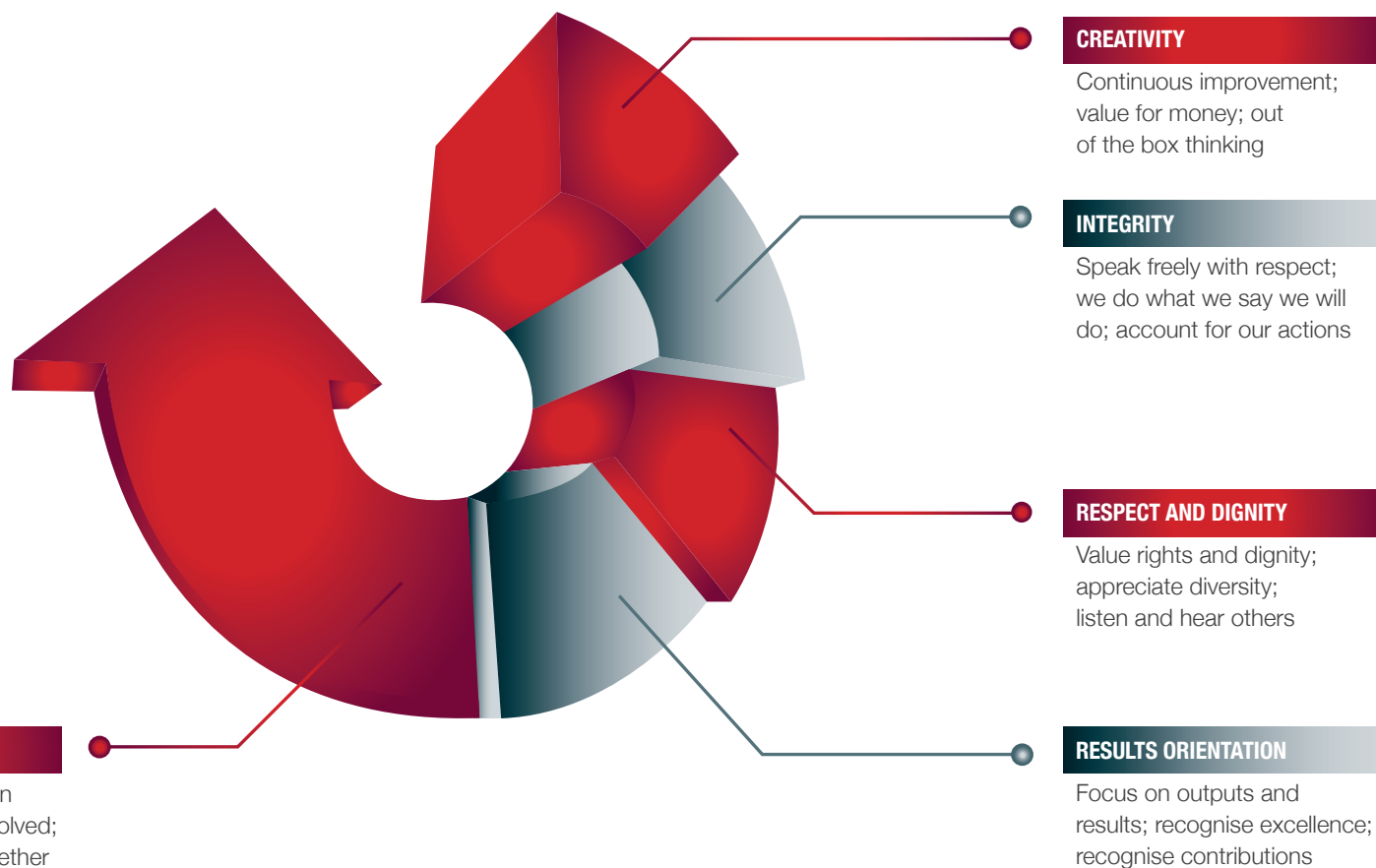
development and technology transfer, in support of national priorities and sustainable growth.

In order to obtain its strategic intent Mintek shall strive to:

- Enhance its visibility and credibility to all stakeholders;
- Research and develop efficient mineral processing technologies and value added products and services;

- Promote the mineral based economies of rural and marginalised communities;
- Uphold good governance practices; and
- Develop human capital and organisational skills to build world class R&D excellence.

Mintek's **shared values** define what it stands for as an organisation and determine the way in which it interprets and responds to business opportunities and challenges. These values are:



1.2

Corporate profile and organisational structure

Mintek is located in Randburg, Johannesburg and was founded in 1934 to assist the mining industry to operate more effectively and profitably. Mintek has achieved international recognition

for its contributions to the global mining sector. The local mining and minerals industry has been very innovative and many notable advances in extraction, refining, and manufacturing

technology that originated in South Africa have impacted on the minerals industry worldwide.





Experimental rubber lined ball mill (0.6m x 0.6m diameter) used to perform laboratory abrasive wear testing of different grinding media/balls from various suppliers, users (mines) and manufacturers.

1.3

Mintek’s Integrated Value Chain

Mintek’s scope of work is illustrated in the integrated value chain outlined below. The bulk of the work is in the parts of the chain that start with concentration through to refining and value addition, as indicated below.





PYROMETALLURGY

With respect to pyrometallurgy, Mintek's work includes:

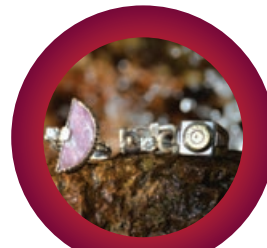
- ▶ Pelletisation and briquetting; Preheating and pre-reduction;
- ▶ DC arc process development and piloting;
- ▶ Modelling and simulation;
- ▶ Submerged-arc furnace (SAF) control strategy;
- ▶ Fluidised bed and controller technologies;
- ▶ Refractories performance investigations;
- ▶ High temperature solid state and phase equilibrium investigations; and
- ▶ Ore, slag, matte and alloy characterisation.



HYDROMETALLURGY & BIOTECHNOLOGY

In hydrometallurgy and biotechnology, Mintek's work includes:

- ▶ Atmospheric and pressure leaching;
- ▶ Bioleaching (refractory gold and base metals);
- ▶ Solvent extraction and ion exchange
- ▶ Electrowinning;
- ▶ Process simulation;
- ▶ Reagent development and evaluation;
- ▶ Gold recovery by CIP/RIP;
- ▶ Activated carbon regeneration;
- ▶ Uranium processing expertise U_3O_8 recovery;
- ▶ Leach circuit control; and
- ▶ Rare Earths Element (REE).



REFINING & VALUE ADDITION

In the latter part of the value chain, Mintek's scope includes:

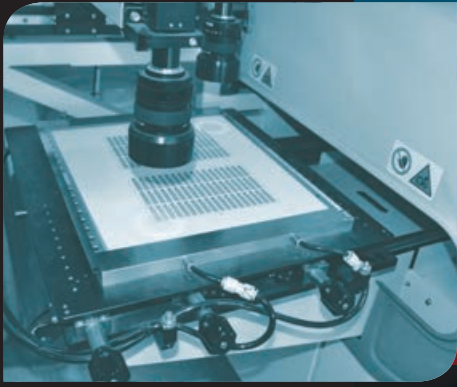
- ▶ Gold refining and value-added products/chemicals; New industrial applications for gold: catalysis, nanotechnology & biomedical;
- ▶ Pyrometallurgical refining of inc (PWG to SHG) and off-grade ferro-alloy fines;
- ▶ Titanium chlorination technology;
- ▶ "Smart" materials and sensors;
- ▶ PGM-based superalloys;
- ▶ Low-nickel stainless alloys;
- ▶ Jewellery fabrication; Gold and platinum jewellery alloys; and
- ▶ Identification of downstream metal-based industries.



GENERAL

Mintek also has resident expertise in the following:

- ▶ Engineering, design, manufacturing, installation and commissioning; and
- ▶ Project management services and Regional mineral-based studies.



Products & Services at Mintek's
Advanced Materials Division
(AMD) offers the Minerals Industry.
From top to bottom:
NicSense™, **MinNanoMinerals™**
and Tissue culture lab.



2

Strategic Performance

Chairperson's Overview	12
Chief Executive Officer's Review	14
Mintek Strategic Objectives	17
Strategic Performance Report	18

2.1

Chairperson's Overview

The challenges for the mining sector continued unabated during 2016. We witnessed a sharp fall in exploration and project development, the cutback on capital expenditure by major mining companies and the struggle by junior miners to raise capital. Furthermore, the global market demand conditions remained low and commodity prices were adversely affected by volatile currencies. Commodities such as coal, PGMs, gold and iron ore continued to represent over 70% of the total revenue of the local mining industry. Despite flat revenues, and global market conditions, the industry is steadily showing promising signs of recovery and an appetite in products and technologies developed by Mintek.

Although Mintek faced its share of challenges in 2016, I am pleased to report that, thanks to the hard work and dedication of the entire Mintek team, we managed to still show notable successes in 2016. Chief among these is the continued progress Mintek has made in expanding its footprint in the rest of the African continent. Subsequent to the excellent results achieved through the application of Mintek's advanced process control systems at Randgold's Loulo mine in Mali, Mintek also concluded installations of its FloatStar™ Level Stabiliser and Flow Optimiser systems on Randgold's flagship plant in Kibali, in the Democratic Republic of Congo. The system was soon extended to include control of the dosing of cyanide in the gold leach circuit using Mintek's LeachStar™ control system. Discussions are underway to extend the system even further to include other sections of the plant.

We also participated in a number of government to government programmes of cooperation. One such programme was the bilateral relations programme between South Africa and Nigeria. Mintek hosted Nigeria's Minister of Solid Minerals Development of the Federal Republic, Honourable Kayode Fayemi and his team on an extremely fruitful visit where Mintek showcased its technologies and facilities to the delegation. Mintek also coordinated a trilateral technical workshop held amongst Mintek, Iran Minerals Processing Research Centre (IMPRC) and Iranian Mines and Mining Industries Development and Renovation Organisation (IMIDRO). The partnership is expected to boost the minerals

processing market between South Africa and Iran.

Closer to home, Mintek hosted researchers from the Botswana Institute for Technology Research & Innovation (BITRI) to forge a closer collaborative partnership between Mintek and BITRI, with the aim of exploring research and development (R&D) opportunities that will benefit the two institutions. A five-day training programme was hosted for the Malian delegates who visited South Africa as part of a capacity building programme for the Women in Mining sector of Mali (AFEMINE). In addition to all the activities on the African continent, Mintek also had active engagements with the Central African Republic, Sudan, Tanzania and Zambia. Mintek also accompanied a delegation of the Department of Science and Technology to Madagascar as part of the Bilateral Agreement signed with South Africa countries in 2015. The Board is quite pleased that the work that Mintek is doing on the continent is a solid demonstration of South Africa's commitment to regional collaboration and development.

Despite the slow South African economic growth, Mintek, continues to support the government's Nine-Point Plan. The plan is aimed at accelerating the economy in the short to medium term by reigniting the economy in order to create much-needed jobs through mining and beneficiation. During the year, amongst a number of skills development initiatives, Mintek trained 300 learners in Mpumalanga in Surface Mining (NQF Level 2) over a period of six months on behalf of the Mining Qualifications Authority (MQA). Learners who

Board Chairperson: Dr Len Konar

benefited from this training came from Chief Albert Luthuli, Emakhazeni, Mkhondo, Thaba Chweu, Thembisile Hani and Umjindi municipalities. This training has created employment opportunities leading to a number of small businesses being registered to pursue mining-related operations.

Derelict and ownerless mines remain a major challenge for South Africa, especially disused asbestos mines. To this end, Mintek continues to manage the implementation of a programme of mine rehabilitation for the Department of Mineral Resources (DMR). The three-year programme valued at R150 million continues from previous programmes and is expected to be completed in 2019. For the year under review, Mintek assisted with the rehabilitation of four sites with a further four sites underway for completion at the end of the 2018/19 financial year. This brings the total number of sites rehabilitated since the inception of the programme in 2009 to 30 sites, 29 of which were asbestos sites. The completed sites benefitted communities from KwaZulu-Natal, Limpopo and Northern Cape provinces with temporary jobs and a healthier environment left behind after rehabilitation.

The partnership between Mintek, government and other science councils in the co-development of TB rapid test kits remains strong. This includes research collaboration with the CSIR for the aptamer-based rapid diagnostic test development of HIV and TB. The DST/Mintek Nanotechnology Innovation Centre concluded a distribution agreement with Afri-Sky Holdings for the marketing and commercialisation of HIV and Malaria rapid test kits with the South African Development Community.

Notwithstanding challenges, Mintek has continued to intensify research collaborations with existing research partners in its relentless pursuit of excellence in the research and development of new technologies for the mining industry. In support of the National Development Plan, and in particular the areas of improved extraction efficiency to extend ore resources, improved energy and water efficiency and downstream beneficiation, value-

added products, Mintek has not slowed down in its efforts to make a meaningful contribution for the country by, among other things, developing a technique for extracting gold from the carbon residue that is used in the gold processing industry. This new process which uses applied chemistry to extract the gold, has indicated a significant improvement in the recovery of gold relative to the traditional incineration process.

Together with African Exploration Mining and Finance Corporation (the South African state-owned mining company), Mintek completed the demonstration of a new sensor-sorting based process for the upgrading of low grade coal so that it meets the specifications for electricity generation. In addition, Mintek has also made huge strides in the development of technologies for Acid Mine Drainage, and for the treatment and recycling of plastic from e-waste in South Africa.

Going forward, Mintek will continue to focus on strategic areas of energy and water efficiency, environmental impact and waste treatment. It will also continue its current momentum of maintaining and developing skills, focused both inwardly and outwardly, to handle the mining sector's expected upturn during the 2017/18 financial year.

The Board remains confident with the business of Mintek and its core competence in working with industry partners to develop cutting-edge technologies for the mining industry and so, foster the country's much-needed economic growth.

This success in performance is excellent work and dedication of Mintek's management team, the intellect and calibre of employees who have through Mintek's vision made this year a relatively successful one. The "clean" audit opinion awarded to Mintek again in 2016 by the Auditor General South Africa is testament to the consistently good governance that Mintek upholds.

As I end my tenure as Chairperson of the Board in March 2017, I wish the incoming Board Chairperson and the current Board all the best as they continue at the helm of this resilient organisation.

The Board joins me in acknowledging the sterling work and oversight role of the previous Board, chaired by Adv. Linda Makatini who has passed on to us, a solid operational entity with sound governance, financial management and ethical culture. They have aptly overseen the further advancement of research and development of cutting-edge technologies which no doubt will be needed in the very near future.

On behalf of the Board, I would like to express my appreciation to the Mintek executive management team, led by the President and CEO, Abiel Mngomezulu who has superbly steered this organisation for 10 years to the marvel it has become. It has been a wonderful experience and a privilege to work with this team. I wish the organisation continued success in meeting its vision and strategic intent and I will follow its achievements with great interest. Finally, as we move forward to 2017 and beyond I am proud of the achievements, hard work and loyalty of the many world-renowned scientists, engineers and support staff that continue to make this transformed organisation, the great organisation that we have come to admire.



Dr Len Konar
Board Chairperson



2.2

Chief Executive Officer's Review

As the resilience of the mining industry continued to get tested by low commodity prices during the course of 2016, our commercial activities were placed under severe strain. At this time last year, we had planned on the basis of industry sentiment that predicted that the downward spiral in mining activity would start easing during the latter part of the 2016/17 financial year. Indeed, industry analysts suggest that the downward spiral has bottomed out, and the outlook going forward suggests an improvement from the beginning of 2017. However, the impact of the upturn has not yet been felt in our revenues. Total revenues for the 2016/17 financial year came 11% short of projection, primarily as a result of products and services that has dropped a further 23.5% compared to last year. In total in three years, Mintek's commercial activity has dropped by 35.9%.

Financial Highlights

The lower than anticipated revenue generated from products and services had a significant impact on Mintek's comprehensive income for the year. Throughout the year, products and services revenue did not materialise as planned due to a general decline in demand for mineral technology research, both locally and internationally. Despite this challenge, our financial position still showed a surplus, in part due to contract research performing exceptionally well against budget as well as income generated from investment activities. This is as a result of more research work being undertaken compared to prior years. As a consequence, while Mintek's annual surplus decreased for the second consecutive year, to R6.0 million, the decline did not have an adverse effect on our operations and we are hopeful that this trend will not persist.

Our balance sheet remains at a healthy 756-million worth of assets and we have maintained a liquidity ratio of 2. Mintek's financial position is greatly enhanced by the fiscal discipline and the effective management of resources that have been developed over the years of my 10-year tenure as the Chief Executive Officer. We implemented sound debtor management strategies that have led to us reducing our debtor days to 45 and keeping write-offs of debt from commercial activities to below 0.25 of commercial revenue. These efforts have been complemented by a

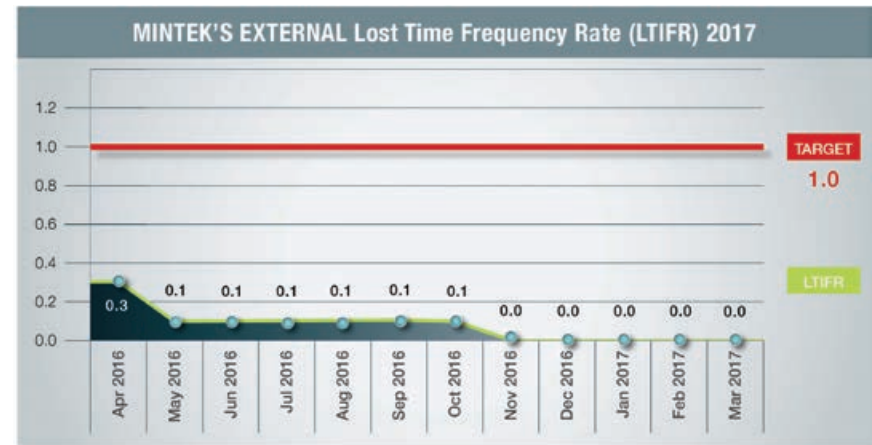
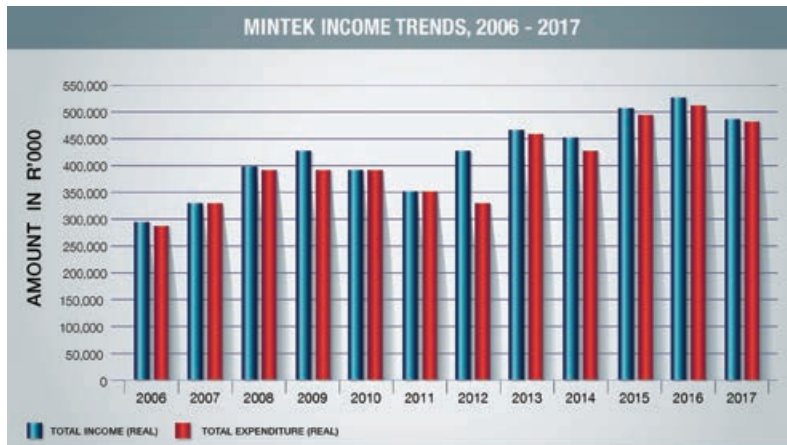
strategy that has optimised our investments to yield a 7.2% return on investment. All of these efforts combined, enable Mintek to ride the crest of a tough industry environment without incurring major financial losses.

As the year came to a close, all indications were that the mining industry was starting to improve and we anticipate that Mintek's commercial income will follow suit.

Safety, Health, Environment and Quality (SHEQ)

Adherence to our SHEQ principles remained a priority for Mintek in our quest to provide a safe and healthy environment for staff, while also maintaining quality standards for the benefit of our clients. Major milestone were attained this year in maintaining a safe and healthy working environment through a concerted effort by management and staff. Following a period of more than a year during which there were no injuries sustained by employees that led to the loss of productive time, Mintek's lost time injury frequency rate (LTIFR) reached a level of Zero, against a target of 1. The milestone was attained in September 2016. We have been tracking LTIFR since 1998, and 2016 was the first time that there was no productive time lost as a result of injuries.

During the year, we also recorded zero Public Dissatisfaction Incidents (PDI), below the target



of one. Monitoring PDI is a critical aspect for Mintek given that our campus is located in a residential area. In a period of a year, not one neighbour complained about noise levels. The noise monitoring programme and preventative maintenance strategy that were put in place, are clearly bearing fruit.

Our certification and accreditation status with respect to ISO9001, ISO14001, OHSAS18001 certification and ISO17025 accreditation was confirmed in 2015 and will remain valid for the next three years subject to annual surveillance audits. Our consistent ability to secure the accreditation and certification gives assurance to our clients of consistent performance. As a result, we were able to achieve a client satisfaction frequency rate (CSFR) of 97%, well above the target of 90%; a health incident frequency rate (HIFR) of 0.1 (which is below the target of 1); as well as an environmental incident (EI) measure of zero, which is below the target of 1.

People Development

In line with our mandate as a research and development institution, we continued to implement sound Human Capital Development interventions that have an internal and external focus. Development interventions that have an internal focus are implemented in recognition of Mintek's scientists, engineers, technicians and other support staff as our single-most

important resource that enabled us to record the achievements that we outline in the rest of this report. It is for this reason that our Human Capital Development programme continues to see an uptake of staff bursaries that exceeds expectation.

A total of 109 employees were awarded staff bursaries for under- and postgraduate programmes as part of their personal growth and development. We also provide comprehensive employee wellness programme through which employees receive advice on personal finance, health and wellness, as well as counselling where necessary. At the end of the third quarter, we recognised excellence of seven teams at Mintek, who were presented with Achievement of Performance Excellence (APEX) trophies in the categories of Development, Procedural Innovation, and Technology Innovation. It is the work of these scientists, engineers and technicians that lead to the development of new technologies or the improvement of existing technologies and processes, which enable Mintek to deliver on its mandate.

Interventions that are focusing externally are primarily aimed at developing a strong talent pipeline for Mintek's technical divisions. The talent pipeline remained solid, with 26 students receiving bursaries to pursue their studies in the science and engineering fields at different universities across the country. These students were given an opportunity to gain work experience during their

vacation, and will be absorbed as employees at Mintek upon successful completion of their studies. The increase in the bursary allocation is a positive reflection of the projected demand for our commercial work by Mintek's technical divisions that is expected to start increasing during the next financial year. We also provided experiential learning and on-the-job training for a total of 108 young people through partnerships with other state entities such as the Mining Qualifications Authority (MQA), National Research Foundation (NRF) and the Department of Science and Technology (DST).

Technical Highlights

The test of the efficacy of our technological innovation is no more pronounced than in the uptake of our technologies, processes and methods by the mining industry. This year, Mintek was proud to showcase a number of demonstration plants. We evaluated an X-Ray Transmission (XRT) sorting technology to improve the quality of coal by improving the Calorific Value of the products at the Vlakkfontein Mine, a mine belonging to African Exploration Mining and Finance Corporation. While XRT technology is widely used in the coal industry in destoning applications, there is no cost effective, energy efficient method in South Africa for producing high quality coal from coarse ore other than the traditional wet dense medium separation (DMS) process. Mintek's demonstration plant resulted in

lower cut-off grades due to flexibility of blending high grade coal with lower grade stockpiles, as well as an energy efficient method for processing of coal and water conservation.

The other demonstration plant was the Reflaut™ (Retreatment Flowsheet for Gold and Uranium Tailings) Demonstration plant at South Deep Mine that showcased a novel method to remove gold, harmful sulphides and radioactive uranium from tailings, thereby significantly reducing the mineral content responsible for generating acid mine drainage.

A number of technologies, methods and products reached significant milestones during the year. Mintek's Cynoprobe™ Cyanide analyser reached its own milestone when one of Mintek's clients purchased the product for its plant in Kyrgyzstan. The transaction meant that Mintek's Cynoprobe's footprint reached its thirtieth (30) country since its launch. The milestone endorses Mintek's effort in its quest to be a global leader in mineral and metallurgical innovation.

Mintek's Carbon Activity Analyser (CAA) reached market-ready status. The CAA is a new automated carbon activity analyser that utilises cheap iodine instead of expensive and toxic aurocyanide as the reagent. The approach results in lower operating costs, and it eliminates the complicated preparation steps and inconsistent results typical of the manual iodine-based measurement technique. The final packaging of the technology has been concluded and Mintek has already received two orders for this new version of the instrument.

For the benefit of small scale miners, Mintek completed a study that resulted in the development of a simple, cost effective and portable tile press which is relatively inexpensive compared to its industrial counterparts. The technology will assist existing ceramic groups to expand their product lines to also include tiles that can be made from sedimentary rock waste to generate more revenue.

The derelict and ownerless mine rehabilitation programme that Mintek implements on behalf of the Department of Mineral Resources continued during the year, following the signing of a contract to continue with the programme

from 1 April 2016. The programme is currently funded to the value of R150 million over a period of three years, ending on 31 March 2019. Notable rehabilitation achievements during the year include the rehabilitation of Buisvlei North, Buisvlei South and Masaneng projects in the Northern Cape as well as Motsane project in Limpopo.

Looking Ahead

The outlook for the next year still suggests a somewhat subdued market conditions for the sector. Even though the downward spiral has bottomed out, we expect the recovery to be fairly slow, with the concomitant improvement in Mintek's commercial activity only turning around towards the end of the next financial year.

It is with great pride that I look back to what this institution has accomplished during my ten year tenure. I therefore wish to thank all past and present employees who made this institution one of the best performing state institutions. I am also thankful of the support Mintek has received from the Department of Mineral Resources and the Department of Science and Technology. I would also like to single out the exemplary leadership of the Mintek Board Chairperson, Dr Len Konar that he unfortunately cut short. I wish him all the best in his endeavours.



Abiel Mngomezulu
President and CEO

▶ South Deep Mine

Enhance Mintek's visibility and credibility
to all stakeholders

1

Research and develop efficient mineral
processing technologies and value
added products and services

2

Promote the mineral-based
economies of rural and
marginalised communities

3

Uphold good governance
practices

4

Develop human capital
and skills to build
world-class R&D
excellence

5



Mintek's Strategic Objectives

2.3

Strategic Performance

STRATEGIC OBJECTIVE 1: ENHANCE MINTEK'S VISIBILITY AND CREDIBILITY TO ALL STAKEHOLDERS

PROGRAMMES	MEASURES/ OUTCOMES	PERFORMANCE INDICATOR	TARGET	ACTUAL	COMMENTS
Integrated marketing and communication functions	Updating and implementing the marketing and communications plan	Annually updated marketing and communications plan approved and implemented	1	1	Target achieved.
Enhancing the visibility and credibility of Mintek	Mintek promotion	# of technical articles in credible publications	35	76	Target exceeded due to low economic activity, more promotional activities were undertaken.
		# of conference presentations and posters	74	162	
	IP creation and transfer	# of Patents filed	7	4	Target not achieved due to having additional work that could not yield discoveries that can be patented and licensed.
		# of IP licence agreements	3	1	
		# of discoveries (IPR-PFRD Act)	21	16	
	Attained annual customer satisfaction target	% Annual Customer Satisfaction Rating Index	> 90	97	Target achieved.
	Enhanced media exposure	Advertising Value Equivalent (AVE) in R million	25.0	20.2	Target not achieved, partly due to inadequacies of monitoring tools. A different approach that combines monitoring tools will be used for the next financial year to improve levels of accuracy in reporting.
	Enhanced relations with oversight bodies	# of requests for technical assistance to the DMR (upon request)	1	1	All targets achieved.
		# of presentations to Parliament on impact of Mintek's work and role	2	2	
		Timely submission of Shareholder's Compact	1	1	
		Timely submission of quarterly reports on the attainment of targets in the scorecard	4	4	
	Integration of staff exchange	# of visits and # of instances of staff exchange	4	7	Target exceeded due to more time available for exchange visits.

STRATEGIC OBJECTIVE 2: RESEARCH AND DEVELOP EFFICIENT MINERAL PROCESSING TECHNOLOGIES AND VALUE ADDED PRODUCTS AND SERVICES

PROGRAMMES	MEASURES/ OUTCOMES	PERFORMANCE INDICATOR	TARGET	ACTUAL	COMMENTS
Competitive technologies, products and services for optimal mineral resource utilisation	Develop analytical and mineralogical methods and supply of services	# of methods	11	11	Target achieved.
		Rand value (Rm)	48.0	28.0	Target not achieved due to the prevailing economic conditions in the country.
	Develop new technologies under state grant	# of internal reports	75	128	Target exceeded due to lack of commercial work.
		# of new technologies	6	5	Target not achieved due to a delay in technologies under development.
		# of prototypes evidenced by reports	2	2	Target achieved.
	Sales of products, plant and equipment	# of reports	10	11	Targets exceeded.
		Rand value of control system sales (Rm)	23.0	24.8	
		Rand value of Certified Reference Materials (CRM) sales (Rm)	4.5	2.54	Target not achieved for the Certified Reference Materials due to unfavourable market conditions for the CRMs.
	Commercial investigations and feasibility studies	# of external reports	119	151	Target exceeded. There was a greater number of small projects due to the state of the industry.
	Provision of Mineral Economics and Strategy advice	# of internal reports	8	14	Target exceeded. More expert work for internal divisions conducted than planned.
Beneficiation to value added products and services	Develop applications for precious-, ferrous- and base metals in the areas of:- Biomedicine (HIV, cancer, malaria) - Catalysis (chemical processing, fuel cells, environmental) - Nanotechnology (water, health) - Physical metallurgy R&D and metallurgical industry support - Physical metallurgy R&D and metallurgical industry support	# of internal reports	18	26	Target exceeded.
		# of external reports	15	15	Target achieved.
		# of reports from the Metals Technology Centre (MTC)	140	168	Target exceeded due to the target under-estimating the demand for MTC services.
Green technologies	Develop water efficient processes and flow sheets to optimise water consumption and enable processing of ore bodies in water stricken areas	# of internal reports	11	18	More focus placed on work on green technologies as commercial work decreased.
		# of external reports	4	7	

STRATEGIC OBJECTIVE 2: RESEARCH AND DEVELOP EFFICIENT MINERAL PROCESSING TECHNOLOGIES AND VALUE ADDED PRODUCTS AND SERVICES *(continued)*

PROGRAMMES	MEASURES/ OUTCOMES	PERFORMANCE INDICATOR	TARGET	ACTUAL	COMMENTS
Green technologies	Develop energy efficient processes, flow sheets and control technologies that minimise energy consumption and carbon emissions	# of internal reports	6	9	Target exceeded, more focus placed on work on green technologies as commercial work decreased.
		# of external reports	4	6	
	Develop waste management and recycling technologies for treating and recycling waste in order to extend mineral resources	# of internal reports	5	6	
		# of external reports	1	2	
	Rehabilitate derelict & ownerless mine sites	Money spent and/or committed on rehabilitation projects (Rm)	55	86.6	

STRATEGIC OBJECTIVE 3: PROMOTE THE MINERAL-BASED ECONOMIES OF RURAL AND MARGINALISED COMMUNITIES

PROGRAMMES	MEASURES/ OUTCOMES	PERFORMANCE INDICATOR	TARGET	ACTUAL	COMMENTS
Development of technologies and strategies relevant to rural and marginalised communities	Establish technologies and strategies relevant to small scale operators, for transfer to rural and marginalised communities	# of technologies adapted or developed	2	2	Target achieved
		# of feasibility reports	10	14	Target exceeded due to an increase in enquiries on samples from small scale miners.
Economically sustainable businesses created in rural and marginalised communities	Develop and support economically sustainable rural and marginalised communities	# of new businesses created	4	5	Target for year exceeded as a result of MQA-funded training in Mpumalanga.
		# of jobs created from new businesses	40	41	Target exceeded.
		% of businesses still in existence after 1 year	95	100	Target exceeded. More businesses have been sustained than predicted.
		% of businesses still in existence after 2 years	70	71	
Training and skills development interventions in rural and marginalised communities	Provide value-added beneficiation training relevant to rural and marginalised communities.	# of people trained	100	312	Annual target exceeded due to the MQA-funded small scale mining training in Mpumalanga.
		Maintain accreditation in jewellery manufacturing / design and small scale mining as evidenced in certificate or report	maintained	maintained	MQA Accreditation valid till 10 February 2018.

STRATEGIC OBJECTIVE 4: UPHOLD GOOD GOVERNANCE PRACTICES

PROGRAMMES	MEASURES/ OUTCOMES	PERFORMANCE INDICATOR	TARGET	ACTUAL	COMMENTS
Enhanced fiscal discipline and the effective management of resources	BEE procurement as a % of total discretionary spend	% BEE Spend of total discretionary spend	80	97.0	Annual target exceeded.
	Strengthened Internal Financial Controls	Unqualified audit as evidenced in audit report	unqualified	unqualified	Annual target achieved.
	Sound Debtor Management	% Debtors write off of commercial revenue	< 0.25	0.04	Annual targets achieved.
		Average Debtors Days	< 65	45	
	Total Income	Rand Value (R'000)	537 319	479 292	Annual target not achieved due to slow economic uptake on commercial customers.
	Net Result (surplus)	Rand Value (R'000)	11 288	6 018	
	Optimal Yield on Investment	% Return on investment	4	7.2	Annual target exceeded due to optimised cash flow planning.
	Total Capital Expenditure	Rand Value (Including Funding) (R'000)	39 082	55 559	Annual target exceeded as more capital projects were done.
	Maintained balance between R&D and Commercial Revenue streams	Ratio of Research / Total Revenue expressed as a %	60	74.1	Ratio not achieved due to lack of commercial activity.
	Maintained balance between TCTC Salary Bill/Total Expenditure	Ratio of TCTC Salary Bill / Total Expenditure expressed as a %	58	60.6	Annual target achieved within the target range (55 to 63).
	Enhanced Liquidity Ratio	Liquidity Ratio	≥ 2	2.2	Annual target achieved.
	Improved cash flows from operations	Cash generated from operations after working capital (excluding movements in deferred income) (R'000)	> 2 000	-19 800	Annual target not achieved due to lack of commercial revenue.

STRATEGIC OBJECTIVE 4: UPHOLD GOOD GOVERNANCE PRACTICES *(continued)*

PROGRAMMES	MEASURES/ OUTCOMES	PERFORMANCE INDICATOR	TARGET	ACTUAL	COMMENTS
Enhanced organisational efficiencies	Productivity Ratio	Recoverability %	90	82.4	Annual target not achieved due to lack of commercial revenue.
	Energy Efficiency	Power factor correction	< 0.9	0.97	Targets achieved.
		Efficiency monitoring	Implementation of energy efficient system	Implementation continued	
	ICT Security	Intrusions/virus breakouts on system	< 3	0	Target achieved.
	Monitoring of critical facility availability	Upside / availability of critical facilities (%)	≥ 98	98	Target achieved.
Compliance with national and international regulatory frameworks, and applicable standards	Compliance with appropriate standards, regulations and legislation	% achievement of compliance checklist	100	100	Target achieved.
	Internal Audits conducted	No. of audits	16	21	Target exceeded.
	Review of the Audit Committee Charter	No. of reviews	1	1	Target achieved.
	Fraud Awareness Campaigns	No. of campaigns	8	11	Target exceeded.
Enhanced Safety, Health, Environment and Quality	SHEQ standards maintained and enhanced	Maintain Mintek Accreditation status	maintained	maintained	Targets achieved for all three SHEQ Standards.
		Achieved target for Fatalities	0	0	
		Achieved target for Lost Time Injury Frequency Rate (LTIFR)	< 1	0	

STRATEGIC OBJECTIVE 5: DEVELOP HUMAN CAPITAL AND ORGANISATIONAL SKILLS TO BUILD WORLD CLASS R&D EXCELLENCE

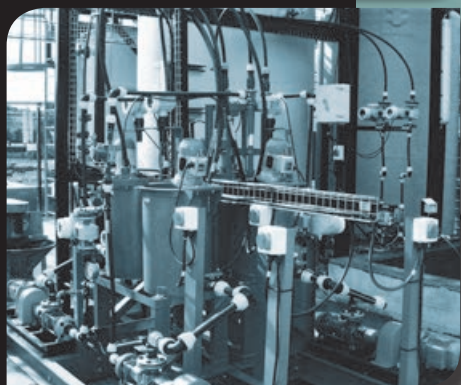
PROGRAMMES	MEASURES/ OUTCOMES	PERFORMANCE INDICATOR	TARGET	ACTUAL	COMMENTS
Training and Skills Development	Enhanced Skills Development	WSP Compliance Report	1	1	Annual targets achieved.
		Total spend on training expressed as a % of payroll	2	2	
	Enhanced relationships with Institutions of Higher Education and other similar organisations.	Number of partnerships in place	6	6	Annual targets achieved and exceeded for science events.
		# of partnerships with previously disadvantaged Higher Education Institutions	3	3	
		# of Graduate Recruitment Programmes and other Science Events	10	16	
	Science, Technology, Engineering and Maths (STEM) Promotion	Annual Provincial and Minquiz competition	1	1	Annual target achieved.
	Effective Full-time Bursary Programme	# of under-graduate bursars	10	16	The initial target was modest, based on the previous year's baseline.
		% Under-graduates Absorption Rate	100	100	Annual targets achieved.
		# of post graduate bursars	13	13	
		% Postgraduate Absorption Rate	100	100	
	Effective Part-time Bursary Programme	# of under-graduate bursars	20	48	Annual targets exceeded due to higher than expected demand for employee bursaries.
		# of post-graduate bursars	38	61	
	Work-Integrated Learning, Studentships and Internship Programmes	# of Candidates enrolled	60	108	The target was based on MQA's indicative figures for Mintek, which they subsequently changed during the course of the year.

STRATEGIC OBJECTIVE 5: DEVELOP HUMAN CAPITAL AND ORGANISATIONAL SKILLS TO BUILD WORLD CLASS R&D EXCELLENCE *(continued)*

PROGRAMMES	MEASURES/ OUTCOMES	PERFORMANCE INDICATOR	TARGET	ACTUAL	COMMENTS
Training and Skills Development	Artisan Learnership Programme	# of Persons enrolled	8	15	The target for ALP was exceeded due to the extension of the programme to include external learners.
		% Retention of learners	100	100	
	Development Programmes for recent graduate scientists & engineers	Graduate Development Programme review report	1	1	Annual targets achieved and exceeded due to the demand for customised programmes for researchers, scientists, engineers and technicians.
	Development Programme for researchers, scientists, engineers and technicians	An approved programme	1	3	
	Transformation of the Mintek Organisation	Report on compliance with DoL regulations	1	1	Annual target achieved.
		% of women at Mintek (towards achievement of Employment Equity targets)	46	40	Target not achieved, this is a stretch target and progress is being made in this area.
		% employees with disability (towards achievement of Employment Equity targets)	3	3	Annual targets achieved.
		Interventions to increase women representation in Mintek	1	1	
		Overall % of designated groups (towards achievement of Employment Equity targets)	90	89	Annual target not achieved yet, but good progress has been made.
	Structured mentorship programme to transfer skills and knowledge from specialists to mid-level professionals	% of employees participating in structured interactions between specialists and mid-level professionals	10	30	Annual target exceeded due to the keen participation of mentors in the programme.
	Compliance with Performance Management Policy	% Performance Contracts and Assessment done and signed (for qualifying employees)	100	100	Annual target achieved.
Organisational Development	Enhanced Experience Profile of Researchers	Average years of Mintek experience of researchers	4	8	Target exceeded due to poor economic climate as older employees are staying longer than projected.
		Average age of researchers at Mintek	33	36	

STRATEGIC OBJECTIVE 5: DEVELOP HUMAN CAPITAL AND ORGANISATIONAL SKILLS TO BUILD WORLD CLASS R&D EXCELLENCE *(continued)*

PROGRAMMES	MEASURES/ OUTCOMES	PERFORMANCE INDICATOR	TARGET	ACTUAL	COMMENTS
Organisational Development	Proportion of Researchers to Total Staff	Proportion expressed as a %	33	37	Target exceeded.
	Proportion of staff with Master's degree	Proportion of staff with Master's degree expressed as a %	10	12	Target exceeded.
	Proportion of staff with Doctoral degree	Proportion of staff with Doctoral degree expressed as a %	5	5	Target achieved due To Poor Economic Climate As Older Employees Are Staying Longer Than Projected.
	Enhanced staff Retention & Succession	Staff Turnover rate	9	8	Target achieved.
		% Staff Turnover of Professionals in Mintek core Divisions	10	13	Target not achieved.
		% of Core to Support employees	75	77	Annual target exceeded.
	Effective Leadership Development Programme	# of employees benefiting from Leadership Development Programme	0	0	There was no leadership programme planned for this year.
Employee Health and Wellness	Enhanced Employee Health and Wellness Programme	# of Employee Wellness Programme interventions	5	10	Annual targets achieved and exceeded due to constant monitoring.
		% of Working days lost to absenteeism	3.5	3.1	
		% compliance with obligatory annual medical assessment	100	100	
		Average time (in months) to fill vacancies	2.5	2.4	
Effective human resource systems	Enhanced administrative efficiency	Vacancy rate	7	2.3	Annual targets exceeded.



Products & Services at Mintek's Hydrometallurgy Division (HMD).

From top to bottom:

MeTRIX™ Laboratory scale demonstration unit, **SAVMIN™** demonstration plant and **NIMCIX™**.



3

Governance & Remuneration

Board Matters	28
The Mintek Board of Directors	28
Executive Members	31
Corporate Governance Report	32
Remuneration Report	39

3.1

Board Matters

The Mintek Board of Directors (the Board) provides effective leadership and strategic direction to enhance the long-term value of Mintek and its shareholders, according to the Mineral Technology (Mintek) Act and the Mintek Board Charter. The Board has overall responsibility for reviewing Mintek's strategic plans and performance objectives, financials, operations,

funding and investment proposals and legislative and corporate governance. The Board exercises this responsibility in terms of the Mintek Act and the Public Finance Management Act (PFMA) as well as considering other Codes on Corporate Governance matters for South Africa. In essence, the Board plays a fundamental role in corporate stewardship and performance.

Other duties of the Board include:

- Setting strategy, policy and structure
- Delegating to management
- Exercising accountability to shareholders and be responsible to relevant shareholders

3.2

The Mintek Board of Directors

The ultimate control as to the composition of the Board rests with the Minister of the Department of Mineral Resources (DMR), who can always

appoint, and – more importantly, sometimes – dismiss a board member. The Mineral Technology Act prescribes the minimum and maximum number

of board members. The members of the Mintek Board and Committees are as follows:

NAME OF DIRECTOR	BOARD APPOINTMENTS			BOARD & COMMITTEES			
	EXECUTIVE	NON-EXECUTIVE	INDEPENDENT	BOARD	AUDIT AND RISK	HUMAN RESOURCES	TECHNICAL
Dumisani Dlamini		✓		Member	Chair		
Daan du Toit		✓		Member			Member
Dr Len Konar		✓		Chair		Member	
Khetiwe McClain		✓		Member		Member	
Phahlani Mkhombo		✓		Member			

NAME OF DIRECTOR	BOARD APPOINTMENTS			BOARD & COMMITTEES			
	EXECUTIVE	NON-EXECUTIVE	INDEPENDENT	BOARD	AUDIT AND RISK	HUMAN RESOURCES	TECHNICAL
Andries Moatshe		✓		Member			Member
Dr Sarah Mohlala		✓		Member			Chair
Abiel Mngomezulu	✓			Member	Member	Member	Member
Samke Ngwenya		✓		Member	Member		
Maroale Rachidi		✓		Deputy Chair	Member	Chair	
Dr Siyabonga Simayi		✓		Member			Member
Tumi Hlongwane			✓		Member		
Mpoti Moalusi			✓		Member		

Non-Executive Directors

Dr Len Konar

DCom; Master of Accounting Science; CA (SA)

Dr Konar has extensive experience as a Non-executive Board member and Chairman of several large companies. He is currently serving in the boards of various major companies, locally and internationally, including Sappi, Steinhoff International, Old Mutual, Exxaro Resources, Alexander Forbes, Lonmin and Illovo Sugar. He has also served as an independent non-executive Director of the South African Reserve Bank, chairman of the Audit Committee and member of the Risk Committee and Nominations and Governance. Dr Konar also serves as visiting academic at several local and international universities, presenting tailored courses and programmes at executive leadership, MBA and PhD levels.

Maroale Jacob Rachidi

PTC; Management Development Programme; Computer Operations and Programming

ICT expert and entrepreneur currently serving as CEO of Tetelo Computer Services. Esteemed in corporate governance, administration, ICT governance and programming. Currently serving as Director in numerous boards including SAFCOL, Industrias Florestais de Manica, SA; IFLOMA; MTO Forestry (Pty) Ltd; Siyaqhubeka Forests (Pty) Ltd and EduPark. Also council member at the University of Limpopo and Chairperson of the Audit and Risk Committee.

Dr Siyabonga Simayi

PhD in Operations Management; MBA; BTech; N Diploma Metallurgical Engineering

A metallurgist by profession, Dr Simayi is a Programme Director: Shared Services–Coega Development Corporation, and also serves as academic research supervisor/promoter at NMMU and Professor of Mining and Environmental Geology – University of Venda on a part-time basis. Previously he worked for Luk Africa Limited; Highveld Steel & Vanadium Corporation and De Beers: Kimberley Mines as a metallurgist and process engineer.



▶ Metal tap

Khetiwe McClain

BA in Fine Arts

Ms McClain has served in various executive roles in both public and private sector, including Harmony Gold Limited, Alexkor Limited, DMR and at the SA Embassy in Italy. She is currently serving as Chief Executive Officer of Closure & Rehabilitation Solutions. She has also served in various non-executive roles that include Chairperson of the Mineral and Petroleum Resources Development Board of South Africa, Member of the Boards of MELCO South Africa, AECI; Manganese and Metals Company, and Village Main Reef.

Dr Sarah Mohlala

PhD, Chemistry, MSc, BSc Hon

Experienced professional with more than 8 years' experience in the scientific field, Dr Mohlala has served as a strategy business analyst at Sasol International Energy; a senior scientist at Sasol Technology and as a researcher at CSIR; and a part-time chemistry lecturer.

Daan du Toit

LLM, LLB, BA

Mr du Toit is currently Deputy Director-General: International Cooperation and Resources at the Department of Science and Technology. He has served the country in various roles in international relations, including DST's representative to the EU at the rank of Minister-Counsellor, and as a diplomat in Brussels.

Andries Moatshe

MSc. Environmental Management

Mr Moatshe is an experienced environmental management specialist. Currently working as Chief Director: Mine Environmental Management at the DMR. His entire career has been on management

Phahlani Mkhombo

LLM, LLB, BProc

Mr Mkhombo is a qualified lawyer and a transaction advisor. He is a member of the South African Restructuring and Insolvency Practitioners Association (SARIPA) and was recently appointed as a Board member of SARIPA, member of International Association of Restructuring, Insolvency & Bankruptcy Professionals (INSOL International), International Bar Association (IBA), the South African Institute of Directors (IoDSA) and Black Lawyers Association (BLA).

Samke Ngwenya

MBA, PGD in Management, BCom

Accounting professional with banking, finance, accounting and auditing experience in property holding, manufacturing and retail, both medium-sized and listed entities. Areas of expertise include statutory audits for medium to large enterprises, financial, accounting, taxation and auditing.

Dumisani Dlamini

MCom, PGD in Business Management, BTech Taxation, N Diploma Accounting, Professional Accountant SA.

Currently serving as the Chief Financial Officer at the National Art Council of South Africa, Mr Dlamini has a rich tapestry of experience in the finance and auditing fields having worked for Engen Petroleum, Ithala Development Finance Corporation and SARS. He also served as Chairperson of Audit committees for various municipalities.

of the environment, from waste management to environmental health and industrial ecology. He has worked for Lafarge, UNISA and various government departments.

3.3

Executive Members

The Executive Management Team prepares and guides the development of Mintek's processes and business operations. The Management Team handles, in particular, Mintek's strategy, budget, major procurements and projects, as well as major policies of administration.

The executive management team consists of:

Abiel Mngomezulu

MSc Engineering (Mining), BSc Hons (Geology)

President and Chief Executive Officer: Abiel Mngomezulu is the current President and CEO of Mintek, a non-executive director of Merafe Resources and one of the six finalists for the title of the Boss of the year 2009. He started his working career in 1979 as an exploration geologist where he made a few discoveries. He later worked on the Wits Gold mines, both as a mine geologist

and also as an exploration geologist mainly on Deep borehole drilling. He later joined the Department of Minerals and Energy (the DME) as a Director: Mineral Economics and left the DME as the Deputy Director General for Mineral Policy and Promotion in 2007. Abiel is the past non-executive director of the Council for Geoscience, Mintek, the South African Diamond Board, State Diamond Trader and the African Exploration, Mining and Finance Corporation.

Gugulethu Nyanda

MBA, BA Hons, BPaed, Dip. HRM

General Manager: Corporate Services, specialising in Corporate Governance, Human Resources Management, Strategic Planning, Communications, Integrity and Compliance Management.

Alan McKenzie

MSc, BSc Hons

General Manager: Technology, specialising in Analytical Services, Pyrometallurgy, Minerals Processing and General Management.

Dr Makhapa Makhafola

PhD (Analytical Chemistry), MSc, Post-Graduate Diploma in Project Management, BSc Hons

General Manager: Research and Development, specialising in Analytical Chemistry, Advanced Materials, Quality Assurance and General Management.

Dr David Powell

PhD (Chem Eng), MSc (Eng)(Metallurgy), BSc (Hons) (Metallurgy), Professional Engineer, FSAIMM, FMES

General Manager: Business Development, specialising in Minerals Processing, Coal Processing, Management of Commercial Operations, General Management.

Sakhi Simelane

MBA, BCom Hons (Auditing), BCom

General Manager: Finance, specialising in Finance, Auditing and General Management.



Gas-fired rotary furnace with a lance rating of 120 kW, able to provide temperatures in excess of 1400 °C.



3.4

Corporate Governance Report

Statement

The Board hereby considers Mintek's annual financial statements to be a fair representation of its financial position at year-end in terms of the South African Statements of Generally Accepted Accounting Practice (GAAP) and as required by the Public Finance Management Act.

Governance Framework

Being a global leader also means that Mintek's business practice has to be world class. With that in mind, Mintek endeavours to ensure that business processes, systems and controls are governance compliant while ensuring efficiency in business. As a science council, Mintek plays a critical role within the South African landscape in respect of research, innovation, service delivery, development and growth.

There are a few legislative frameworks that Mintek operates within, they are:

- The Mineral Technology Act No. 30 of 1989;
- The Public Finance Management Act (PFMA), which also governs Mintek and finance management related matters as a Schedule 3B Company;

- The King IV Report which aims at promoting best practice in corporate governance across organisations and applies to public entities and public enterprises that fall under the PFMA;
- The Governance Protocol which provides guidance to the public sector and its entities operating within the political-economic sphere. While the Protocol applies to Mintek, it does not seek to supersede the King Code, but rather amplify the requirements.
- According to The Protocol, Boards constitute a fundamental base of corporate governance, and as such, Mintek must be headed and controlled by an effective and efficient Board appointed in terms of the Mineral Technology Act.

The Board

The Board believes that strong corporate governance is fundamental for the achievement of sustainable value for all stakeholders. Accordingly, Mintek is committed to the principles of openness, integrity and accountability in all its dealings with its stakeholders. Mintek endorses the Code of Corporate Practices and Conduct as set out in the King IV Report and subscribes to the PFMA. The Board as an oversight body firmly believes that

the primary objective of the corporate governance system is to ensure that both the Board and management carry out their responsibilities ethically and effectively.

Delegation by the Board

To ensure best practise, the Board has delegated certain functions and responsibilities to three committees of the Board, namely: the Audit and Risk Committee (ARC), the Human Resources Committee (HRC) and the Technical Committee (TC) particular issues and report back to the Board with decisions and recommendations. However, ultimate responsibility of all matters remains with the Board.

The current Board has been in office since 1 June 2016 and will complete their three-year terms on 31 May 2019.

Appointments

Members of the Board are appointed based on their business acumen, experience and knowledge, as well as other relevant skills. The Board is accountable to the Minister of Mineral Resources and as a result a shareholder performance agreement (the Compact) has been



Left: New Analytical Services Laboratory.

Centre: Feeding PGM ROM sample into the primary vibrating feeder of the Rados plant.

Right: Carbon-in-leach (CIL) process.

concluded between the Board and the Minister of Mineral Resources, who is the Executive Authority. The Compact entails strategic objectives to be achieved and forms the basis for quarterly performance reporting to the Executive Authority on these objectives. Mintek has a Board secretariat that is responsible for ensuring Board support to enhance maximum Board functioning.

Processes

There is careful planning when scheduling dates of Board and committee meetings and these are communicated well in advance. The Board secretariat consults with the directors before fixing the dates of the meetings to ensure their attendance. The Board meets at least

four times a year. As warranted by particular circumstances, ad hoc meetings are also convened to deliberate on urgent, substantive matters. The Board reserves at least one day per year to discuss the strategic long-term plan of Mintek. Board meetings, with the exception of certain in-camera sessions, are attended by all members of executive management. Furthermore, selected members of executive management and senior management participate in certain committee meetings.

At the beginning of their term, Board members take part in an orientation programme, which gives them some understanding of Mintek's business operations so that they are able to assimilate into their new roles.

Board Performance

The Board Secretariat conducts an annual assessment of the effectiveness of the Board as a whole, effectiveness of the committees and individual contributions. The assessment comprises self-assessment, Board assessment and peer evaluations.

Board Committees and their Functions

Three committees, the ARC, the HRC and TC assist the Board in discharging its duties and responsibilities. The functioning of these committees is guided by Board approved Charters and ToRs which are reviewed annually, and are summarised in the table below.

COMMITTEE OBJECTIVES		HIGHLIGHTS OF ACTIVITIES FOR THE YEAR	
The Audit and Risk Committee (ARC) The Committee is established to assist the Board in discharging its duties relating to:			
➤ Effectiveness and efficiency of operations;		➤ Approved the ARC & internal audit charters, the internal audit strategic plan for 2017/18 to 2019/20 as well as components of the shareholder agreement dealing with group financials and risk management	
➤ Safeguarding of the company's tangible and intangible assets (including information);		➤ Approved the Mintek audit strategy for 2017/18	
➤ Compliance with applicable laws, regulations and supervisory requirements;		➤ Discussed and monitored ICT steering committee activities, internal audit quarterly reports, tip-offs and theft and fraud quarterly reports	
➤ Supporting business sustainability under normal as well as adverse operating conditions;		➤ Approved the audit and risk committee report for inclusion in the Mintek annual report	
➤ Reliability of reporting;		➤ Discussed and monitored risk steering committee activities and amended the risk plan accordingly	

COMMITTEE OBJECTIVES (continued)		HIGHLIGHTS OF ACTIVITIES FOR THE YEAR	
The Audit and Risk Committee (ARC)			
The Committee is established to assist the Board in discharging its duties relating to:			
➤ Behaving responsibly towards all stakeholders;		➤ Approved the audited financial statements for 2016	
➤ The operation of adequate systems and control processes; and		➤ Approved the fraud risk and whistle blowing policy	
➤ The preparation of accurate financial reporting and statements in compliance with all applicable legal requirements and accounting standards.		➤ Approved the revised delegation of authority policy	
		➤ Through consultation and agreement with the AGSA, approved the Mintek group management and audit reports for 2016	
		➤ Discussed and monitored AGSA findings	
THE HUMAN RESOURCES COMMITTEE (HRC)			
The Committee is established to assist the Board in:			
➤ Reviewing and determining human resource-related policies, including conditions of employment, reward, remuneration and retention policies;		➤ Approved the disciplinary code and grievance procedure	
➤ Reviewing aspects of the shareholder's compact that relate to human resource development, and reviewing performance against targets; and		➤ Approved the performance development and management policy	
➤ Consideration of the annual review of remuneration packages.		➤ Approved the 2016/17 annual salary increases	
The HRC also looks into human resources policies, internal controls, circumstances, conditions and activities that affect material changes to policies and procedures and conditions of service for all employees in compliance with demands and vested interests of Mintek's stakeholders.		➤ Discussed and monitored reports on employee relations, staff appointments and terminations, employee wellness, employment equity and human capital development	
		➤ Implemented and monitored sick leave analysis report in order to enhance efficiencies and improve productivity at work	
THE TECHNICAL COMMITTEE (TC)			
This Committee assists the Board in discharging its duties relating to the legal mandate of Mintek regarding its core business. It provides a forum for discussing technical issues for consideration by the board in informing strategy development and implementation in Mintek. Furthermore, the TC advises on utilisation of expertise, project proposals and financing thereof, looking into various co-operatives and related strategies and the possible expansion of Mintek business within the said mandate.		➤ Discussed and gave leadership with regards to Mintek strategic partnerships	
		➤ Noted international trips undertaken during the financial year	
		➤ Approved all planned international visits for 2017/18	
		➤ Reviewed, MTEF projects, Science Vote projects, corporate SHEQ activities and safety statistics	
		➤ Considered and reviewed the Mintek performance scorecard for all the technical divisions	

As indicated in the table above, during the year under review, the Board's activities focused on building on Mintek's strengths. This included promoting the economic sustainability of the business and on delivering on Mintek's mandate. To this end, the work of the Board and committees ensured that Mintek's operations were conducted with due regard to the

expectations and needs of all its stakeholders, the safety and health of employees and the communities that Mintek serve, and the development of effective systems which ensure proper access to and dissemination of credible information.

Both the Board and committee meetings are held

in an environment of intellectual honesty of purpose, truthfulness and mutual respect. These meetings require reporting of the highest standard by management and robust and constructive challenge and debate among all Board and committee members.

BOARD AND COMMITTEE MEETING ATTENDANCE: NON-EXECUTIVE DIRECTORS

NAME OF BOARD AND/OR COMMITTEE MEMBER	MEETINGS			
	BOARD	ARC	HRC	TC
Dr Len Konar (Board Chairperson)	3/3	2/3	3/3	n/a
Maroale Rachidi (Board Deputy- & HRC Chairperson)	3/3	2/3	3/3	n/a
Dumisani Dlamini (ARC Chairperson)	3/3	3/3	n/a	n/a
Dr Sarah Mohlala (TC Chairperson)	3/3	n/a	n/a	2/2
Abiel Mngomezulu (Ex-officio & CEO)	3/3	3/4	3/3	2/2
Daan du Toit	2/3	n/a	n/a	0/2
Khetiwe McClain	3/3	n/a	2/3	n/a
Phahlani Mkhombo	3/3	n/a	n/a	n/a
Andries Moatshe	3/3	n/a	n/a	2/2
Samke Ngwenya	3/3	3/3	n/a	n/a
Dr Siyabonga Simayi	2/3	n/a	n/a	2/2
Tumi Hlongwane	n/a	2/3	n/a	n/a
Mpoti Moalusi	n/a	3/3	n/a	n/a

BOARD AND COMMITTEE MEETING ATTENDANCE: EXECUTIVE MANAGEMENT

Abiel Mngomezulu (Ex-officio & CEO)	3/3	3/4	3/3	2/2
Peter Craven*	1/2	2/3	n/a	1/1
Dr Makhapa Makhafola	3/3	n/a	n/a	2/2
Alan McKenzie	3/3	n/a	n/a	2/2
Gugulethu Nyanda	3/3	3/4	3/4	1/1
Dr David Powell	1/1	n/a	n/a	1/1
Sakhi Simelane	3/3	4/4	n/a	n/a

* retired in December 2016

Internal Audit

At Mintek there is an in-house internal audit section in terms of section 51(a)(ii) of the PFMA Act No. 1 of 1999 as amended. Mintek's Internal Audit (IA) is governed in terms of the Standards for the Professional Practice of Internal Auditing (SPPIA) as prescribed by the Institute of Internal Auditors. The Head of Internal Audit reports directly to the CEO administratively and to the ARC functionally.

The internal audit section is an independent, impartial and consulting activity designed to add value and improve Mintek's operations. It helps Mintek accomplish its objectives by bringing a systematic, disciplined approach to evaluate and improve the effectiveness of governance, risk management and control processes. The ARC approves the charter, audit plan and budget of internal audit to ensure it operates independently. The internal audit section has direct access to the ARC and regular meetings are held with the chairperson of the ARC. Comprehensive reports on internal audit findings are presented to the executive committee and the ARC quarterly. Follow-up audits are conducted in areas where major internal control weaknesses are found.

The internal audit section has been requested by executive management to conduct more Information and Communications Technology (ICT) audits with a view to ensure that internal control deficiencies are detected and corrected. This is against the backdrop of the number of findings raised by the Auditor General South Africa in respect of its ICT audit.

Internal Control

Mintek maintains internal controls and systems, designed to provide reasonable assurance regarding the integrity and reliability of its financial statements, to safeguard, verify and maintain the accountability of assets, and to comply with applicable laws and regulations. The directors are ultimately responsible for the company's system of internal control, designed to identify, evaluate, manage and provide reasonable assurance

against material misstatement and loss. The effectiveness of these controls is monitored by the internal auditors, who report to the ARC frequently. The ARC requested management to review and evaluate Mintek's existing internal controls to further identify areas that can continually be improved upon. The Board considered reports on controls from internal audit, the external auditor and the compliance and risk management units.

For the period 1 April 2016 to 31 March 2017, nothing came to the attention of internal audit to suggest any issues. Thus, internal audit is of the opinion that, overall, the internal controls including financial controls of Mintek are adequate and effective.

Risk Management

The Board, with the assistance from the ARC and the Risk Steering Committee (RSC), is responsible for the governance of risk by ensuring that management maintains a sound system of risk management and internal controls to safeguard Mintek's assets, and determines the extent and nature of the significant risks which the Board is willing to take in achieving Mintek's strategic objectives.

The RSC is a management committee that continually reviews the risk management process, internal controls, and significant risks facing the organisation. The RSC reports to the ARC and provides them with a risk assessment report at appropriately scheduled intervals. The ARC ensures that management has implemented a process for risk management, including an annual risk management plan to identify, manage and report on the risks that might prevent Mintek from achieving its strategic objectives. In particular the ARC:

- reviews and recommends amendments to the risk management policy;
- ensures appropriate review of identified risks, together with the assessment of probability and impact;
- ensures appropriate review of risk action plans

for identified risks;

- reviews significant transactions that are not a normal part of Mintek's business; and
- reviews and monitors related party transactions and assesses their propriety.

Meetings are held on a quarterly basis or as required. The risk management process includes numerous opportunities for rigorous debate to assess and evaluate the significance of each risk, which is a combination of impact multiplied by probability. The assessment of the potential impact of Mintek's risks and their associated probabilities are determined by the members of Mintek's RSC. The assessment process is designed to be as objective and quantitative as possible, but still contains a degree of judgement. Some risks will be connected to, or dependent upon, other risks. The RSC then considers the different ways that Mintek can respond to these risks, and the responses will be recorded in Mintek's Risk Implementation Plan. The options for responses include avoidance, mitigation, transference, exploitation, termination and integration. This process allows the RSC to update, as required, Mintek's risk plan, risk management strategy and risk management policy. Mintek utilises the services of insurance brokers on an annual basis to analyse and assess the risks associated with its assets, which are insured, together with public liability and professional indemnity, for the risk assessed.

ATTENDANCE AT CORPORATE RISK STEERING COMMITTEE			
NAME	CATEGORY	POSSIBLE NO. OF MEETINGS	ATTENDED
P Craven (Chair)¹	GM: Business Development	2	2
D Powell (Chair)²	GM: Business Development	2	2
P Gibbons	Manager: Human Resources	4	4
M Ginindza	Head: SHEQ	4	2
B Hewu	Manager: Engineering & Maintenance Services	2	2
M Makhafola	GM: Research & Development	4	3
M Mathose³	Head: Internal Audit	1	1
A McKenzie	GM: Technology	4	4
A Mngomezulu	President & CEO	4	3
N Mthalande⁵	Head: Internal Audit	2	2
O Mutloane⁴	Manager: Engineering & Maintenance Services	1	1
G Ndebele	Head: Security & Campus Support Services	4	4
G Nyanda	GM: Corporate Services	4	3
H Pretorius	Manager: Finance	4	4
S Simelane	GM: Finance	4	4
H Venter	Head: Information Technology Services	4	3

¹ Appointed as Chief Operating Officer in November 2016 and retired in December 2016

² Appointed Chairperson in January 2017

³ M Mathose resigned on 31 May 2016 - K Mokgalaka attended 1 of the 4 meetings on behalf of Internal Audit

⁴ O Mutloane resigned on 31 July 2016 - I Thothela attended 1 of the 4 meetings on behalf of EMS

⁵ N Mthalande joined Mintek on 8 August 2016

Fraud Prevention

Mintek takes fraud very seriously and is committed to a high standard of ethical conduct and adopts a zero tolerance approach to fraud. Mintek has adopted a fraud prevention plan that incorporates principles contained in the Public Sector Anti-Corruption Strategy and aligned to the Protected

Disclosure Act, 2000 (Act 26 of 2000) and seeks to focus particularly on creating awareness and promoting ethical business conduct. The Fraud Prevention Committee consists of standing members with roles in finance, security and employee relations. The committee also includes a

chairperson who is normally a divisional manager, appointed by the CEO on recommendation by Mintek's executive committee. In addition, the CEO forms part of the committee and the Head of Internal Audit serves as an advisor. The committee ensures that cases of fraud, corruption and theft reported

through various channels are investigated. It also monitors progress of investigations and ensures that recommendations made by investigators are implemented by responsible people. Mintek ensures that there is a service for all stakeholders to report anonymously any unethical behaviour. This includes reports of suspected fraud, corruption, dishonest practices or other similar matters. The service is run totally independently of Mintek and all anonymous disclosures are accepted and anonymity honoured.

The ARC is responsible for the development of policies and practices for detecting, reporting and preventing fraud and corruption, serious breaches of business conduct, and whistle-blowing procedures that support reporting to the ARC.

Regular reports are submitted to the ARC by management, along with any further documentation and information requested on Mintek and the Fraud Prevention Committee's fraud and corruption prevention activities.

Code of Conduct and Business Ethics

Mintek's Code of Conduct and Business Ethics (the Code) serves to ensure a consistent and fair approach to ethics and management of conduct by advising employees on the required standard of conduct and behaviour in the workplace. This Code clarifies Mintek's expectations of its employees' conduct and behaviour at all times in line with Mintek policies and procedures. The Code's guiding principles include:

- Conduct of Mintek's business with honesty and integrity by all employees and contractors.
- Display of acceptable and/or satisfactory behaviour of employees at all times.
- Voluntary compliance with all applicable laws and good business ethics practices.
- Fair dealings for mutual benefit in Mintek's relationships with customers, partners, contractors, suppliers and other stakeholders.
- Commitment of employees to adhere to the principles in this Code.

Mintek executive management is responsible for ensuring that this Code is enforced and adhered to by all employees and will investigate in the appropriate manner any breach of the Code irrespective of the seniority of the offenders. It is therefore obligatory for employees to report all actual or suspected contraventions of any section of this Code to their immediate Superiors.

Management

The President/Chief Executive Officer manages Mintek and is assisted by five general managers. This team, in addition to the internal auditor, makes up Mintek's Executive Committee which meets on a weekly basis to review strategic and operational issues. This meeting is chaired by the CEO, who is responsible for the execution of the company's strategy and reports to the Board. Executive management is supported by fourteen divisional managers who are in charge of Mintek's operating divisions and centralised support functions.

Operational Performance

Mintek reports to the Department of Mineral Resources (DMR) and is also accountable to the Department of Science and Technology (DST) for its technology-related R&D activities. Various key performance indicators (KPIs), encompassing financial, organisational, innovation and learning, human resources and transformation perspectives, provide Mintek with a basis for evaluating its activities in the identified key performance areas.

Each KPI is supported by a set of identified measures, that provides a more specific and consistent base from which to assess progress.

Mintek's Management Committee convenes on a monthly basis where business plans, financial results and policy updates are presented. The budget for the current year is usually reviewed in September by executive management in order to keep track of and ensure overall sound financial management.

Going Concern

The Mintek Board reviewed the Entity's financial

budgets for the period 01 April 2016 to 31 March 2017 and is satisfied that adequate resources exist to continue business for the foreseeable future.

Safety, Health, Environment and Quality (SHEQ)

The Safety, Health, Environment and Quality (SHEQ) committee is a management committee that oversees the policies relating to safety, health, environment and quality and their implementation across Mintek.

The SHEQ committee reviews operational performance, anticipates potential issues and provides support in setting direction for improvements. A functional safety, health, environment and quality unit provides a coordinated and effective specialist advisory support to the SHEQ committee.

Mintek has been certified by accredited independent external auditors to meet the requirements of safety and health (OHSAS 18001), environmental management (ISO 14001), and quality (ISO 9001). The following SHEQ scores were achieved at the end of the financial year:

- The lost time injury frequency rate (LTIFR) started at 0.3 in April 2016 and ended on 0 at the end of the financial year against a target of 1.0.
- The Health Incident Frequency Rate (HIFR) started on 0 and ended the year on 0.1 well below the target of 1.0.
- There were no major environmental incidents reported during the financial year, resulting in the environmental incident frequency rate (EIFR) remaining at 0 throughout.
- The external client satisfaction frequency rate (CSFR) started and ended the year on 97%, above the target of 90%.
- The internal client satisfaction frequency rate (CSFR) ended on 95%, above the target of 90%.
- The public dissatisfaction incidents (PDI) started at 3 at the beginning of the financial year and ended on 0 at the end of the financial year.

3.5

Remuneration Report

Mintek's remuneration strategy and practice is informed by a rigorous analysis of remuneration trends in the environment. Despite the tough competition created by mining industry remuneration practices, Mintek continues to strive to maintain a fair, robust and appropriate remuneration and rewards practice for its employees, which is augmented by other interventions that are aimed at improving staff motivation and retention.

The determination of Mintek's remuneration strategy and policy is among the duties of the Human Resources Committee (HRC). The committee ensures that remuneration policy framework supports the strategic aims of Mintek's business and enables the recruitment, motivation and retention of employees at all levels, while complying with all relevant regulatory and legal requirements. The members of the HRC for the year under review were:

- MJ Rachidi (Chairperson and Non-executive Deputy Board Chairperson)
- Dr L Konar (Non-executive Board Chairperson)
- K McClain (Non-executive Board member)
- A Mngomezulu (CEO and Ex-Officio)
- G Nyanda (Executive member – GM: Corporate Services)

Remuneration Policy

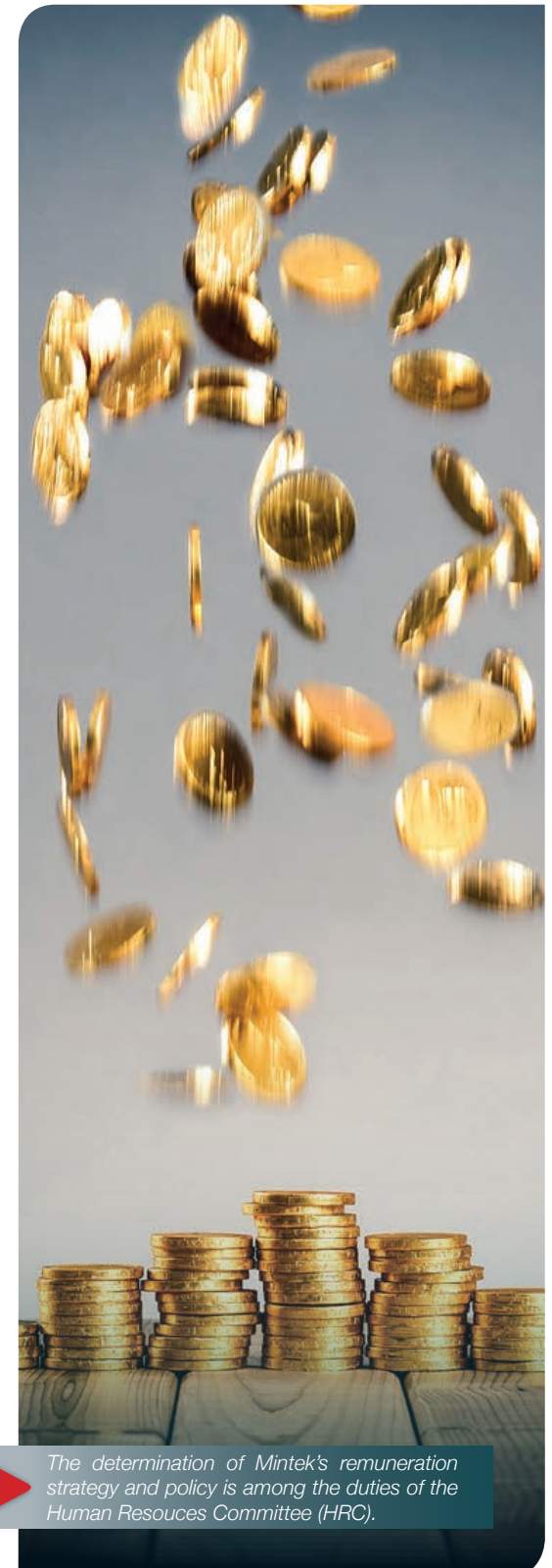
There were no changes to Mintek's Remuneration Policy during the period under review. The policy objectives remain that of implementing a fair and just rewards and benefits scheme that does not discriminate on race, gender, creed or in any other form of discrimination. It also advances the principles of fairness and equity in pay by promoting internal parity. The internal disparity that was found to be existing in 2013, was first

addressed during the 2013/14 financial year, with an aim of normalizing the pay curve for a small proportion of levels on the job grading system after board approval. The year 2016/17 marked the fourth year of implementation of the normalization process.

The quest to contain Mintek's salary bill also continued during the year under review. While Mintek ensures that employees are fairly rewarded, it also ensures that there is a healthy balance between revenue and total employee costs. As a consequence, the remuneration mix that has been adopted included a performance-based, once-off bonus that does not have a long-term impact on the size of the salary bill. The growth rate of the salary bill is kept within the inflation target range.

Other Financial Benefits

The basket of other employee benefits is a deliberate strategy adopted by Mintek to mitigate the risk associated with its inability to compete with industry, in term of salary packages. The intention is to improve the quality of work life for the employees of Mintek, while also improving organisational performance. This basket includes a generous study package comprising of comprehensive bursary scheme that includes transfer payments to academic institutions, purchasing of study materials and books as well as leave provision for attending classes, preparation for exams and consultation with supervisors for Masters' and Doctoral students.



The determination of Mintek's remuneration strategy and policy is among the duties of the Human Resources Committee (HRC).



*Services and Technologies offered
by Mintek's Minerals Processing
Division.*

*From top to bottom: Flotation
Cells, Grinding Media and the
Physical Separation sorting floor.*





4

Operational Performance

Energy Minerals	42
Base Metals	42
Ferrous Minerals	43
Technology Metals	44
Industrial Minerals	45
Precious Metals	45
Eco Efficiency and Environmental Protection	47
Advanced Metal Applications	50
Small Business Development	52
Process Monitoring and Control	54
Collaborations and Science Promotion	56

XRT Coal Sorting Technology

Dry sensor-based sorting techniques such as x-ray transmission (XRT) have been successfully implemented for de-stoning/waste rejection applications both locally and internationally. The use of dry processing methods will become more important as water availability becomes a greater concern for mining companies and the availability of a secure water supply is expected to decrease significantly in the future. Furthermore, there are extensive southern African coal reserves located in arid regions that will need to be exploited to replace the Witbank coalfield.

XRT is particularly suitable for dry coarse coal beneficiation in the size range -120 mm +20 mm. In a unique application of this technology, Mintek investigated the application of XRT to produce both a low-grade Eskom-specification product and high-grade, niche quality product for the metallurgical sector. Preliminary laboratory XRT testwork results on coal from Vlakfontein mine indicated that different grades of coal could be distinguished by XRT sensors as the basis of an upgrading process. However, in order to evaluate sorter separation efficiency at industrial throughput rates, a production scale XRT sorting demonstration plant was commissioned

at Vlakfontein mine with a design capacity of 125tons/hr of sorter feed.

The results of the demonstration tests at Vlakfontein mine are consistent with the bulk pilot testwork conducted at Mintek during 2014, demonstrating the robustness of the sorting process. The research and test work done on two coal seams has demonstrated that XRT technology can effect a separation between various grades of coal and waste on both a laboratory and production scale, thus indicating that the use of the technology is not only technically limited to de-stoning applications.

Mintek has developed and patented an autogenic reagent generation technology for the purification of value metal process liquors by chemical precipitation. Conventional precipitation methods for the purification of process streams by the addition of precipitating agents such as lime or sodium hydroxide result in the introduction of sodium and calcium impurities in the value metal solution. The autogenic reagent generation process is aimed at addressing this problem by introducing a new method of using a value metal-containing neutralising reagent to minimise impurity introduction. The autogenic reagent is precipitated separately from a portion of the impure feed with lime or sodium hydroxide. The resulting value metal precipitate is subsequently used as a neutralising agent to reject impurities

while the value metal dissolves in solution. The autogenic reagent generation concept was applied to the purification of a nickel sulphate stream to prove its viability. The nickel sulphate stream containing iron, copper and cobalt as major impurities was purified by hydroxide and sulphide precipitation with nickel hydroxide and nickel sulphide respectively.

Complete removal of iron and copper was achieved by hydroxide precipitation, with over 99% precipitation efficiencies obtained. Copper sulphide (CuS) precipitation resulted in complete CuS precipitation at high nickel sulphide (NiS) excess of ~790%. It is suspected that the CuS precipitate formed during sulphide precipitation coated the NiS particles, thereby limiting further

precipitation to occur. Any unreacted NiS solids could be recycled back into the circuit for further reaction and to minimise reagent costs. Vigorous agitation may be required for higher NiS reactivity to avoid CuS coating on the NiS surface.

A flowsheet for the purification of a nickel sulphate stream to produce nickel sulphate hexahydrate, meeting the stringent specifications of the battery industry was developed and verified by HMD for Thakadu Batteries. This process uses the Mintek patented autogenous reagent generation process and received positive media coverage in an article in the Mining Weekly on battery development in South Africa.

4.3

Ferrous Minerals

PyEarth™

PyEarth™ is a novel smelting process to concentrate rare earth elements in slag while extracting the iron and some of the manganese from the ore as a metal product. The process was demonstrated at pilot scale, nominally 500 kg per day, over a period of two weeks. The results from the smelting work were very encouraging and industry interest has resulted in two interested parties signing memoranda of intent with Mintek for the possible implementation of the technology. Each party will be granted a licence to PyEarth™ if the projects are implemented. PyEarth™ technology is particularly effective for deposits with high-iron as these deposits tend to be too low grade and (or) complex in composition for normal extraction processes to be economically viable.

BOFLUX™

The Era-Min funded project, BOFLUX™, aims to demonstrate potential energy and recovery benefits through small additions of boron containing minerals to ferrochromium smelting processes. Mintek is collaborating with EtIProducts (Finland) and Siyanda Chrome Smelting Company (South Africa) on this project and the testwork conducted showed significant potential benefits for low-grade chromite sources. The work supports Mintek's Low-grade Chromite Process (SA Patent 2015/03921). Boron is potentially beneficial for ferrochromium smelting as an additive as benefits include lowering of slag viscosity and slag production (volume), both aspects which can be leveraged to lower energy consumption overall. Laboratory scale tests were successfully completed and the outcomes of the project were achieved. Further collaboration with industry is being evaluated, namely to secure funding for pilot or industrial scale testing of boron addition.

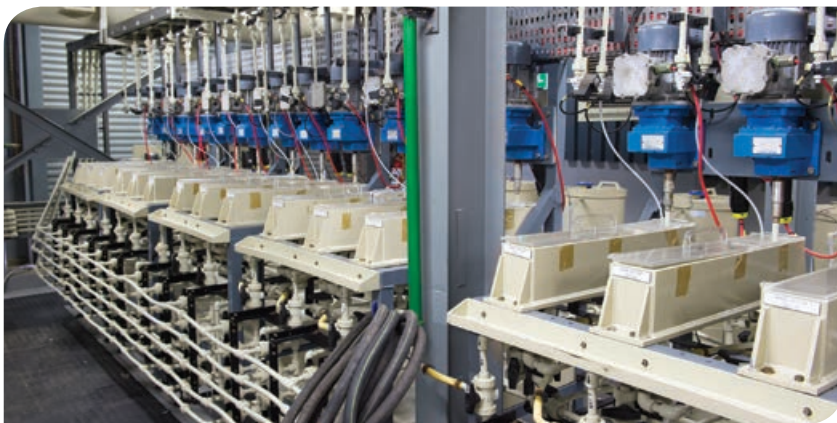
Chrome Tailings Projects

Mintek recently completed testwork on gravity separation of UG2 tailings generated at the Bokoni chromite mine and thereafter used these results to simulate various possible plant configurations using the gravity spiral concentrator. The objective was to develop an optimum flowsheet of spirals in terms of chromite grade and recovery. Generally tailings from the existing UG2 circuits (for PGM recovery) are still of very high grade in terms of chromite hence it is economically beneficial to recover this chromite from the tailings. Testwork conducted at Mintek enabled the generation of live data that could be used in simulations. The simulation exercise that was undertaken rendered a positive outcome for a potential spiral plant configuration with acceptable grades and recoveries being attained at a relatively simple spiral configuration consisting of four stages of spirals. The impact of this being that the targets of the chromite plant are achieved at a relatively simple flowsheet when it is known that chromite beneficiation flowsheets are very complex. This particular outcome could also be directly linked to the nature of the material treated as mineralogical analyses proved the chromite to be well liberated.

Mintek also investigated if chromite can be upgraded from UG2 primary flotation tails to a saleable >40% Cr₂O₃ product at minimal PGMs losses. Characterisation of the primary flotation tails showed that majority of chromite grains were liberated followed by plagioclase and pyroxene with clean chromite grains at 44% Cr₂O₃. Liberation characteristics of chromite, pyroxene, plagioclase, mica and quartz provided an opportunity to remove coarse chromite. The majority of the PGMs were locked in gangue minerals such as plagioclase, pyroxene and



Starting fire – Lancing of taphole of the furnace.



chromite. More than 10% of PGMs were still associated with chromite. A predictive model was thus created, utilising mineralogical, size and density information to predict a closed spiral circuit and reflux classifier performance.

Comparative testwork and modelling indicated that the reflux classifier provides superior recoveries when compared to spiral

concentrators. Reflux classifier, testwork indicated that chromite product grade and recovery is sensitive to feed head grade and particle size distribution. The reflux classifier testwork showed that for the chosen set of operating conditions 2-stage reflux classifier with a scalping screen upfront in an open circuit can produce >40% Cr_2O_3 product at approximately 10% mass yield overall. About 0.6 ppm Total

PGMs+Au was lost to the chromite concentrate. This is related to the percentage of PGMs such as laurite locked within chromite.

4.4

Technology Metals

REE Processing

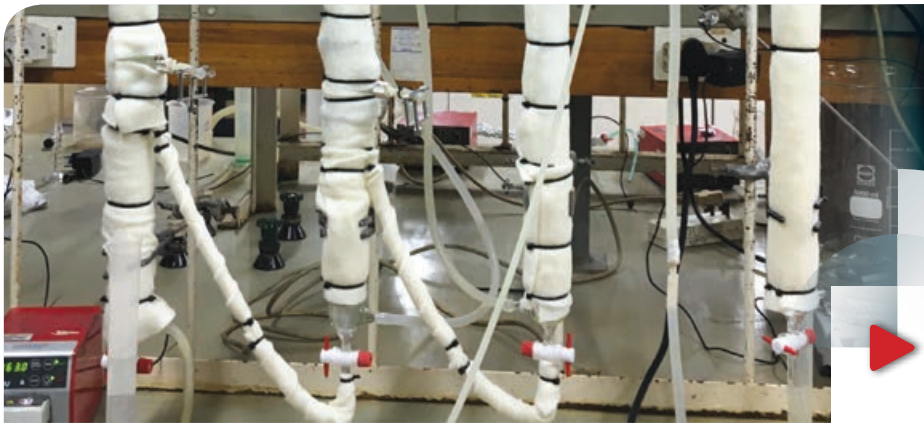
The rare earth element (REE) sector is still depressed, but Mintek has issued a large number of pilot plant proposals. They focus on the purification and separation of REE and therefore on maximum value extraction.

Mintek's REE processing competence was showcased through a paper and presentation on the recovery of REE from phosphogypsum dumps. The international reputation of Mintek's HMD in this field was again confirmed by the invitation and participation of the HMD delegate in the Canadian Rare Earth Elements Network (CREEN) workshop. CREEN was organised

at the conference by the Canada Centre for Mineral and Energy Technology (CANMET). Mintek's PDD presented on the topical theme of energy efficiency through innovative pre-reduction research and representatives from the technology divisions visited CANMET's facilities. Mintek and CANMET are developing collaborative projects which aim to share and transfer knowledge, skills and equipment during this collaboration. Mintek delegates who had attended the IMPC conference also visited CANMET in Ottawa to view their facilities and modern equipment as well as to meet with the management of CANMET. The attendance at the CREEN workshop and the visit to CANMET were undertaken under the auspices of

activities covered by the South Africa / Canada bilateral MOU.

Mintek currently participates in a South Africa/ Finland collaborative research project which aims at the recovery of rare earth elements (REE) from phosphogypsum waste material. An investigation at Mintek, into the large anomalies in the phosphogypsum recovery efficiencies with sample age, led to a discovery that may lead to a process for the manipulation of the feed material in such a way that the recovery of REE can be enhanced significantly. This may lead to protectable IP for Mintek.



Left: Rare earth element (REE) plant.

Centre: Excavation of a tap hole.

Right: Testwork in progress (The resin-in-leach (RIL) technology).

4.5

Industrial Minerals

Phosphate Beneficiation

Gaya Resources Ltd is currently upgrading the Lucunga ore through the existing phosphate beneficiation plant with the concentrate being aimed at sale to various producers in the fertilizer industry. In 2015, Mintek completed a bankable feasibility study (BFS) as well as confirmatory testwork on the North and South samples of the Lucunga deposit which aided the design of their plant (which was carried

out by DRA). The Lucunga deposit may be divided into the Northern and Southern parts, with the Southern deposit being notable in containing high amounts of clay material that embeds the phosphate and hence need to be removed. Although previous metallurgical work was done on the North and South Lucunga samples, there was some doubt about the representativity of the sample hence a scope of work aimed at confirming the results achieved previously as well as aimed at producing bulk

concentrate and tailings for further downstream testing at external facilities. The North sample was subjected to continuous pilot scrubbing and the South sample was initially soaked for 24 hours and thereafter scrubbed for 7 minutes. Target market grade specification of $>30\%$ P_2O_5 was attained with low contained deleterious elements (Al_2O_3 , Fe_2O_3 and MgO). Mintek concluded that the samples would have to be treated independently with product blended in the correct ratios prior to drying.

4.6

Precious Metals

Projects Involving Gold Recovery

One of Mintek's major technology focus areas for its HMD is the treatment of material from gold tailings storage facilities. Mintek therefore had to demonstrate to the industry that it has the expertise and drive to take a leading role in the responsible exploitation of this material. A paper was presented at the 23rd WasteCon Conference and Exhibition in Johannesburg and

Prospectors & Developers Association of Canada (PDAC) held in Canada March 2017 offering the industry insights into the impacts of the different processing options for SA gold tailings, not only on profitability or environmental impact, but also on their potential liability.

The resin-in-leach (RIL) technology developed by Mintek for gold recovery from resin and carbon fines was tested on real samples originating from

South African gold processing plants. Results of the testwork indicated that a conceptual flowsheet is applicable for gold recovery from real adsorbent fines. The real fines samples contained a significant amount of impurities co-loaded with gold which affected the gold recovery from fines in terms of gold upgrade onto the coarse resin. However, the technology still looks feasible. It was calculated that more than 98% Au could be recovered from the carbon fines within four

adsorption stages. The technology seems to be feasible at a reagent cost of <0.8% of the revenue expected. It is recommended that the RIL method for gold recovery from resin fines should be optimised further by varying the lixiviant quantity and composition. Additionally, the pre-treatment procedure should be confirmed for resin originating from uranium processing plants. From the scouting tests conducted regarding the elution of gold from a SA resin with NaOH/NaCN, the temperature was found to have a significant positive effect on gold removal from a cation exchange resin. A modified RIL method was developed and successfully tested for gold recovery from SB resin beads (without breakage).

Minfurn™ Project

Minfurn™ activity was focused on the water industry and the application of 200kg/h Minfurn™ 200 in gold mines. Operation of Minfurn™25 was successful at Rietvlei Water treatment plant (RWTP). Due to a manpower shortage issue, RWTP decided that the Minfurn™25 should be operated by an external company that will sell the regenerated carbon to RWTP. Mintek is expecting proposals from two potential companies who are willing to operate the Minfurn™ at RWTP by mid-June 2017. Mintek will manage the project. The 200kg/h Minfurn™ will be rented to Evander Gold Mine (EGM) from August 2017. EGM has issued a purchase order for renting the Minfurn™200 for a period of six months with an option to further extend the lease. In order to change from existing Rotary Kiln operation to Minfurn™, EGM needs to modify the existing carbon handling system in their metallurgical plant. Modification at Evander metallurgical plant is expected to be completed by July 2017. Routine sale of Minfurn™ spares to existing customers and servicing of Minfurns™ were carried out throughout the year.

▶ DC Furnace

4.7

Eco Efficiency and Environmental Protection

Mining Effluent Projects

The Mintek Technology Demonstration site, in Randfontein, provides a platform for the intelligent integration of various Mintek technologies to remediate highly polluted sites such as Robinson Lake. A conceptual flow sheet was developed, which included a number of Mintek technologies, which enabled the generation of, amongst other process streams, potable water and irrigation water, as well as intermediate streams containing high concentrations of uranium and base metals for treatment and recovery. The Mintek technologies that were implemented included:

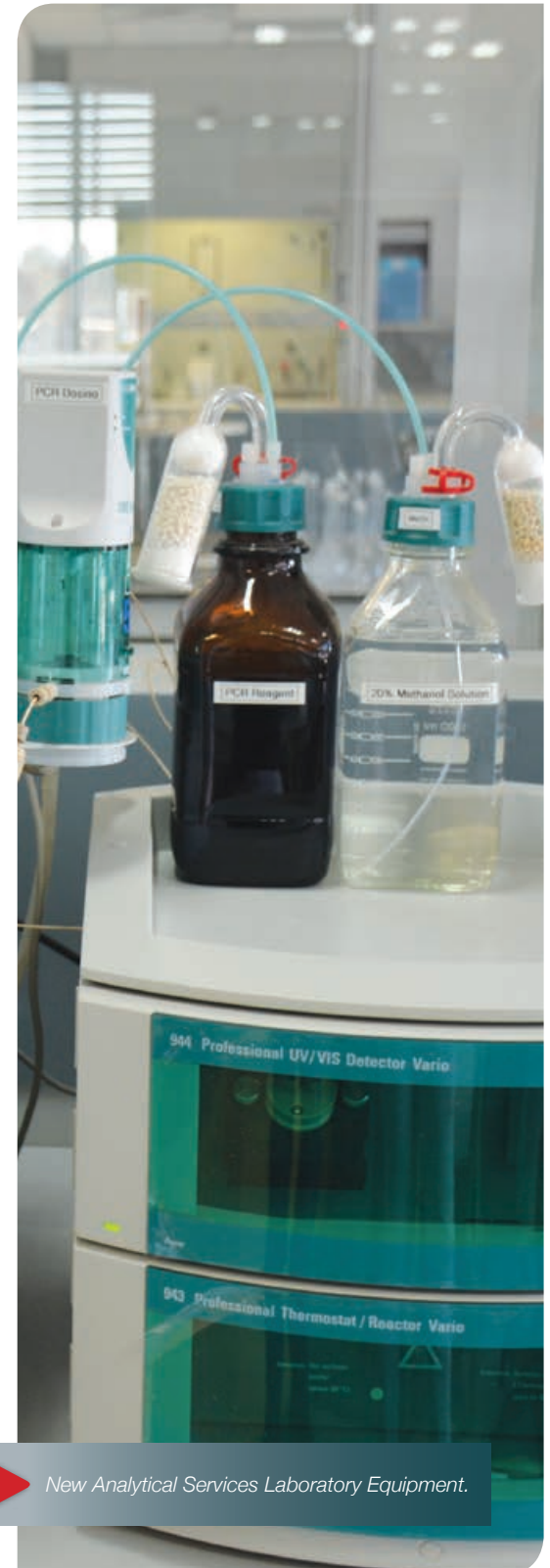
- SAVMIN™ for the treatment of acid mine drainage and mine-impacted water.
- Biological sulfate reduction for the removal of sulphates from acid mine drainage.
- Physical separation methods for the treatment of gold and/or base metal containing tailings or sediments for the production of a value containing sulphide concentrates.
- Biological oxidation of sulfidic mine tailings for the extraction of metals of interest.
- Silicate encapsulation for the treatment of acid mine drainage and mine-impacted water.
- Mintek's MetRIX™ resin-in-pulp (RIP) ion exchange process for the recovery of uranium and base metals from Robinson Lake soil sediments.
- NICMembrane technology for the removal of selected heavy metals from waste waters and effluents.

The progress to date can be summarised as follows.

- The collection and characterisation of a bulk sediment/ soil sample from Robinson Lake for uranium and base metal processing during the RIP laboratory and pilot tests.

- Laboratory evaluation and optimisation of operating parameters, using the bulk Robinson Lake sample, for uranium leaching, and uranium and base metal RIP.
- The installation and commissioning of the uranium leaching circuit and uranium RIP circuit at the Mintek Demonstration site and evaluation of the process conditions as per the laboratory tests. Preliminary results from the pilot circuit are similar to the laboratory test work and indicate that 70% uranium recovery can be achieved with a uranium loading of between 40-50g/L.
- The commissioning and evaluation of the bioleaching circuit for the treatment of gold bearing tailings.
- The evaluation of technologies for the treatment of AMD from Shaft 8 and/or 9 including:
 - The operation of a SAVMIN™ pilot plant campaign for the treatment of 2 m³/h AMD for evaluation of operational parameters in the SAVMIN™ process.
 - The installation and commissioning of the biological sulfate reduction circuit at the demonstration site. Preliminary results show that the sulfate concentration can be successfully reduced from 2600 mg/L to 100mg/L at a feed flow rate of 32 L/d and an overall retention time of 7.5days
 - The installation and commissioning of the silicate encapsulation reactor circuit and evaluation of the process efficacy to treat AMD directly.
 - The evaluation of the NICMembrane™ circuit to treat AMD directly.

This technology integration platform provides applicable processes for the remediation and



New Analytical Services Laboratory Equipment.



potential restoration of heavy polluted natural sources such as lakes and rivers.

Energy Recovery from Slag

The first energy recovery from slag prototype is nearing completion. The prototype will test if liquid slag can be processed via Mintek's novel grate design to demonstrate whether it is feasible to recover energy from slag through this design. The design is an example of cross-disciplinary innovation as it is based on designs used in the cement industry. South Africa's pyrometallurgy industry produces large volumes of liquid slag (typically in excess of 1500 degrees Celsius). Mintek is aiming to develop an efficient, yet simple to operate, system to recover some of this energy to either generate electricity or preheat or dry feed materials.

Waste and Residue Recycling Projects

Tailings Treatment

The strong performance of the gold price, increasingly lower ore grades in deep underground mining operations and higher labour and electricity costs are underlining the attractiveness of gold tailings retreatment operations in South Africa. The vast resources locked up in existing tailings dams and dumps in Gauteng are further encouraging the retreatment of gold tailings. The re-processing of old tailings dumps has the potential, not only to recover gold, but to bring about additional benefits such as minimising pollution, reducing the occurrence of acid mine drainage, opening up space for alternative land

uses, job creation as well as increase the overall revenue of gold in South Africa. Consequently, Mintek has been actively involved in tailings reclamation projects over the last few years.

Mintek demonstrated its trademarked Reflaut™ tailings retreatment process at South Africa-based gold miner Gold Fields' South Deep mine, near Randfontein. The Reflaut™ process, which refers to Retreatment Flowsheet for Au and Uranium Tailings, aims to recover gold, while also reducing the amount of radioactive uranium and sulphides (the mineral contents responsible for generating acid mine water) present in the tailings. The preliminary work on the tailings material was completed at Mintek and the 200 kg/h Reflaut™ flotation plant has been operated during November 2016 at South Deep mine.

During the Reflaut™ process, gold, sulphide and uranium-rich concentrates are recovered using a flotation process. The sulphide concentrate undergoes oxidation (bio-oxidation, pressure oxidation or roasting), which oxidises the sulphides in order to remove the AMD potential. This step also results in acid generation which is used to leach the uranium, followed by solid/liquid separation, where the gold (solid) and uranium (liquid) are separated. The uranium liquid is then combined with the flotation tailings stream where the uranium is selectively removed, while the gold reports to a carbon-in-leach gold leach circuit. The resulting tailings stream, which has a sulphide content of less than 0.3% and a uranium content of less than 40 ppm, is sent for disposal/deposition.

Mintek believes there is inherent potential that exists in reprocessing the gold mine dumps, which would result in the recovery of economic value from minerals and land. In support of the exploitation of this secondary mineral resource, Mintek is currently undertaking a study aimed at updating a database of all known mine dumps in South Africa, including ownership, size and grade/ composition. This could serve as reference source to develop and sell technology solutions for reprocessing mine waste of various types.

Treatment of Electronic Waste

Due to increased consumer demand, rapid changes in technology and inventions of new electronic devices, electronic waste (e-waste) has emerged as one of the fastest-growing waste streams globally. In South Africa, e-waste has been identified as one of the five priority waste streams to be addressed under the DST's Waste RDI Roadmap. The non-availability of technology and lack of investment in local e-waste recycling technology are often cited as explanations for the low levels of recycling in South Africa, particularly for certain components (e.g. cathode ray tubes) and complex fractions such printed circuit boards (PCBs), phosphor powders, and certain types of plastics and glass.

A research programme conducted as part of the Waste and Residue Recycling programme, is evaluating and developing technologies for the recycling of e-waste. Projects currently in progress include the development of a hydrometallurgical



Left: NIC Membrane™ circuit to treat AMD directly

Centre: Reflaut™ process, gold, sulphide and uranium-rich concentrates are recovered during a floatation process

Right: Mintek demonstrated its trademarked Reflaut™ tailings treatment process at South Deep mine, near Randfontein

process for the treatment of printed circuit boards (PCBs). Previous work conducted on PCBs indicated that copper recoveries of up to 97% could be achieved by leaching in sulphuric acid. However, the leaching kinetics are slow due to the larger particle size and lower initial solution potentials. Current work is focusing on metal recovery from a high grade PCB sample in a mixed chloride/ sulphate leaching system with the aim of improving the leach kinetics.

The lack of processing options for the recycling of cathode ray tubes (CRTs) in South Africa has resulted in large stockpiles of monitors with no resolution to the problem. The lead content of the glass making up the CRTs classifies it as a hazardous waste, resulting in high disposal costs. Mintek has undertaken to investigate the processing of the CRT glass with a view to create a clean slag along with a saleable lead product. Testwork in a gas-fired rotary and 200kVA DC Arc furnaces showed promising results and further optimisation will continue to increase extraction and produce non-hazardous slag.

Various types of plastics are found in electronic waste, some of which contain hazardous components. The plastic manufacturing industry blends shredded/granulated e-waste plastic scrap with virgin material to produce various extruded plastics products, such as roofing tiles, fence poles and plumbing pipes. It is acknowledged that there is up to a three-fold difference in the prices received for the pelletized plastic fraction compared to electronic plastic in its raw form. With this in mind, Mintek procured a pilot scale plastic

pelletizing line capable of producing pellets from e-waste plastic. The plant is capable of producing 3mm diameter pellets at an output of 60 – 90 kg/h and is currently being commissioned.

Mintek also conducted an assessment of the opportunities for the co-processing of e-waste in the existing minerals processing, smelting, refining and hydrometallurgical industries in South Africa. This was done with a view to establishing whether the capacity exists to do so, what the cost implications are, and whether there are barriers preventing the integration of e-waste in existing feed streams. In parallel, a study was conducted for the DST as one of the deliverables of South Africa's 10-year Waste Research, Development and Innovation (RD&I) Roadmap. The aim of the study was to assess the technology currently used in the dismantling, pre-processing and processing of e-waste in South Africa.

Collaborative European Union research activities related to e-waste treatment include participation in a Horizon 2020 funded project, EWIT (Development of an e-Waste Implementation Toolkit) and participation in a "Beyond Europe" programme evaluating technology development for advanced treatment of e-waste in South Africa as a model for similar emerging economies.

Mine Site Rehabilitation

Mintek is managing the implementation of a programme of mine rehabilitation in collaboration with, and funded by the DMR. The programme

formally continued from previous programmes with the conclusion of contract between the parties on 22 March 2016 with effect from 1 April 2016. The programme is currently funded to the value of R150 million over a period of three years, ending on 31 March 2019.

Notable achievements related to the programme during the year include:

- Completion of the Masaneng project in the Northern Cape and the practical completion of the Buisvlei North project in the Northern Cape as certified by Mintek's Consulting Engineer. These two projects were completed under the previous 3-year contract.
- Completion of the Buisvlei South and the Motsane rehabilitation projects.
- Survey of the extent of surface asbestos contamination of Heuningvlei Village.
- Selection and formal appointment of two geotechnical engineering service providers (Zitholele and SRK) for the duration of the new contract.
- Preliminary ranking of the 61 asbestos sites provided by DMR for the new contract, based on data collected by CGS.



4.8

Advanced Metal Applications

Nanotechnology Innovation Center

The DST/Mintek Nanotechnology Innovation Centre is a DST Flagship programme initiated in 2007 with the focus of using nanotechnology to develop products and technologies in the areas of nanominerals (nanostructured materials), water (treatment and remediation) and health (diagnostics and bio-sensing). The Centre has 4 Units that carry out this mandate:

Biolabels Unit

The aim of the Biolabels Unit is to develop nanotechnology-based alternatives for addressing health issues, such as diagnostics and therapeutics. The Unit does research and development of rapid diagnostic tests for animal and human disease detection for use at the point of care testing. Prototypes for HIV and Malaria have been developed and are currently undergoing field testing to validate their performance. Rapid test for zoonotic disease detection (Rift Valley Fever Virus and Brucellosis) are under development. Once the prototypes have been validated, manufacturing will take place in Mintek's ISO 5 manufacturing cleanroom for commercialization. The environmentally-controlled cleanroom has semi-automated machinery, with production capacity of 21 million tests per annum. The Unit has partnered with an industry partner (Afri-sky Medical), who will be marketing and commercializing the diagnostic tests. The Unit together with its

partners Afri-sky Medical and a South Korean-based company, NanoEntek Inc, have been awarded a 3 year contract for the supply of confirmatory HIV rapid test kits to the South African government in 5 Provinces.

Sensor Unit

The Sensor Unit's mandate is to develop electrochemical sensors that are easy to use and do not need skilled personnel, robust in that they can be used in remote areas where sophisticated storing equipment is not available, portable and cheap. The unit has developed a glucose sensor that uses nanoparticles produced in-house instead of enzymes used in the traditional sensors, and in-house produced screen printed electrodes which form the base of the sensors. The Unit is busy working on fine tuning the sensor to function in the presence of other interfering biological species. The Unit is currently working with the Measurement and Control (MaC) Division to develop a meter used to read the sugar levels in human beings.

Water Unit

The Water Unit continues to perform development of novel membrane materials and adsorbent composites for water treatment and wastewater remediation. The Water Unit intensified its technology demonstration programme by conducting medium-term piloting of its technologies on the treatment

of acid mine drainage/mining effluent and car wash effluent, and these assessments showed an upgrade of the water quality to levels that show potential for reuse in various applications.

Furthermore, the Unit was awarded a grant to the value of €90 000 under the Leading Integrated Research Agenda (LIRA) 2030 for Africa programme, to conduct a feasibility study on the use of renewable energy for use to power decentralized water treatment plants for the supply of clean drinking water to growing township communities in African cities. This study will be undertaken jointly with the Copperbelt University (Zambia) and the Human Sciences Research Council of South Africa. The study is expected to generate new solutions-oriented knowledge and contribute to the development of new urban paradigms in Africa and make African cities more resilient, adaptable and healthier.

Nanominerals Unit

The Nanominerals Unit undertakes scientific research projects which have direct applications and correlation to the other development units (Water, Sensors and Biolabels) within the Mintek NIC. The Unit houses researchers with a wide range of proficiencies, and hence, nanostructures of numerous shapes and sizes such as nanotubes, nanowires, and nanoparticles have been synthesized and characterized extensively



Left: Rapid diagnostic test development facility.

Centre: Nanostructured polymeric absorbents.

Right: Screen printed electrodes for NICSens on DEK 248 CE Screen printer.

and applied to various technologies such as water treatment and rapid diagnostic test kits and gas sensors. The group has successfully synthesized and tested the application of a new type of nanowires for gas sensing, especially on one of the most dangerous gases which have claimed many lives of underground miners.

HySA Programme Office

The HySA National Programme was established by the South African Government 10 years ago, with the expressed aim of addressing the future energy security challenges of the country through the Hydrogen Economy, as articulated in the government's Integrated Resource Plan (IRP) of 2010 strategy publication. In line with this strategy, implementation agencies which comprises three (3) Centres of Competence (CoC), namely; HySA/Catalysis, which is jointly hosted by the University of Cape Town (UCT) and Mintek; HySA/Systems, which is hosted by the University of the Western Cape (UWC); and HySA/Infrastructure, which is jointly hosted by North West University (NWU) and the CSIR, were established by the Department of Science and Technology (DST).

After the first 5-year programme review which took place in 2014, a key recommendation by the review panel was that, given the impressive growth of the programme, a central co-ordinating office was now needed to assist the Centres of Competence (CoCs) in achieving their future performance goals of the Programme. In line with the review panel's recommendations, in the first quarter of FY 2016/17, the Department

of Science and Technology (DST) approached Mintek with a request to host the HySA Programme Office (HySA PO). The envisaged functions of the office were to provide the future strategic direction for the Programme, and co-ordination of the R&D and commercialisation efforts on behalf of the DST.

Mintek agreed to host the office and a Programme Manager was appointed on the 1st November 2016. Working closely with DST, the Programme Office has started to take over the co-ordination functions from DST. A team of specialist staff is currently being recruited for the full function of the Programem Office.

HySA/Catalysis Programme

Given the increasing demand for membrane electrode assemblies (MEAs) from HySA/Catalysis, both from the programme's commercialisation arm (HyPlat) and national demonstration projects driven by the DST, the need has arisen for both University of Cape Town and Mintek to adopt a single MEA fabrication procedure. An agreement was reached for both centres to implement the Dual Direct™ catalyst coated membrane (CCM) route given that most commercial demand is for CCM based MEAs that typically have a performance advantage over the standard catalyst coated substrate or gas diffusion electrodes (CCS) based MEAs. In addition the Dual Direct™ method lends itself more readily to high volume and lower cost manufacturing of MEAs that will become more important as demand for the HySA/Catalysis MEAs grows. In this work, the application of the Dual Direct™ CCM procedure was validated at Mintek on several H₂-only and

CO-tolerant based MEAs. The H₂-only MEAs were compared to a benchmark CCM supplied by UCT, against which the performance of the MEAs matched very well. The CO-tolerant CCMs, on the other hand, were compared to an industrial reference MEA, and again these closely matched the performance of the benchmark MEA under pure H₂, H₂/N₂ and reformat testing conditions. Hence, the Dual Direct™ CCM route was successfully implemented at Mintek and will be adopted in the majority of MEA development activities going forward. This will ensure direct transferability between Mintek and UCT of any advances made at either centre, and has improved the production capacity of HyPlat, allowing increased demand to be more easily met.

Future work will focus on evaluating the durability of the HySA/Catalysis fuel cell catalysts in MEAs through the application of in-situ accelerated durability test protocols developed in the US DoE fuel cells programme, which have become the industry standard protocols. Specifically these protocols target the inherent Pt particle stability of the catalysts and the corrosion of the support carbon materials under operational conditions. This will provide a complete picture of catalyst durability and afford invaluable guidance in the H₂ development of HySA/Catalysis' next generation of electrocatalysts.

Centre for Metal-based Drug Discovery

The group in this Centre undertakes early stage drug discovery with the primary objective of identifying novel inhibitors of HIV-1 replication. The



group comprises both chemists and biochemists and utilizes a structure-based approach to design and discover useful, small-molecule, inhibitors.

Products and Services: During the 2016-17 financial year CMDD continued to successfully secure commercial work for internal and external clients, offering services such as organic chemical analysis, microbial count, bacterial identification, xanthates analysis, etc. CMDD sought the provision of SANS 241-1: 2015 for assessing the quality of drinking water, and had started implementing some of the analytical tests for ca. 50 determinants (Mintek already offers waste water quality analysis).

New services offered included acute aquatic toxicity tests and toxicity identification evaluation in waste water systems: CMDD has acquired a Microtox® M500 analyser to determine acute aquatic toxicity, and Mintek effluent plant, boreholes, fish pond and water treatment technology developments were identified as key areas to best illustrate the capabilities of the toxicity test. This test can help

in the early detection of any toxic effect emanating from industrial operations by monitoring the quality of the surrounding aquatic environments, locating and remediating the cause of toxicity at its source. It can also provide a fast mean of assessing progress during the development stages of water treatment technologies (i.e. acid mine drainage). Due to the above work, CMDD was requested to monitor some of the influents to Mintek treatment plant, highlighting the importance of correct disposal and treatment of acidic waste, which as per Mintek procedures, must be done at the source.

Dioxin responsive CALUX® bioassay — CMDD is building new capacity around the provision of a cost-effective environmental testing and monitoring solution for dioxin and other harmful persistent pollutants in gas emissions and other matrices.

FoodSecurity—Aiming to develop novel compounds against agriculturally related pests and diseases, significant progress has been made on the Rep

protein production and activity assays. Chicoric acid, was tested against Rep, and inhibited the protein, even at low micro molar concentrations. The inhibition of Rep by chicoric acid is a novel finding of this study, and may prove to be significant in the development of strategies in combating plant viruses.

Drug Discovery Project - An adaptation of the robust AlphaScreen assay for High Throughput Screening (HTS) of a 20,000 commercial compound library has been successfully implemented, allowing the identification of 66 compounds with novel structures as HITS for the HIV-1 Integrase-LEDG/p75 assay – with inhibitory percentage of over 50% at 10 µM following the TRUHITS validation assay. Two new families of compounds were designed, synthesised and biologically evaluated with the objective of selecting compounds showing over 50 % inhibition at 100 µM for further chemical modification, while other two families of compounds were submitted for provisional IP protection.

4.9

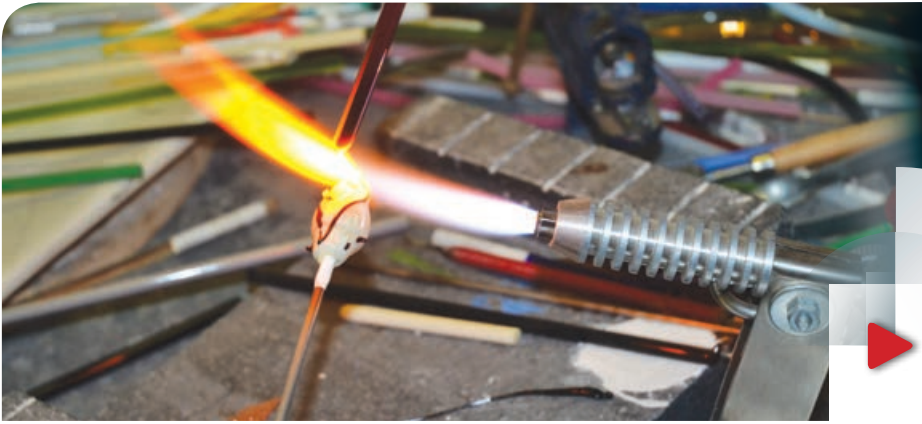
Small Business Development

Research in Small Scale Mining

During the year a study was conducted on the different applications of sedimentary rock wastes that can be used to benefit the communities around them. The study looked at

applications such as fibre glass manufacturing, aggregates production, cement and ceramic tile manufacturing as a small or medium business venture. The study resulted in the development

of a simple, cost effective and portable tile press which is relatively inexpensive compared to its industrial counterparts, as it is made of hard plastic, ceramic moulds and uses compressed



Left: Nanominerals Ni Grids.

Centre: Silver earrings manufactured with naturally occurring seeds.

Right: Jewellery manufacturing (Glass Beads).

air to press and release tiles. This technology will assist existing ceramic groups to expand their product lines to also include tiles that can be made from sedimentary rock wastes and this can generate more revenue. Since it is simple to use, it is envisaged that it will also allow people living with physical and mobility impairments to be able to produce tiles.

Ferrochrome slag is a waste produced during chromite ore smelting processes, where metallic iron-chrome alloy is separated from the gangue minerals. Metallurgical slags, including that of ferrochrome are internationally recognised as suitable material for use in construction such as in aggregate for concrete and even in brickmaking. Tests showed that ferrochrome slag satisfies the South African National Standards (SANS) specifications in terms of durability and composition as pavement aggregate. The legal and environmental implications of using the metallurgical slag in construction were also studied in-depth. Small-Scale Mining and Beneficiation developed a process flowsheet that will enable the Bafokeng community in the Bojanala district municipality in Rustenburg, North West Province, to produce aggregates that are suitable for pavement construction, while at the same time isolate the Cr(VI) streams (-6.7mm class size class) for further metal recovery.

Training and Development

The Malawian Department of Mines sent two delegates to Mintek for a period of one month for training on an introductory course in the cutting and polishing of semi-precious gemstones and

on jewellery manufacturing. By the end of the training the learners were able to manufacture saleable products.

Mintek hosted a delegation of three people from Mali as part of the capacity building programme for the Women in Mining Sector of Mali (AFEMINE). The training was arranged by the DMR and the delegation spent one week at the SSMB division learning about gemstone cutting/polishing, jewellery manufacturing, glass beads and small scale mining.

Mintek and the MQA entered into a memorandum of agreement to train 300 learners in Mpumalanga in Surface Mining (NQF Level 2) over a period of six months. The training consisted of both theoretical and practical components that covered learners from six municipalities across the province. The programme assisted in uplifting the communities where a number of people were previously retrenched ex-mine workers that were unemployed. The programme was successfully completed and out of the total number of learners trained 53% were female and 47% male. The training was well received by the six municipalities and has created an opportunity for employment with a number of small businesses being registered that will pursue mining type operations.

Throughout the year, Mintek continued to provide technical and marketing support to the two beneficiation centres that were set up in the Northern Cape. The centre in Upington has improved tremendously and the learners have

come up with several new product designs in both ceramics and jewellery. There has also been a dramatic increase in the foot traffic that passes through the centre on a daily basis especially from tourists that visit the area. This has helped increase the sales of the centre. The Upington centre manager won the best social enterprise award for 2016 in the Strike a Rock Awards, an initiative of the Northern Cape Premier's office, in conjunction with the Mme Re Ka Thusa Trust Fund which aims at celebrating and supporting local business women and women-owned enterprises in the province. Mintek completed the expansion of the existing Jewellery project in Kuruman to include new equipment and workbenches. The project beneficiaries were also re-trained and are now also able to utilise the Amaso technology to manufacture beads from recycled glass. This will now serve as the third beneficiation centre in the Northern Cape.

Technology Development

Mintek's Measurement and Control (MaC) Division managed to achieve a number of significant milestones in its efforts to bring new process monitoring and control products to the market. One such product is the development of a gravity concentration spiral control system. These spirals, which are used extensively within South African mining operations for the concentration of minerals such as chromite and heavy mineral sands, typically have no automatic system of regulation, resulting in fluctuating performance and loss of valuable mineral recovery. In the 2016/17 financial year, Mintek demonstrated a prototype control system on a local spiral plant used for chromite recovery, and established that the control system was able to improve the concentrate grade by as much as 2% using the novel actuation system, which is the subject of a provisional patent. The actuation system manipulates the mineral band positions directly on the spiral surface, and can be used to control grade and/or recovery of the spirals. In 2017/2018 extensive work will be undertaken to push this technology towards commercialisation.

A product that has reached market-ready status is the new Carbon Activity Analyser (CAA). This new automated carbon activity analyser utilises cheap iodine instead of expensive and toxic aurocyanide as the reagent, resulting in lower operating costs, and eliminating the complicated preparation steps and inconsistent results typical of the manual iodine-based measurement technique. Mintek has so far received two orders for this new version of the instrument.

The MaC division has also developed a novel adaption of an ultrasonic technology, typically used for car parking/proximity sensors, to be used for the measurement of pulp density

in a leach tank. Mintek's existing Carbon Concentration Meter (C²M) has seen good uptake by the market since its launch, but its reliance on external density measurement in its calculations prevents it from being a completely stand-alone instrument. The density is normally manually measured and input into the system. To make the C²M a truly stand-alone instrument, ultrasonic time-of-flight technology was adapted and integrated into the existing C²M head, to provide a density measurement, allowing the C²M to compensate for variations in density without relying on outside information. This results in more accurate, consistent measurements, while simultaneously reducing manufacturing costs.

Marketing Activities

On the business front, Mintek continues to make good progress expanding its footprint in Africa. Subsequent to the excellent results achieved through the application of Mintek's advanced process control systems at Randgold Loulo mine in Mali, the organisation has concluded installations of its FloatStar™ Level Stabiliser and Flow Optimiser systems on Randgold's flagship plant, Kibali, in the DRC. The system was soon extended to include control of the dosing of cyanide in the gold leach circuit using Mintek's LeachStar™ control system, and discussions are underway to extend the system even further to include other sections of the plant.

A two-week marketing trip to Zambia was undertaken during which five plants were visited to examine each plant's performance and make recommendations on how performance can be improved through the application of advanced process control (APC). The marketing visit was successful since even with the copper price under some pressure, there was significant interest in what Mintek has to offer.

Process Control Systems

Mintek received a large order for a Mintek FloatStar™ Advanced Control System for the 1.5 MTPA expansion at Hindustan Zinc Limited (HZL) of the Vendanta Group, Sidensar Khurd Mine in Udaipur India. Mintek's advanced process control systems are already installed on a number of HZL Lead-Zinc flotation concentrator plants in India. An order was also secured, and the FloatStar™ subsequently successfully commissioned, at the Neves-Corvo copper and zinc mine in Portugal. Neves-Corvo is owned and operated by the Portuguese company Somincor, which is a subsidiary of Lundin Mining. Mintek installed an advanced process control system at Lundin's Eagle mine in the USA in 2015. The Neves-Corvo order is largely as a result of the exceptional results Mintek's control system was able to achieve at Eagle, as Lundin is seeking to extract similar performance from its other operations. This is the first Mintek FloatStar™ to be sold into Portugal. In a similar vein, after the successful installation of Mintek's FloatStar™ Level Stabiliser at Tharisa Mine in South Africa towards the end of the previous financial year, a purchase order for the expansion of the Mintek control system to include FloatStar™ Flow Optimiser on part of their flotation circuit was received this year.

In terms of furnace control, two FurnStar™ Minstral systems were successfully commissioned at a greenfield manganese smelter plant in Malaysia. The plant is majority owned by a South African company, and the Minstral was specified for this project through prior positive experiences at their local operations. Commissioning was performed by Process IQ, Mintek's distributor for the Australasian region, allowing for more localised support to the end client. FurnStar™ Minstrals were also recommissioned on the two furnaces at Samancor Chrome's recently acquired

Terris Chrome Smelter (formerly International Ferrometals), resulting in the Minstral being the primary control system on all four Samancor smelter plants. Lastly, work was also conducted at the Transalloys plant, owned by Renova Mining Industries, which operates 5 submerged-arc furnaces producing silicomanganese near Emalahleni in Mpumalanga. The two larger furnaces (Furnaces 5 and 7) have been controlled by Mintek's FurnStar™ Minstral controller for several years. Good controller performance on these furnaces have resulted in Transalloys purchasing an additional Minstral controller. Originally, this was commissioned on Furnace 1 for a short period, but due to market conditions affecting furnace availability, the plant requested this controller be moved to Furnace 6 and Mintek successfully accomplished its commissioning during the year. Although the layout of the furnace is unconventional, the flexibility of the FurnStar™ suite made it possible to adapt the controller for compatibility with the furnace.

Process Instruments

Mintek continued to make good progress in capturing market share with its Cynoprobe™ instrument. Kumtor Gold Company purchased Mintek's Cynoprobe™ Cyanide analyser for its

plant in Kyrgyzstan, the first in this country, and then a further two were commissioned at Troy Resources' Karouni Project in Guyana, also a first, expanding the Cynoprobe's footprint into its fourteenth country to date. Two Cynoprobes™ also were added to Mintek's tally of 10 in Mexico with the commissioning of two instruments at Fresnillo plc's San Julián plant, further strengthening Mintek's position in this market, and two were delivered to Cia Minera Poderosa S.A. in Peru. Peru is seen as a growth market for Gold and hence Mintek's Cynoprobe™. The Poderosa sales bring the number of Cynoprobes™ sold into Peru to five.

Ten Carbon Concentration Meters and a Carbon Movement Controller were commissioned in Kazakhstan - an excellent step forward in acquiring a footprint for these newly released products in the Commonwealth of Independent States (CIS) region. Several units were also sold into Africa, Australia and within South Africa.





4.11

Collaborations and Science Promotion

International

- A collaboration project, INTPART kicked-off in February 2017, The INTPART Metal Production collaboration project aims at strengthening the ties between Norway and South Africa through joint research and education projects conducted at the four participating institutions: NTNU and SINTEF in Norway, and the University of North-West (NWU) and Mintek in South Africa. The project runs over three years (2017 – 2019) and is funded by the Norwegian Research Council (NRC) and NTNU. In essence, the INTPART Metal Production Project aims at enhancing international participation in research and education, through long-term collaboration between two of the main countries involved in metals production: Norway and South Africa. The long-term vision of the project participants is for Norway and South Africa to excel in research and education in the field of metal production. Mintek will play a key role in this collaboration, hosting international researchers at its facilities for extended stays, while researchers from all participating institutions will collaborate on a variety of pyrometallurgical topics of interest.

- Mintek presented at the 17th IFAC (International Federation of Automation and Control Symposium on Control, Optimization and Automation in Mining, Mineral and Metal Processing (MMM) in Vienna on Mintek's market leading StarCS Automodeller and the StarCS RNMPD technologies.
- The third annual AMREP (Applied Mineralogy for the Resource Efficiency of Platinum Group Metals) workshop took place in Hannover, Germany, where Mintek presented its work to date.
- Mintek attended the World Mining Congress in Rio, Brazil in October and whilst there concluded the 3-year collaboration agreement with Centro de Tecnologia Mineral (CETEM).
- As part of a DMR-led delegation Mintek presented on "Minerals-Based Community Development Projects" at the 63rd Annual National Mine Safety and Environment Conference in the Philippines. This presentation highlighted the work being done by Mintek and its applicability to the Philippines.
- During September 2016, Mintek visited the Beijing General Research Institute for Mining and Metals (BGRIMM), the Metallurgical

Corporation of China (MCC), and the Beijing Axis, all located in Beijing, China. The Mintek team then attended the 18th China Mining Congress & Expo 2016, themed, "From Novel Concepts, to Innovative Solutions". This Conference was successfully held at the Meijiang Conference and Exhibition Centre in Tianjin, China on 22-25 September 2016. The Mintek stand formed part of a branded South African Pavilion. The pavilion also accommodated the Department of Mineral Resources (DMR), the Department of Trade and Industry (the DTI), Council for Geo Sciences (CGS), Mine Health and Safety Council and the South African Diamond and Precious Metals Regulator (SADPMR). The DTI also hosted the South African Investment Seminar Dialogue where presentations were made by Mintek, the CGS, and a consolidated presentation on the new Minerals sector, by the DMR.

- During the Africa Down Under Conference in Australia from 6th to 9th September 2016, a South African delegation led by the DMR, hosted a lunch event to initiate investment dialogue with potential investors in mining projects in South Africa. Mintek showcased its expertise and achievements and gave a



Left: Mine Metallurgical Managers Association meeting before a tour of Mintek.

Centre: Mintekker, Ashma Singh at the The Mining Show, Dubai, UAE.

Right: Delegates from Egypt and Jordan attended the International Atomic Energy Agency (IAEA) Fellowship programme hosted at Mintek.

presentation highlighting how Mintek utilises the available expertise and its vast experience in the minerals industry to fulfil its mandate. A number of showcase achievements was also presented in support of the value proposition offered by Mintek to the development of projects.

- From 25th - 26th October 2016, Mintek attended The Mining Show 2016 in Dubai, UAE. The main objective of the conference was to ensure that proceedings, exhibitions and featured events address the required needs for the mining value chain. The Mining Show is the largest mining conference and exhibition in the Middle East, Africa, Central Asia and South Asia and is ideally located to promote mining equipment, leading technologies and services. The Show is a catalyst for the mining sector and is a gathering of mining companies, ministries, investors and key solution providers. Mintek hosted an exhibition stand to market their core functionalities.
- The International Mineral Processing Congress (IMPC) is one of the highlights on the international conference calendar for the minerals and mining industry. IMPC hosted the Conference of Metallurgists (COM 2016) in Québec City in Canada from 11-15 September 2016. Mintek had a very strong presence at the conference by sponsoring an exhibition booth with all the Mintek Technology Divisions represented. This provided a strong platform for interaction with industry players

and potential clients in order to promote the products and services that Mintek can offer to the industry.

- Mintek attended the Developers Association of Canada (PDAC) International Convention which was held in Toronto, Canada, from 5 to 8 March 2017. Mintek was represented at the Trade Show by means of a shared booth with SENET and the Nigeria Ministry of Mines & Steel Development as part of the MineAfrica exhibition. The stand exhibited a poster which summarized the metallurgical project development capabilities of Mintek.

During this time, Mintek also attended the Canada-Southern Africa Chamber of Business 18th Annual African Mining Breakfast and the MineAfrica 15th Annual Investing in African Mining Seminar. Mintek moderated in one session and presented on the tailings project demonstration done by Mintek in 2016. The presentation was a brief description of Mintek followed by the introduction to the gold tailings project. The presentation further described the Reflaut™ process and the benefits of using the Reflaut™ process to re-process gold tailings. The presentation was well received and had one enquiry requesting more details of the project. The conference proved to be a fruitful exercise in showcasing and promoting the research being conducted at Mintek and maintaining Mintek's relevance in minerals expertise. Other activities involving Mintek were:

- Panel discussions on Africa's Mining Industry with Webber Wentzel;

- Joint Working Committee for Mining and Development of South Africa/Canada where a progress update was done on work done between the mineral resources ministries of the two countries; and
- The South Africa Investment forum panel discussions.

Mintek also visited a number of Toronto based companies during this visit. These included;

- A presentation and discussion with a technical team from Barrick Gold relating to sensor based sorting of waste material from base metal ores as well as various other waste rejection options and uranium removal from base metal ores;
- Discussions with Gekko systems on research and equipment options for underground ore processing;
- Discussions with Montero mining about their efforts to refinance their rare earth project and their request for a technical proposal;
- Discussions with staff from the Natural History Museum about participation in joint EU Horizon 2020 projects; and
- Discussions with Alex Grose the MD of Mining Indaba about the experience of the 2017 Mining Indaba.
- In October 2016 Mintek's Analytical Services Division was invited to present on "The role of analyses in mineral processing", at the 1st



International Mineral Processing Activists Symposium (IMPAS), in Tehran, Iran. A number of meetings were held to discuss possible business opportunities and collaboration between IMIDRO and Mintek. As a follow up of this symposium, Mintek has been requested to submit a proposal for the establishment of an analytical facility in Iran.

- Mintek's Mineralogy division presented the workdone on asbestos as part of the D&O mines project at the European Mineralogical Congress in Rimini, Italy.

Africa

- Mintek's Biotechnology Division continued its participation in a number of European-funded collaborative research programmes. As part of the dissemination activities of the E-waste Implementation Toolkit (EWIT) project, presentations were delivered at a Pan African conference in Nairobi, Kenya and at the Pan African Parliament in Midrand, South Africa. The kick-off meeting of a project with Austrian partners, evaluating the feasibility of implementing mobile e-waste treatment technologies in South Africa, was held during February 2017.
- Mintek accompanied a Department of Science and Technology delegation to Accra, Ghana as part of the Bilateral Agreement signed between the two countries in September 2012. The focus areas identified where it

included Mintek's participation were the treatment of acid mine drainage and e-waste, water treatment using nanotechnology, and modelling of Carbon-in Leach (CIL) plants.

- Mintek hosted the Ambassador of the Republic of Suriname to South Africa to discuss their initiative of Mercury Free Gold Mining in Suriname. Suriname has a long history of artisanal and small scale gold mining and the use of mercury for extraction has resulted in the pollution of rivers, environmental degradation and loss of lives. Mintek together with CGS will help develop a long term plan to eliminate the use of mercury in Suriname.
- Three technical papers were published by employees in the Small-Scale Mining and Beneficiation Division. A peer-reviewed paper entitled "When policy is not enough: Prospects and Challenges of Artisanal and Small-Scale Mining in South Africa" appeared in the Journal of Sustainable Development Law and Policy (Volume 7), Afe Babalola University, Nigeria. In the past two decades, several programmes and initiatives have been introduced to promote and advance the Artisanal and Small-scale Mining (ASM) sub-sector in South Africa. This paper reflects on past experiences and assesses the impact made by the initiatives introduced.
- Mintek accompanied a DST delegation to Madagascar as part of the Bilateral Agreement signed between the two countries in 2015. The focus areas of Mintek are in Small-Scale

Mining (including Gemstone beneficiation), Nanotechnology and Capacity Building in Madagascar.

- Mintek hosted a three-month training programme on Minerals Processing and Beneficiation, aimed at building capacity for the 19 participating scientists and technologists who represent 13 Non-Aligned Movement (NAM) member countries.
- The fellowship scheme which is in its second year, is a joint initiative of the Department of Science & Technology (DST), South Africa, and The Centre for Science & Technology of the Non-Aligned Movement and Mintek.

South Africa

- Mintek presented a five-day course on "Principles of Chromite Smelting" attended by 35 delegates from a prominent ferrochrome producer in South Africa. The course addressed chromite smelting metallurgy, mass and energy balance principles and operational efficiencies and delegates were provided with a range of tools and calculation methodologies that can be applied in a production environment. The course not only provided an opportunity to transfer skills, but resulted in several enquiries for commercial proposals.
- Mintek presented five technical papers at the SAIMM Hydrometallurgy 2016 Conference, which was held in August 2016 in Cape Town,



Left: Mintek and Norwegian delegates at the INTPART Metal Production kick-off meeting held at Mintek.

Centre: Investment seminar at China Mining.

Right: Seshree Pillay and Jakolien Strauss at Alta 2016.

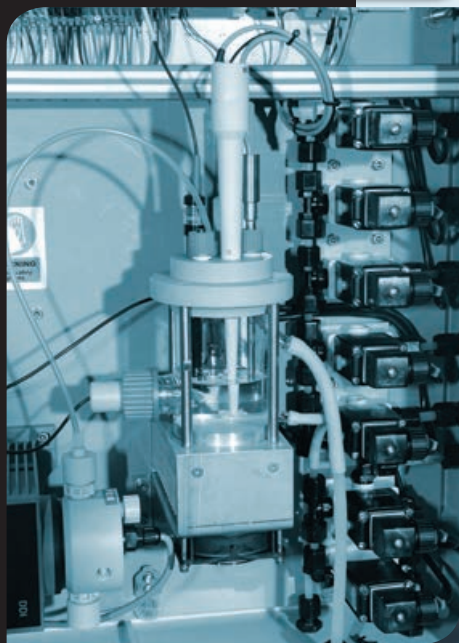
of which three papers were presented by the Hydrometallurgy Division (HMD) and two by the Pyrometallurgy Division (PDD) staff. The papers were very topical in the current mining environment and focussed on reduction and treatment of waste streams, new advances in gold processing, properties of high-titania slag from titaniferous magnetite process and a new pyrometallurgical technology for extracting rare earth elements (REE) from difficult to treat deposits, PyEarth™.

- Three technical papers from the HMD were also submitted to the SAIMM Hydro 2016 Conference, which was held in August 2016 in Cape Town. The topics of these papers address Mintek's patented MgO recycle technology, the SAVMIN™ mine effluent treatment process, as well as advancements in gold processing.
- A paper on research undertaken on Cathode Ray Tube (CRT) recycling in SA as part of the Urban Mining Electronic Waste Project was published in the Multidisciplinary Digital Publishing Institute (MDPI) Recycling Journal.
- On 16 February 2017, members of the MiWare Consortium, including delegates from VTT, Flootech, Outotec, Agnico Eagle (all of Finland), IVL (Swedish Environmental Research Institute), AngloCoal and WADER (South Africa), visited the SAVMIN™ and Robinson Lake demonstration site. During this site visit, the concept of intelligent integration

of technologies for the rehabilitation of heavily polluted sites was introduced to the visitors. This highlighted Mintek's commitment to responsible mining and showcased a number of Mintek technologies.

- Mintek hosted the 6th Annual Gauteng Nanosciences Young Researchers' Symposium (NYRS) by the DST/Mintek Nanotechnology Innovation Centre (NIC) in partnership with the South African Nanoscience Initiative (SANI) on 18 November 2016.
- Small-Scale Mining and Beneficiation also published a paper on the Status of Artisanal and Small-scale Mining sector in SA: tracking progress that was published in the SAIMM Journal Volume 117.
- The Small-Scale Mining and Beneficiation division presented a paper entitled "Mineral Opportunities in the Eastern Cape Province" at the Business Seminar on mining opportunities in Chris Hani and Joe Gqabi District Municipalities in the Eastern Cape. The outcome of the seminar was that a forum be formed with the primary role of the forum to provide support services to the sector.
- The 6th Analytical Symposium was held on 21 October 2016. This was co-hosted by Mintek and the South African Spectroscopic Society, who have partnered with Mintek in hosting the Symposium. The topic under discussion was "The Environment". Mintek contributed 7 presentations from a total of 13, and 3 poster presentations.

- In May 2016, the Biolabels Unit concluded a distribution agreement with Afri-Sky Holdings for the marketing and commercialisation of the HIV and malaria rapid diagnostic test kits within the SADC region.



A selection of Environmental Technologies & Services Mintek offers the Minerals Industry. From top to bottom: **NICMembrane™**, **SAVMIN™** and **Cynoprobe™**.





5

Sustainable Development

Performance Against Mintek's Sustainability Focus Areas	62
Investing in Mintek's People	66
Recognition and Excellence Awards	68
Safety, Health and Wellbeing of Mintek's People	71
Protection of the Environment	72
Quality of Mintek's Work	75
Corporate Social Responsibility	76

5

Sustainable Development

For a global leader in its field, it is vital for Mintek to adopt a business practice of sustainable development. Mintek has therefore tailored its activities, to not only meet the needs of its stakeholders, but also ensuring that its practises enhance, protect and sustain human and natural resources for the future. The activities vary from upskilling the workforce to raising awareness and funds for just causes.



▶ Aluwani Nemaxhwi: From a painter at EMS to now working as an Engineer-in-Training in the Graduate Development Programme in SSMB.

5.1

Performance against Mintek's Sustainability Focus Areas *(continued)*

The table below lists Mintek's sustainability-related focus areas and summarises its progress in addressing these areas.

INVESTING IN MINTEK'S PEOPLE	
How Mintek Performed in 2017	What Mintek is Committed to
▶ Allocated 29 full time and 109 part time bursaries towards feeding its bursary pipeline and for the recruitment and retention of critical skills.	✓ To continue to increase the number of employees participating in structured mentorship programmes to transfer skills and knowledge from specialist to mid-level professionals.
▶ Mintek trained 15 learners on the artisan learnership programme against a target of 8.	✓ Increase innovative activities centred on graduate mentoring and training of mentors.
▶ Achieved 89% of designated group representation against a target of 90%.	✓ Continue efforts to build a values-driven high-performance culture across all of the operations.
▶ Achieved the target of 3% for employees with disabilities.	✓ Continue positive progress towards achieving employment equity in the workplace.
▶ Achieved 8% staff turnover rate against a target of 9%.	✓ Integrate graduates into the Mintek environment.
▶ Hosted 10 wellness interventions against a target of 5.	✓ Increase the proportion of staff with MSc and PhD degrees.
▶ Spent 2.5% of payroll on training and development interventions for its employees. Of this 85% (over R6m) was spent on core/technical training with the balance spent on soft skills training.	✓ Roll out more empowerment strategies for women and people with disabilities.
▶ Against a target of an average of 4 years of Mintek experience for its researchers, Mintek was able to achieve an average of 8 years, well above the target.	✓ Continue to implement strategies to retain professional staff at Mintek.
	✓ Further develop the capability and increase the ability of Mintek to attract a broad spectrum of young graduate scientists and/or engineers.
	✓ Continue to enhance employee health and wellness programmes.



Top Achievers from Mintek's GDP programme (from the left: Walter Ndlovu; Mosili Pebane; Hlengiwe Mnculwane; Nanji Sheni and Mbavhalelo Maumela); Right: First Aid competition Participants at the Mintek Wellness Week 2016.



ENSURE SAFETY, HEALTH AND WELLBEING OF MINTEK'S PEOPLE

How Mintek Performed in 2017	What Mintek is Committed to
▶ The Lost Time Injury and Health Incident Frequency rates at year-end were 0,0 and 0.1 respectively and well below the targets of 1.0.	✓ Continue efforts to have zero harm in all areas of safety, health and wellness.
▶ There were no major environmental incidents reported during the year.	✓ Continue blood donation drives, TB screening initiatives and weight maintenance programmes.
▶ There were no work-related fatalities during the year.	✓ Increase audiometry and ENT initiatives amongst employees to determine incidences of hearing loss due to noise.
▶ All Mintek divisions scored higher than the 80% target on their internal audit scores for integrated SHEQ audits.	✓ Continue efforts on HIV/AIDS awareness and support.
▶ Mintek had a total of 31 injuries on duty, none of which resulted in lost time from work	✓ Continue to encourage employees to do physical exercises and quit smoking in order to improve spirometry.
▶ Conducted 906 medical surveillances for employees, bursars and trainees, including 550 annual medicals, 210 entrance medicals and 133 exit medicals.	
▶ A total of 715 spirometry tests were performed.	
▶ A total of 872 audiometry tests were performed during the year. Only 14 of these tests recorded were in the PLH (10-19.9%) range while a total of 20 fell within the PLH (5-9.9%) range.	

MINTEK'S RESPONSE TO ENVIRONMENTAL CHALLENGES

How Mintek Performed in 2017	What Mintek is Committed to
▶ 70% of Mintek's technical divisions managed to score 100% on their legal compliance audits.	✓ To continuously report on environmental process improvements.
▶ Mintek's recycled waste has been dealt with in accordance with SANS 10234.	✓ To intensify efforts to save water through the reticulation project.
▶ Nearly 20 049 kg of waste was recycled, compared to around 22 000 kg the previous year.	✓ Further investments and increased investigations to reduce atmospheric emissions.
▶ Approximately 66.7 tons of scrap metal was recycled, compared to 81.6 tons the previous year.	✓ To continue benchmarking efforts for the establishing of best practice and identify areas of improvement in Mintek's water footprint.
▶ Total carbon emissions measured for the year amounted to 11 435 tons/year CO ₂ , down by 3 714 tons/year CO ₂ on the previous year.	
▶ Total water consumption has decreased from 65.1 megalitre last year to 55.82 megalitre this past financial year.	



Left: Participants at the official opening of the NAM Training on Mineral Beneficiation, on 13th May 2016.

Centre: Participants at the NAM Training on Mineral Beneficiation, which concluded on the 31st of July 2016.

Right: Rachel Sogoba, Karabo Gabanagosi and Dembele Zouman are sharing skills in the processing of special stones to create jewellery during Training for Mali Women in Mining.

THE QUALITY OF MINTEK'S WORK

How Mintek Performed in 2017	What Mintek is Committed to
<ul style="list-style-type: none"> ▶ All but one technical division managed to achieve external customer satisfaction rates of above 90%. Mintek's average rate at the beginning and at the end of the financial year was 97%. 	<ul style="list-style-type: none"> ✓ To continue the integration of Mintek's audits for ISO 9001, ISO 14001 and OSHAS 18001.
<ul style="list-style-type: none"> ▶ All technical divisions reached their 80% target for project information chart (PIC) submission success. PIC is a measure of the quality of the initial information on environmental aspects and compliance with Mintek codes and policies. 	<ul style="list-style-type: none"> ✓ To continue with value-adding process improvements, process performance and management programmes with regards to quality of Mintek's research and technology development work.
<ul style="list-style-type: none"> ▶ Mintek produced 61 technical articles in credible publications (74% higher than the target of 35). It also far exceeded the number of conference presentations and posters (162 against a target of 74 which is 119% higher than the target). 	<ul style="list-style-type: none"> ✓ To increase training interventions and ensure that more employees are educated on ISO 9001 changes.
<ul style="list-style-type: none"> ▶ Mintek filed 4 patents, which was lower than the target of 7. In addition, fewer than planned IP licence agreements were obtained (3 of 7) and made only 16 out of a planned 21 discoveries. 	<ul style="list-style-type: none"> ✓ To continually work on improving external and internal customer satisfaction rates.
	<ul style="list-style-type: none"> ✓ To continue to send more promising young scientists and engineers to participate at relevant conferences all over the world.

SMALL BUSINESS AND SUPPLIER DEVELOPMENT

How Mintek Performed in 2017	What Mintek is Committed to
<ul style="list-style-type: none"> ▶ Successfully adapted and developed 2 new technologies relevant to small scale operators, for transfer to rural and marginalised communities. 	<ul style="list-style-type: none"> ✓ Continue efforts to develop and support economically sustainable rural and marginalised communities.
<ul style="list-style-type: none"> ▶ Mintek successfully created 5 new businesses against a target of 4 under the objective "development and support of economically sustainable rural and marginalised communities". From these businesses, 41 jobs were created, against a target of 40. 	<ul style="list-style-type: none"> ✓ Intensify training and skills development interventions in rural and marginalised communities.
<ul style="list-style-type: none"> ▶ 100% against a target of 95% of businesses set up in 2016 are still in existence while 71% against a target of 70% of businesses set up in 2015 are still in existence. 	<ul style="list-style-type: none"> ✓ Sustain efforts to provide technical and marketing support to beneficiation centres in provinces agreed on with the MQA and other funders.
<ul style="list-style-type: none"> ▶ In partnership with the MQA, Mintek was able to exceed its target of training 100 people by 212% (i.e. 312 people trained) in areas that are relevant to rural and marginalised communities. 	<ul style="list-style-type: none"> ✓ Continue retraining efforts with learners to utilise Mintek's Amaso technology to manufacture beads from recycled glass.
<ul style="list-style-type: none"> ▶ Spent 97%, against a target of 80%, on BEE procurement as a % of discretionary spend. 	



Delegates of the 6th Annual Gauteng Nanosciences Young Researchers Symposium 2016, gather outside Mintek for a group photo.

5.2 Investing in Mintek's People

Mintek's training and development interventions that were implemented during the period under review had a dual-focus. The first area of focus was the development of our employees through short skills training and part-time bursaries towards substantive qualifications. Training and development of our employees positively contributes to our strategy execution and overall performance as an organisation. It enhances employee engagement and connectedness with the organisation, and is a critical component of our retention strategy.

In this regard, Mintek invested a total of R7 066 302 in payments to service providers for the delivery of various employee development programmes including short courses, certificate programmes, management development and mentorship programmes, during the period under review. Ninety percent (90%) of the employee development programmes spent went towards core/technical training. In addition, Mintek invested R2 113 101 in employee bursaries.

As a consequence, Mintek's qualification profile continually improves, reflecting the substantial investments in employee development that characterises the company ethos. By the end of the financial year, more than two-thirds of our employees had a qualification that was at NQF Level 6 and above. Even more encouraging is the fact that 39.2% of employees had a post-graduate qualification that was at honours, masters and doctoral

levels. For a science council that relies heavily on the quality of employees to develop products and services, Mintek's training and development interventions must yield suitably qualified scientists, engineers, technicians and even support staff.

The second area of focus was the talent pipeline of young people who were studying full-time towards a qualification in the science, engineering and technology fields of study. Externally focused programmes are aimed at developing Mintek's future pipeline of science and engineering candidates by providing undergraduate and postgraduate bursary programmes for full-time study and internships supported by mentoring. A total of R3 183 496 was transferred to a number of universities, as part of Mintek's bursary programme that funded full time students.

Female representation in the bursary cohort has improved significantly, and stood at 73% female at undergraduate level and 66% at postgraduate level by the end of the financial year. These are future Mintek employees, who will not only contribute effectively to the core business of Mintek, but will also yield a positive shift in the demographic profile of the organisation as we strive to attain our employment equity targets.

Employment Statistics

On 31 March 2017, the total permanent employee count at Mintek was 646 which comprised 379

males, 251 females and 16 foreign nationals. The single biggest block of the head count is the skilled technical, academically qualified, junior management and supervisor occupational level that accounted for 53% of the total staff complement, followed by the semi-skilled occupational level at 20% that included our operators and technical staff responsible for operating the wide range of technical plant and equipment of Mintek. This profile is in line with the nature of the work of Mintek.

At higher levels, Mintek had a total of 93 professionals, specialists, and middle management-level employees, which was 14% of the total. At senior and top management levels we had 14 senior managers (2.2% of the total) and 6 top managers (forming less than a percent of the total).

For the first time in its history, Mintek reached the 40% level mark in female representation. This milestone is a result of continued efforts to encourage women in science and technology and has come from a base of 33% three years ago. We will continue to strive towards the attainment of 46% female representation in our staff complement, which is equivalent to the female component in the Gauteng demographic profile of the population. It is a stretch target, but is attainable if we keep increasing our efforts.

Pipeline Development Programmes

Effectively identifying and developing the next wave of scientists and engineers is crucial to Mintek's ability to develop a healthy talent pipeline that supports succession and ensures business continuity. As mentioned above, Mintek has a healthy bursary programme that serves to maintain the desired flow of suitably qualified graduates over the long-term. Furthermore, the Graduate Development Programme (GDP) and coaching and mentoring programmes provide a more structured approach to nurturing and advancing the skills and capabilities of both new graduates and existing employees in Mintek. The GDP emphasises on-the-job technical training supplemented with formal supervisory and management training. While the coaching and mentoring programme will promote a culture of continuous learning and growth within Mintek.

During the year under review Mintek awarded 29 full time bursaries. Some highlights include:

- Increased number of female bursars to 68% of the 29 bursaries awarded
- 89% of the awarded bursaries are from the previously disadvantaged groups
- 100% absorption rate of the 4 undergraduate and 4 postgraduate students who successfully completed their studies
- 16 undergraduates and 13 postgraduate students

A critical success factor of Mintek's GDP is the regular assessments of the competency levels and progress monitoring of the graduate trainees at the different stages of their rotation among various Mintek divisions.

Ultimately, graduates are rated on the Mintek performance management system based on input that includes records of attendance and participation in training programmes. During the period under review all GDP participants successfully met or exceeded requirements of the programme, which meant that they could proceed to the next level of employment as professionals, rather than trainees.

We also implemented other pipeline development programmes that are collaborative efforts between Mintek and other state entities, namely, the National Research Foundation (NRF), the Department of Science and Technology (DST), as well as the Mining Qualifications Authority (MQA).

The annual DST and NRF Internship Programme, known as the Professional Development Programme (PDP) attracted five candidates during the year, three Pre-Doctoral and two Post-Doctoral candidates. The PDP is a critical initiative of the DST and NRF, whose objective is to address the shortage of students registering for full-time post-graduate studies. Mintek hosted the five candidates full-time on a fixed-term contract basis, and provided them the much-needed opportunity to conduct their research using Mintek equipment and resources, under the supervision of Mintek's research specialists.

A few programmes of the MQA were also implemented during the year. MQA programmes are largely work integrated learning programmes and form a critical requirement for National Diploma students who normally require practical learning experience in order to graduate. To support this need, Mintek, would host the students in the Work Integrated Learning (WIL) programme, to offer practical learning to students from Universities of Technology.

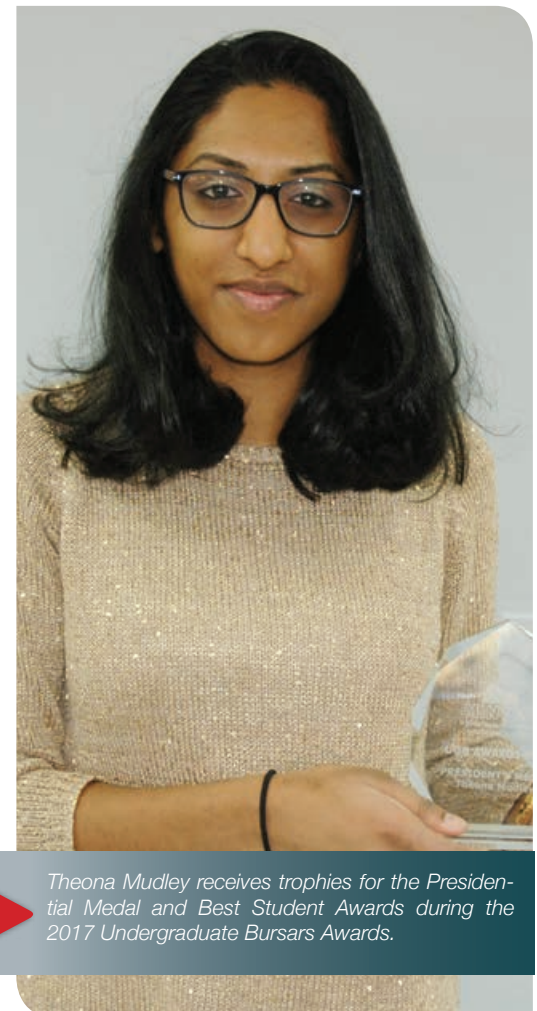
During the period under review, a total of 108 students participated in the programme. Of these,

- 29 new students were appointed in January 2017;
- 32 students currently are enrolled; and
- 27 students completed their programme in February 2017.

Both the PDP and the WIL programmes are examples of the success that can be attained if state entities collaborate for the benefit of the country, and the beneficiaries of the programmes that would otherwise not obtain enriching experiential learning opportunities. Programme participants not only obtain an opportunity for practical learning experience, they also stand to be



The BIO-MNL First Aid Team who won the 2016 First Aid Competition, held during Wellness Week 2016. From left to right: Susan Brill, Nontobeko Nxulalo, Richard Lefawane and John Neale.



Theona Mudley receives trophies for the Presidential Medal and Best Student Awards during the 2017 Undergraduate Bursars Awards.

the first people to be considered for employment, should entry level positions become vacant. Equally, Mintek has an opportunity to identify high potential students who could be suitable for future absorption into the business ranks.

Artisan Learnership Programme

The Artisan Learnership Programme is a unique

initiative that is both an employee development and a pipeline development programme. It emerged from a history where it was solely focusing on “growing our own timber”, but has since extended to include external participants. The motivation for extending the reach of the programme was primarily to recruit females into a field that has previously been dominated by males.

Mintek has partnered with the Mining Qualification Authority (MQA) to deliver the programme. During the year under review, the programme enrolled 12 learner-artisans, 6 internal learners and 6 external learners. All of them are female. Mintek fosters a culture of recognising employee performance and long service commitment.

5.3

Recognition and Excellence Awards

Apex Awards

Mintek's Apex Awards are prestigious awards that are aimed at giving due recognition to excellence amongst employees. This year they were awarded in the following three categories (a) Development, (b) Technical and (c) Procedural Innovation. The awards are announced annually in December during the Excellence Awards ceremony, and are preceded by a rigorous selection process that ensures that only the best ideas go through for consideration by the selection committee.

In the **Development** category, Mintek recognises successful demonstration of pilot plant testwork or a technology demonstration which could lead to technology transfer. The award in this category went to Stefan Smit, Zikhona Magaxeni and Yashveer Ramparsad, who are employees in Mintek's Measurement and Control Division. The three employees received the award for developing an automated iodine based carbon activity analyser. The technique that the team developed uses a cheaper reagent and eliminates the complicated preparation steps, resulting in lower operating costs for clients.

In addition, Stefan Smit took another award in the same category with Bart Groenewald, for “an integrated ultrasonic-based density and carbon concentration”. Stefan and Bart took technology that is typically used for car parking/proximity sensors, and adapted it for integration into a product previously developed by Mintek to improve measurement accuracy and consistency, while also reducing manufacturing costs.

The third award in the Development category went to Kabwika Bisaka and Itumeleng Thobadi, who led a team of nine researchers' work on an improved ilmenite smelting process known as “Impril”. The process that they developed is intended to be a solution that can be retrofitted to existing smelters, or incorporated into future projects, to reduce electrical energy requirement for an existing smelter and foaming as significantly less gas is generated in the furnace. This technical innovation has the potential to contribute significantly to the Ilmenite Smelting Industry in South Africa and could ultimately lead to an advantageous commercial application for Mintek.

The **Technical Innovation** category is for an adaptation or discovery of a process or product with novel characteristics, which could ultimately lead to beneficial commercial application. Under this category, Christoph Pawlik from Hydrometallurgy Division received an award for a project that focused on the rejection of ferric sulphate from rare earth elements (REE). Mintek is quite excited about this innovation because of its potential in resolving problems created by conventional methods that lead to high REE losses due to co-precipitation and a significant tailings discharge volume due to the use of high neutralising reagent.

Olga Yahorava and Olga Bazhko received an award for the recovery of gold from fine carbon. The method is innovative because of the low energy requirements relative to combustion or ashing; lower cyanide concentrations are required; relatively low resin-to-carbon ratio required for gold transfer and the overall gold recoveries of >98% can be achieved.

The last category of **Procedural Innovation** recognises an adaptation or discovery of a process which could accelerate, simplify, or improve quality and cost effectiveness to financial advantage. A team of Engineering and Maintenance Services employees walked away with an award for the implementation of an energy monitoring and control system. The team included Andile Sabani, Mohau Dithejane, Lebo Mocheku, Shidumo Maluleka, Hlayisani Moyane, Boitumelo Ntlhoko, and Walter Mashimbye. Their work was in support of Mintek's energy saving initiatives. The team worked on building and equipping a control room which could be used to monitor Mintek's services and control the usage thereof, thereby enabling Mintek to load shed or load shift at any time when the demand for energy is high or whenever it is deemed necessary.

The awards ceremony was held in December 2016, and made for a great way to energise employees as they prepared for the start of a new year.

Long Service Awards

The Long Service Awards are awarded to employees in recognition of their commitment and loyalty to the organisation. These are awarded in categories of 40, 35, 30, 25, 20, 15, 10 and 5 years. Recognition of long service has been found to be a significant motivator for employees as they look forward to achieving the next milestone, even as they are receiving an award. The awards also contribute meaningfully to Mintek's retention strategies.

1

CATEGORY 1 DEVELOPMENT

"Development of an Automated Iodine Based Carbon Activity Analyser."

WINNERS: Stefan Smit, Zikhona Magaxeni, Yashveer Ramparsad



2

CATEGORY 1 DEVELOPMENT

"Development of an Integrated Ultrasonic-Based Density and Carbon Concentration."

WINNERS: Stefan Smit, Bart Groeneveld



3

CATEGORY 1 TECHNICAL INNOVATION

"Rejection of Ferric Sulphate from Rare Earth Element (REE) Sulphate Leach Liquors after High Temperature Sulphuric Acid Cracking of Fe Rich Supergene Monazite Ores."

WINNERS: Christoph Pawlik



4

CATEGORY 1 TECHNICAL INNOVATION

"pyEarth-Pyrometallurgical Process to Upgrade Difficult to Treat High-Iron-Low Grade Rare Earth."

WINNERS: Itumeleng Thobadi, Kapwika Bisaka



5

CATEGORY 1 TECHNICAL INNOVATION

"Gold Recovery from Fine Carbon."

WINNERS: Olga Yavorava, Olga Bazhko



6

CATEGORY 1 PROCEDURAL INNOVATION

"Energy Monitoring & Control System."

WINNERS: *Back Row:* Walter Mashimbye, Andile Sabani, Mohau Dithejane, Hlayisani Moyane, Shidumo Maluleka. *Front Row:* Lebo Mocheku, Boitumelo Ntlhoko



LONG SERVICE AWARDS

30

LONG SERVICE AWARDS | 30 Years



Andrew Letsebe
BIO



Matlala Elias Mohale
EMS



Bernard Joja
MPD



Glen Michael Denton
PDD



Monique Ann Milicevic
PDD

35

LONG SERVICE AWARDS | 35 Years



Mfundo Alberton Mphephuka
IAC

40

LONG SERVICE AWARDS | 40 Years



Bartholomeus Stefanus Groeneveld
MAC



Charles Laurence Bushell
MNL

External Recognition

As a significant global leader in mineral and metallurgical innovation, Mintek prides itself in its team of scientists, engineers and researchers that fly our flag at international forums. One such employee, Dr Joalet Steenkamp received the Extraction and Processing Division (EPD) Pyrometallurgy Best Paper Award at the 146th TMS Annual Meeting and Exhibition held on 28 February 2017 in San Diego, California. The award-winning paper entitled "Tap-Hole Life Cycle Design Criteria: A Case Study Based on Silicomanganese Production" is authored by Joalet, in collaboration with Hayman D, Sutherland J and Muller J. It is published in the Journal of Metallurgy (JOM) of June 2016.

We also congratulated Dr Joalet Steenkamp and Dr Quinn Reynolds who were both awarded silver medals at the Annual General Meeting of the Council for Southern African Institute of Mining and Metallurgy (SAIMM) in August 2016. The awards were for the papers they published, which were making a major contribution to the professions of mining and metallurgy as well as the standing of SAIMM.

Another professional recognition during the year came from the Mineralogical Association of South Africa (Minsa) who awarded Mintek's Mosili Pebane the Minsa book prize for her Honours project on the Bushveld chromite. The award was presented at the Minsa AGM in Cape Town, during the 35th International Geological Congress held in 2016.

In March 2017, Nanji Sheni and Tshiamo Legoale carried the flag of Mintek as young scientists with a flair for presenting their highly complex and scientific work in a way that can be exciting and easily understood by the general public. Nanji and Tshiamo made it into the Top Ten group of young scientists to compete in the final competition of FameLab South Africa, ahead of a number of their peers who were equally competent. FameLab is an international science talk competition that is supported by the British Council and the South African Agency for Science and Technology

Advancement (SAASTA) in South Africa, and coordinated by Jive Media Africa. The competition aims to nurture science communication with an innovative format. The next phase of the

competition will decide who represents South Africa at the final stage of the competition that will be held in the United Kingdom.



From left to right: Dr Joalet Steenkamp and Dr Quin Reynolds, Chief Engineers at the Pyrometallurgy Division, awarded silver medals for Papers at the Annual General Meeting of the Council of SAIMM.

5.4

Safety, Health and Wellbeing of Mintek's People

Mintek maintains a sound corporate Safety, Health, Environment and Quality management (SHEQ) system that continually passes audit scrutiny as well as the opinion of our key stakeholders such as our employees, clients and neighbours. Our strategy, as outlined in the Shareholder Compact, is to go beyond compliance by making SHEQ our way of conducting business. It is this strategy that has enabled us to maintain the status of Zero fatalities and reach massive milestone of Zero lost time injuries. Mintek ensures that every employee and service provider who are in our campus, works in a safe and healthy environment. The attainment of Zero lost time injuries is a testimony that the joint effort of the Mintek community bore fruit.

During the past financial year, Mintek held four (4) Corporate SHEQ meetings as well as a series of divisional engagements on matters relating to the systems, processes and interventions that jointly contribute to maintaining a safe and healthy working environment. The meetings are used for monitoring and reporting on progress that is made against safety and health targets and standards; progress on environmental protection, including radiation protection and nuclear material management as well as training and inspections, among other things. The meetings also review policy, objectives, targets and procedures of our SHEQ system, as well as customer satisfaction frequency rates, both internal and external. Our measure of external client satisfaction was also above target for the entire 2016/17 financial year, ending the year on 97%.

Client satisfaction was measured through a poll of more than 150 responses received from our

clients during the year under review.

Employee Wellness

The wellness of employees requires close collaboration between Mintek and the employee, with each playing a distinct but complementary function. The greater responsibility lies with the employee, with the employer providing support and creating a conducive environment. It was in that spirit that Mintek created a wide range of platforms and forums for self-mastery so that employees could take responsibility for their physical well-being and health, financial well-being, professional development as well as emotional well-being.

In June 2016, a financial health seminar was held at Mintek for the benefit of employees. The seminar was facilitated by industry experts that are licensed advisers. It focussed on advising employees on the best possible methods of incorporating financial health strategies into their style of living and spending. Topics that were covered included financial planning – especially for retirement; risk planning; investments and savings.

Following up on the trail of financial wellness, employees received Robin Banks' "Mind Power" and "Victim to Victor" Workshops that challenged them to consider a different way of thinking. The workshops were essentially about the awakening the mind to unleash a better "self" amongst the participants. Employees obtained great tips on how to focus on self-empowerment and taking personal responsibility as the victim to victor mindsets.



Mosili Pebane, Scientist-in-Training at the Mineralogy Division, recipient of the Kai Batla Prize for outstanding Performance in Geology Honours.



Nanji Sheni and Tshiamo Legoale and during the Famelab Semi-Final Competition held at Wits on 24 March 2017.



Occupational Health

Mintek takes the wellbeing of staff and surrounding community very seriously. At Mintek there is strong focus on primary prevention of hazards. We achieve this by constantly training our employees

on safety procedures and other training such as Health and Safety Law, basic fire-fighting and basic radiation protection training. In addition we have a very strong SHEQ structure that meets regularly and reports on any health and safety issues. We

also ensure that we protect the environment that we work in. As a result of our stringent rules, no major health incident has been reported.

5.5

Protection of the Environment

As a good corporate citizen, Mintek has a responsibility to ensure that its operations do not contribute to environmental degradation by monitoring its environmental footprint and implementing a wide range of measures to protect the environment. The measures that we implement mainly pivot around water and energy use, as well as the

management of waste that follows the waste lifecycle that prioritises reduction, re-use and recycling, recovery, and treatment before disposal. Mintek is also mindful of the potential noise pollution that our operations could have, particularly because the Mintek campus is located within close proximity to a residential area. As a result, we have

been implementing a noise-control measure that has resulted in a public dissatisfaction incident rate of Zero. That means, during the 12-month period leading to March 2017, there were no incidents of noise pollution reported by Mintek's neighbours.

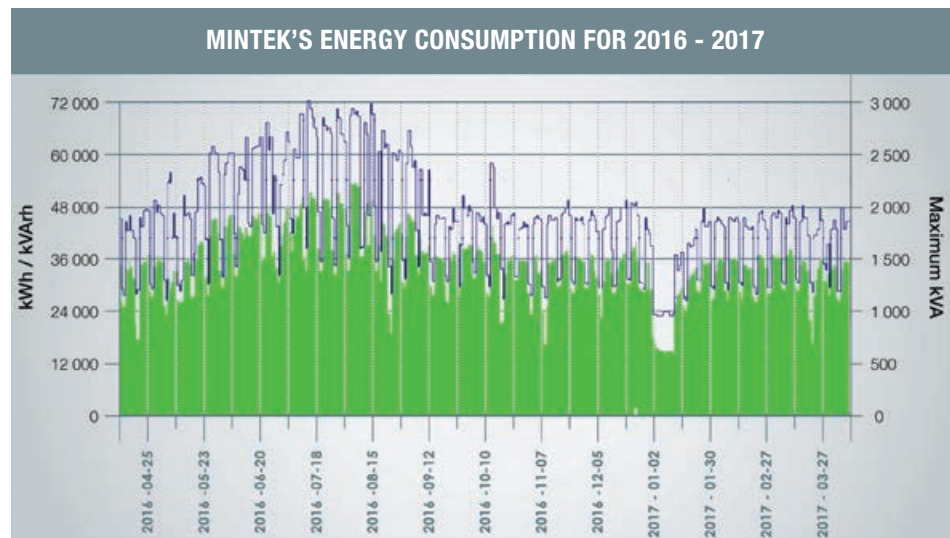


Figure 1: Energy consumption for 2016-2017



Left and centre: Robin Banks and participants in the “Victim to Victor” follow-up motivational talk held for Mintek employees during the 2016 Apex Awards Ceremony.

Right: Mintek's Netball Team during a match against Direct Channel Holdings (DCH) on the 3rd of June 2016, at Mintek.

Emission Source	CO ₂ equivalent (tons/yearCO ₂)	% of total emissions
Direct emissions (Scope 1)		
Process emissions – Bay 1 & Bay 2	17.6	0.15 %
Direct coal used	0.00	0.00 %
Direct diesel used	743.93	6.51 %
Direct LPG used	5.33	0.05 %
Direct CO ₂ used	1.94	0.01 %
Energy use related emissions (Scope 2)		
Electricity consumption	10 041.78	87.82%
Indirect emissions (Scope 3)		
Domestic & international flights	529.58	4.63%
Car use (petrol)	47.37	0.41%
LDV use (diesel)	5.49	0.05%
LDV use (diesel double cab 3.0 litres)	16.93	0.15%
Employee private vehicles used on Mintek business	26.13	0.23%

Table 1: Summary of Mintek's GHG emissions for 2016-2017

Mintek's Carbon Footprint

Mintek first calculated the carbon footprint of its operations in 2011. Since that first report, four internal reports and executive briefing notes have been prepared on the Mintek carbon footprint and the tax implications anticipated if current draft legislation were to be enacted. The total emissions in tons of carbon dioxide equivalent (tCO₂^{eq}) for the reporting year 2016/17 were 11 434.23 tCO₂^{eq}. Compared to the baseline carbon footprint measured in 2011, the past financial year has seen a decrease of 69% in calculated emissions.

The most significant source of emissions at Mintek

remains energy use in the form of purchased electricity from coal-fired power stations on the national electrical network. The electrical energy use (Scope 2 emissions) represent the biggest share of Mintek's carbon emissions profile at 87.82% of total reportable emissions. Direct emission (Scope 1) accounted for 6.71% of the total emissions and indirect emissions (Scope 3) accounted for 5.47% of the total emissions profile of Mintek. Improved energy management practices and software have been implemented to further reduce these emissions, but electricity will remain the most significant emissions component of Mintek's business activities, especially in the core business

units, where electrical smelting furnaces form a key part of the organisation's business activities. The Engineering and Maintenance Services division (EMS) is embarking on a programme to establish clear targets and a baseline to measure and reduce its energy consumption in the future. It is believed that accurate measurement and management of the electricity consumption across the business operations will enhance the responses and improve the ability to reduce the overall carbon footprint.

On 3 April 2017, the Department of Environmental Affairs published the National Greenhouse Gas Emission Reporting Regulations under the National Environmental Management: Air Quality Act.

These regulations provide clarity around who must report on their greenhouse gas emissions and how the greenhouse gas emissions must be reported. Mintek has been using the GHG Protocol Corporate Standard as a guideline for recording its carbon footprint since its first Carbon Footprint report of 2011. The new regulations require that reporting must be aligned to the 2006 IPCC Guidelines.

The implications for Mintek (now classified as a Category B emitter in the new regulations) are that it must submit emissions and activity data collected that is related to the relevant activity or activities set out in the Regulations when requested by the competent authority. It follows that Mintek must keep recording its greenhouse gas emissions but that the recording must align to the regulated reporting format in case of a possible future request for information. These changes will be implemented in the next Carbon Footprint Report (to be renamed to Greenhouse Gas Emissions Report) and it is expected to look radically different from the last carbon footprint reports that were produced.

Mintek's Water Footprint

The issue of water and its management has become increasingly central to the global debate on sustainable development. This interest has been driven by growing water demand, increasing water scarcity and/or degradation of water quality. The National Water Act (NWA, No. 36 of 1998) direct that organisations have a duty to identify, measure and act on the impacts that its activities may have on the country's environment.

The calculation of a Water Footprint provides the total amount of water used both directly and indirectly over the period of a financial year and reflects the sum of the water used in the various steps of the production chain of an organisation. Mintek recorded its first water footprint as a corporate entity in 2015/16. Mintek repeated the recording of its water footprint in 2016/17 in order

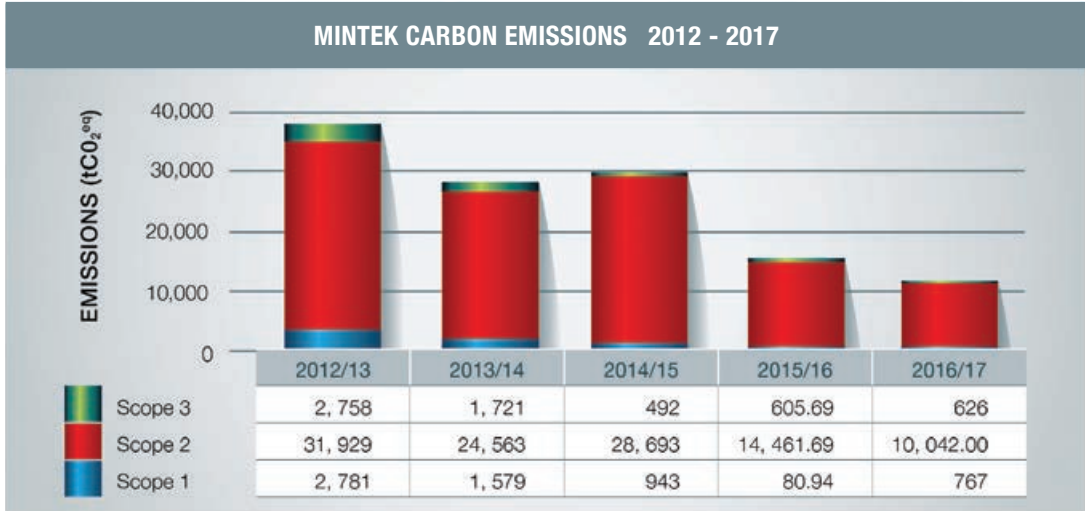


Figure 2: Comparison of Mintek's Carbon emissions for all reporting periods on record.

to provide an annual update on the water footprint of the organisation.

The most recent report records that Mintek's total Blue Water Footprint is 55 820 kilolitres per annum. This water is consumed during the production system, especially test works and laboratory analyses at technical divisions. The technical divisions of Mintek, where most of the test works and laboratory analyses take place, release process water to the on-site effluent treatment plant, from where it is released to the municipal sewerage system under permitted agreement. This process water is sampled and treated before every discharge to the main sewer. The concentrations of chemicals in the process

water comply with the required quality standards of Johannesburg City and, in some instances, are even lower than the natural concentrations. Both Mintek's Green and Grey Water footprints are zero. The total blue water footprint which includes direct consumption is measured at 55 820 kilolitre per annum for the period from 1st April 2016 to 31st March 2017. The result indicates that nearly 90% of the total blue water footprint is associated with services that Mintek produces and offers. Most of Mintek's water footprint is attributable to operational water uses. The facilities that consume considerable amounts of water include Jumbo bay & store, crushing and drying areas, west yard and gardens followed by Block 9000 and the single quarters.

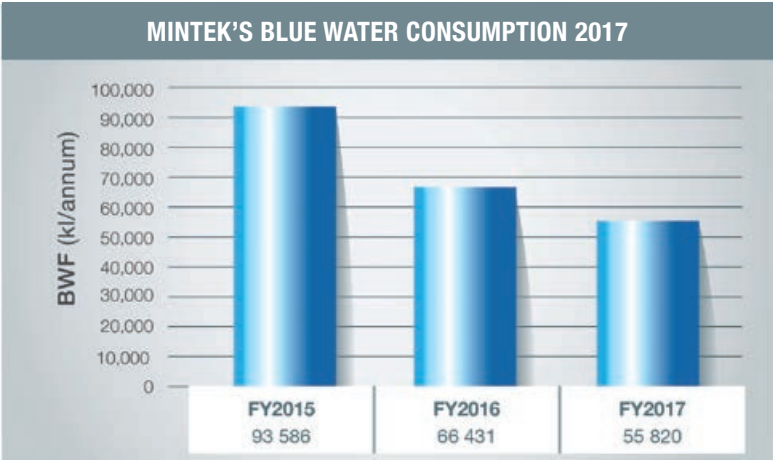


Figure 3: Mintek's Blue Water consumption for 2016-2017 compared to the base year.

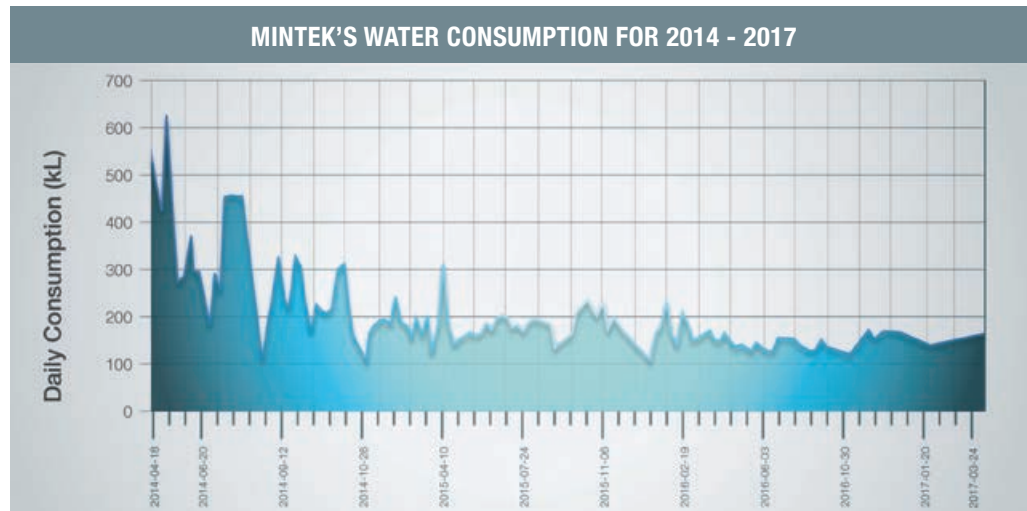


Figure 4: Daily Water Consumption from 2014-2017

The only other inflow and contribution to Mintek's blue water footprint is borehole water. Overhead water used in Mintek's daily operations is included in the blue water footprint and is obtained from the same municipal supply.

There is no use of green water (rainwater or borehole water) included in Mintek's operations, services or products, so there is no operational green water footprint. Additionally, the process water produced during the production steps of Mintek's operations are treated prior to being discharged to the municipal main sewer. The concentrations of chemicals in the process water are legally

compliant to the standard of Johannesburg Water and it is not discharged to a natural water course. Therefore, the grey component of the operational water footprint is zero. Mintek's total Blue Water Footprint is 55 820 kilolitres per annum.

Mintek's blue water footprint has decreased to 55 820 kilolitres per annum for the period starting from 01 April 2016 to 31 March 2017. The major reasons are the ongoing water reticulation programme especially additional sources of water for use on site and effective water management strategies applied on water network system across Mintek's campus. The water reticulation

programme has been achieved the following highlights from 2014/15 FY to date:

- The bus-shed meter was faulty at some point and was replaced by Johannesburg water after estimating usage for a long time,
- Leak detection measures: in the past there were leaks (some underground, others in the tunnels) that resulted in water being wasted
- Reduction in lawn irrigation from purchased water
- Water awareness created in the EMS division at Mintek

5.6

Quality of Mintek's Work

Mintek's customer base largely consists of repeat clients who are drawn to our products and services by a consistent quality management systems that assures them of the quality of our work. Mintek continues to build its reputation for quality by maintaining certification with the ISO 9001 quality management standard. By doing so, Mintek ensures the consistent quality of its products and services and this makes an important contribution to its long-term revenue and profitability.

Our promise to quality is always tested through client surveys that customers are asked to complete at the end of each transaction.

The survey tests a customer's satisfaction with the product or service, the promptness within which our service or product was delivered, the degree of satisfaction with communication during a project, and the customer's perception of "value for money". Further, they are asked if they would

bring repeat business and recommend Mintek to others. At the end of the 2016/17 FY, all Mintek's technical divisions were able to achieve customer satisfaction frequency rates (CSFR) above the corporate target of 90%. This realised an overall Mintek CSFR of 97% by the end of the financial year.

Figure 5 (page 76) shows Mintek's overall achievement of customer satisfaction since the end of the 2011/12 financial year.

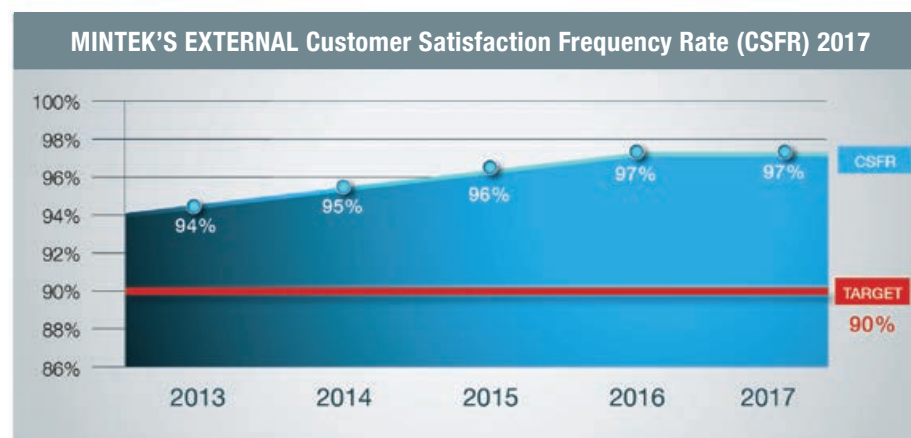


Figure 5: Customer Satisfaction Frequency Rate

Project Information, Safety and the Environment

All Mintek's technical divisions monitor the risks associated with their work through project information charts (PIC). The quality of the information submitted for the risk assessment is measured by the PIC submission success rate where the target has been set at 80%.

The PIC provides assurance that all Mintek's projects are executed according to a set of protocols that consider whether the project involves the treatment

of solid or liquid materials; whether it involves the building or operation of equipment and whether the project has any potential significant environmental or safety risks. During 2016, all Mintek technical divisions were able to achieve submission success rates of higher than the 80% target.

Continuous Training of Technical Personnel

During the year, the SHEQ corporate team had a number of training sessions which focused, amongst others, on overhead crane control,

emergency preparedness, hazardous chemical handling and storage and forklift driving. Mintek also ensures that it has a sufficient number of employees that are educated on ISO9001 changes and that can serve as integrated SHEQ lead auditors. Other training courses and activities included Safety awareness (OSHAS18001 system and OHS Act legal requirements), hearing conservation, and corrective action, preventive action, root cause analysis and incident investigation and reporting.

5.7

Corporate Social Responsibility

Mintek's corporate social responsibility strategy is closely aligned to its primary objectives which are to promote mineral technology and to foster the establishment and expansion of industries in the fields of minerals through research, development and technology transfer.

The strategy is based on two major pillars, the first being corporate initiatives and the second being employee-driven initiatives.

Minerals Education Trust Fund

Mintek continued to support the Minerals Education

Trust Fund, which was founded by the Chamber of Mines so that the industry could consolidate its support towards education, teaching and research.

The purpose of the fund is to support institutions of higher learning attract, retain and develop undergraduate teaching staff; create academic centres of excellence; and foster collaboration.

Mintek made a cash contribution of R43 368 during the year under review, as well as in-kind support provided through participation of Mintek's senior

managers at the level of the board of trustees.

School Shoes for Learners

Bawokuhle Primary School is in the category of "no-fee" schools, which are so designated because of their location in some of the poorest communities in the country. The school is situated in Gembokspruit, Mpumalanga Province, and it was identified by Mintek employees Nomalanga Mabalane and Kedibone Mokgalaka as a beneficiary for this employee-driven school support programme.



Left and right: Mintek employees participating in the 2017 Shavathon, being shaved and having their shoes polished on the 3rd of March 2017. Mintek raised R42 720 in total during the event.

Initially, the school had indicated that at least 54 learners were in need of school shoes. As a result, Nomalanga and Kedibone had worked on a target of 54. However, by the end of the campaign a total of 60 pairs of school shoes were purchased by our members of staff, as well as a selection of books.

On 16 January 2017, books and shoes were delivered to a very grateful Bawokuhle Primary school community. The principal, teachers and learners expressed their gratitude to Mintek for the assistance.

Casual Day

In support of the National Council for Persons with Physical Disabilities in South Africa's flagship initiative, Casual Day, Mintek mobilised all employees to support the campaign by purchasing tickets at R10 each. In turn, employees dressed in casual clothing and costumes that brought a lot of fun and laughter to what would have been an ordinary working day. At Mintek, Casual Day is both a campaign to mobilise support for people and allow employees to have a special day at work.

A total of 475 tickets were sold throughout the organisation. At one of the Divisions of Mintek, Pyrometallurgy Division, employees dressed as witches and wizards, and sold 116 tickets among themselves.

Other Mintek divisions also showed an amazing spirit of solidarity with people with disabilities by

participating in the annual event. A total of R4 750 was collected.

Supporting Cancer CANSA Shavathon

In support of people affected by cancer, Mintek, once again, mobilised its 646-strong employees to participate in the annual workplace CANSA Shavathon that was held in March 2017. A total of R42 720 was collected during the campaign. This year, the campaign featured new exciting activities that were aimed at encouraging participation in order to surpass the R31 475 that was donated the previous year.

Shifting gears and adding newer, exciting activities gave a much-needed boost to the initiative that resulted in a 36% increase in donations from the previous year.

Employees donated different amounts towards the cause, in return for a chance to have their hair shaved or sprayed in beautiful colours. For added fun, employees could also have their shoes shined, shoulders massaged or have their photos taken in a beautifully dressed, colourful booth – all in return for a small donation towards the cause.

Mintek thanks all its employees for participating in the event, and the solidarity pledge they showed to people affected by cancer. Mintek also acknowledges the support of the International Academy of Hair Dressing of Sandton as well as

Body Definition, both of whom volunteered their services to help with the event.

Nelson Mandela Day

The International Nelson Mandela Day has been entrenched in Mintek's calendar as our employees join the global movement to do good in honour of the late former President Nelson Mandela. Mintek employees spent their 67 minutes with the children of Bongani Community Development Centre, where they distributed clothing, food parcels, blankets and toys.

Bongani Community Development Centre a non-profit organisation that supports vulnerable children, youth and senior citizens in Soweto, graciously received the donations. Our employees have been consistently supporting this initiative, and keep challenging one another to remain active participants in stimulating positive social change, in honour of the late former President Nelson Mandela.

GENERAL INFORMATION

Country of incorporation and domicile	South Africa
Mintek Directors (As of 31 March 2017)	Dr Len Konar <i>(Chairperson)</i> MA Mngomezulu <i>(President and CEO)</i> Dumisani Dlamini Daan du Toit Khetiwe McClain Phahlani Mkhombo Andries Moatshe Dr Sarah Mohlala Samke Ngwenya Maroale Rachidi Dr Siyabonga Simayi
Mindev Directors	MA Mngomezulu SA Simelane RL Paul M Mphomela GL Rapoo
Registered office	200 Malibongwe Drive Randburg 2194 South Africa
Business address	200 Malibongwe Drive Randburg 2194 South Africa
Postal address	Private Bag X3015 Randburg 2125 South Africa
Bankers	Absa Bank Limited
Auditors	Auditor-General South Africa



6

Financial Performance

Chief Financial Officer's Review	80
Audit and Risk Committee Report	83
Directors' Responsibilities and Approval	85
Directors' Report	86
Report of the Auditor-General South Africa	86
Annexure to the Report of the Auditor-General South Africa	91
Audited Financial Statements	92
Consolidated Statements of Financial Position	92
Consolidated Statements of Comprehensive Income	93
Consolidated Statements of Changes In Equity	94
Consolidated Statements of Cash Flows	95
Accounting Policies	96
Notes to the Consolidated Financial Statements	101
Audited Financial Statements (Mindev)	117
Mindev (Pty) Ltd Statement of Financial Position	117
Mindev (Pty) Ltd Statement of Changes in Equity	117
Mindev (Pty) Ltd Accounting Policies	118
Mindev (Pty) Ltd Notes to the Financial Statements	119



6.1 Chief Financial Officer's Review

Principal Activities

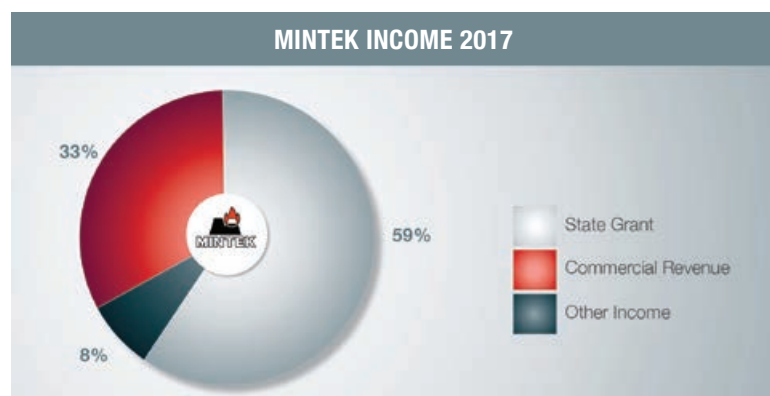
Mintek is South Africa's national mineral research organisation and is one of the world's leading technology organisations specialising in mineral processing, extractive metallurgy and related areas. Mintek works closely with industry and other R&D institutions and provides service test work, process development and optimisation, consulting and innovative products to clients worldwide. Mintek is a state owned science council which reports to the Minister of Mineral Resources.

Financial Performance

Profitability

The 2017 financial year was extremely challenging for Mintek but despite harsh economic conditions the group remained financially sustainable. The mining industry continued to face a host of unresolved challenges ranging from tumbling demand, increased cost pressures, lack of financing, declining grades and volatile commodity prices.

Mintek's net surplus fell by 56% to R6.0m (FY 2016: R13.8m). Income decreased by 9% to R479.3 m which is in contrast with the 4% increase of the previous financial year.



Commercial revenue's contribution to total income decreased from 36% during the previous financial year to 33% in 2017. The downward trend for commercial revenue is mainly due to a continuing reduction in the demand of mining research as a result of the slump in the mining industry.

The South African Rand was extremely volatile during the year under review, not just against the US Dollar but against all major currencies. On average the South African Rand did however recover somewhat against the major currencies but the devalued Rand affected Mintek's business negatively as it increased the cost of imports which in turn affected the pricing of goods and services.

The strengthening of the Rand did impact on exports where services are rendered to foreign customers which resulted in net foreign exchange loss of R2.7m compared to the foreign exchange gain of R1.5m in 2016.

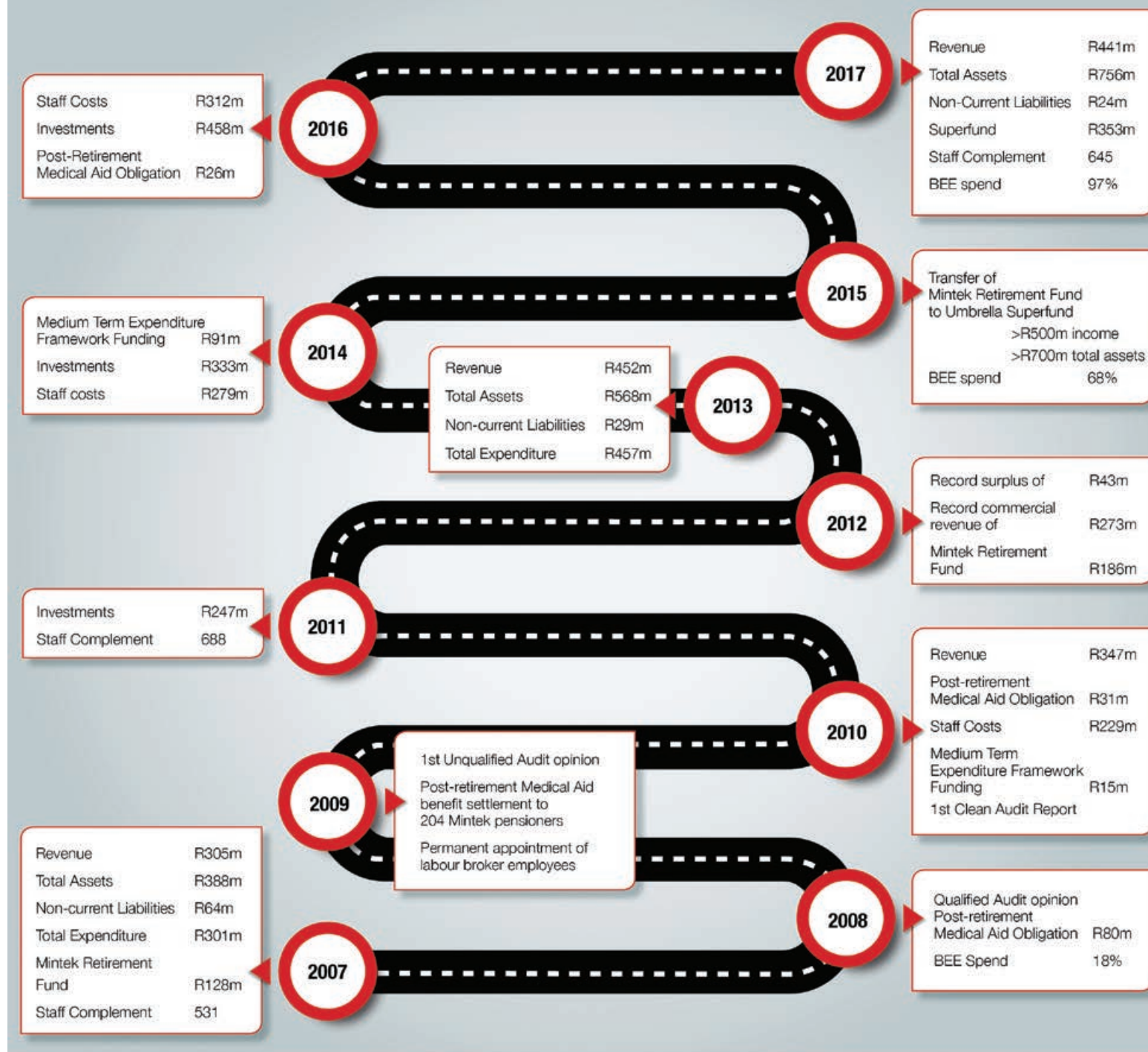


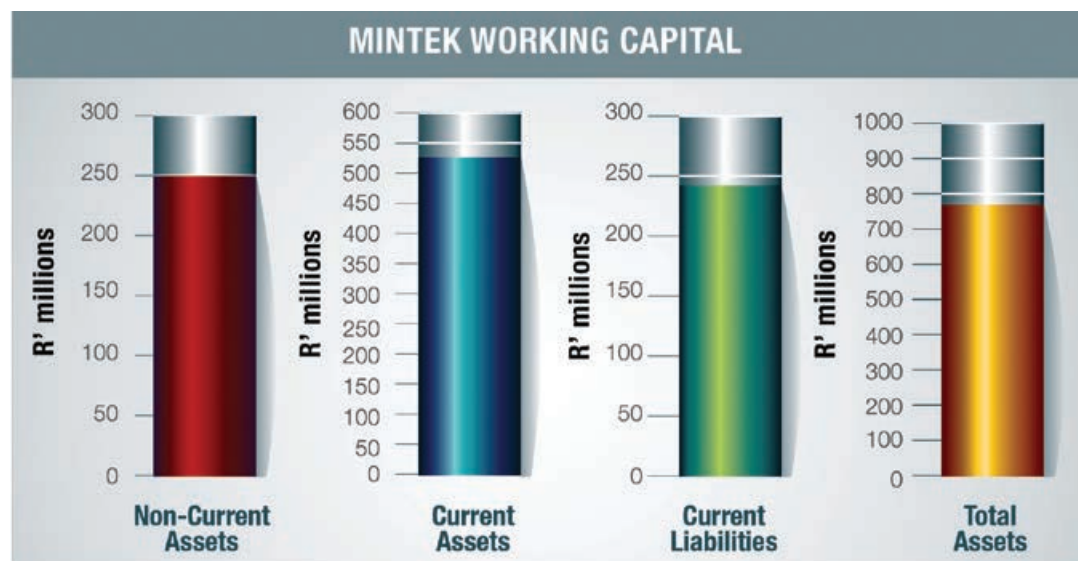
Interest income decreased slightly by 2% to R32.0m. The interest rates remained stable during the financial year while the funds available for investment reduced resulting in lower interest income earned.

Total expenditure decreased by 8% in 2017 whereas the previous year saw a 5% increase. This can be attributable to the reduced commercial income and a concerted effort to keep spending to a minimum during this time. Although employee related costs decreased marginally by 4% they still remain the biggest cost component of Mintek's operating costs as they contributed to 60%, (61% 2016 FY) to the total operating costs. The significance of this expenditure is in line with Mintek's business operations that require highly specialised skills.

Mintek continued to efficiently manage its working capital in order to improve liquidity and profitability. Trade debtors comprise a major component of

MINTEK - A Financial Snapshot of the Past Ten Years





Mintek's current assets, debtors days decreased from 52 days in 2016 to 45 days in 2017. The provision for bad debts amounted to R289k in 2017, (2016: R296k). The low bad debts ratio to trade debtors is mainly due to a strict credit policy, monitoring of credit limits and tight debtors collection procedures.

The current ratio remained stable at 2.2 amidst the economic turmoil.

Fixed Assets

Capital expenditure decreased by 7% to R55.5m in 2017. Fixed assets acquisitions mainly comprised of office refurbishments, purchase of equipment for research and cash generating machinery. State funding towards the purchase of assets decreased by 42% to R27.5m.

Cash Flow Management

Cash and cash equivalents increased from R18.6m in 2016 to R48.3m in 2017. Short term investments however decreased from R457.7m to R413.7m in the current year.

Going Concern

Mintek annual financial statements have been prepared on the going concern basis.

The Board has performed a formal review of the Group's ability to continue trading as a going concern in the foreseeable future and based on this review, consider that the presentation of the financial statements on this basis is appropriate. There are no pending or threatened legal or arbitration proceedings, which have had or may have a material effect on the financial position of the Group.

Events After the Reporting Date

There have been no facts or circumstances of a material nature that have arisen between the financial year-end and the date of this report.



Audit and Risk Committee Report

REPORT OF THE AUDIT AND RISK COMMITTEE – as required by Treasury Regulations 27.1.7 and 27.1.10 (b) and (c) issued in terms of sections 51(1)(a)(ii) and 76(4)(d) of the Public Finance Management (PFMA) Act 1 of 1999, as amended by Act 29 of 1999.

1. Audit and Risk Committee Members and Attendance

The Audit and Risk Committee (ARC) consists of the members listed hereunder. During the financial year under review the Audit and Risk Committee held three meetings and appropriate feedback was provided to the relevant Accounting Authority on matters that were within the mandate of the ARC.

NAME	QUALIFICATION	CATEGORY	ATTENDANCE
D Dlamini	M Com, PGD Bus Mngt, BTech Taxation, ND Accounting, Prof Accountant SA	Non-executive	3/3
M Rachidi	PTC, Mngt Dev Progarmme, Computer Operations and Programming	Non-executive	3/3
S Ngwenya	MBA, PGD in Mngt, BCom	Non-executive	3/3
A Mngomezulu	MSc Engineering (Mining), BSc Hons (Geology)	Executive	3/3
M Moalusi	B Acc; CA (SA)	Independent	3/3
T Hlongwane	B Com, HDE (Acc), CA (SA)	Independent	2/3

2. Audit and Risk Committee Responsibility

The Mintek ARC wishes to report that it has complied with its responsibilities arising from section 51(1)(a) as well as with Treasury Regulations 27.1.7 and 27.1.10 (b) and (c) issued in terms of sections 51(1)(a)(ii) and 76(4)(d) of the Public Finance Management Act 1 of 1999, as amended by Act 29 of 1999. The ARC also wishes to report that it had adopted formal terms of reference.

The ARC is able to report that external audit; which is performed by the Auditor-General, is independent of Mintek.

The ARC has discharged all its responsibilities as contained in the ARC charter.

3. Effectiveness of Internal Control

The PFMA 51(1)(a)(i) states that the accounting authority must ensure that the entity has maintained an effective, efficient and transparent system of financial and risk management and internal control.

The system of internal control and the concomitant control environment within Mintek were reasonably effective as the various reports of the Auditor-General and Internal Audit will attest.

4. Governance of Risk

The PFMA 51(1)(a)(i) states that the accounting authority must ensure that the entity maintains an effective, efficient and transparent system of financial and risk management and internal control.

The ARC has the responsibility to ensure that a risk management process is in place at Mintek and as such can report that Mintek has maintained an effective system of risk management.

5. Internal Audit

The ARC was responsible for ensuring that Mintek's internal audit section was independent and had the necessary resources, standing and authority within Mintek to enable it to effectively and efficiently discharge its duties. Furthermore, the Audit and Risk Committee oversaw cooperation between the internal and external auditors, and served as a link between the accounting authority and these functions.

The ARC considered and approved the internal audit three-year rolling strategic audit plan for the period 2017/2018 – 2019/2020.

6.2 ARC Report *(continued)*

6. Whistle Blowing

The ARC received and dealt with any concerns or complaints, whether from within or outside of Mintek, relating to fraud, corruption, theft and maladministration.

7. The Quality of Management and Monthly Quarterly Reports submitted in terms of the PFMA

The ARC reports that, during the year under review, they were presented with regular monthly or quarterly management reports to enable them to:

- i. Monitor the integrity, accuracy and reliability of the financial position of authority with an authoritative and credible view of the financial position of Mintek;
- iii. Review the disclosure in the financial reports of Mintek and the context in which statements on the financial health of Mintek are made; and
- iv. Review all material information presented together with the management accounts.

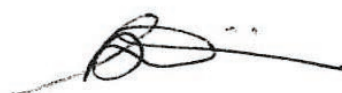
8. The quality of Budgets Submitted in terms of the PFMA

The ARC reports that, during the year under review, they were regularly presented with a budget to enable them to:

- ▶ Review and ensure that the annual budgets of Mintek were balanced, credible and realistic against the approved business plans; and
- ▶ Monitor and periodically review the implementation of the approved budget of Mintek by the accounting authority.

9. Evaluation of Financial Statements

The ARC has evaluated the group and the company Financial Statements for the year ended 31 March 2017 and concluded that they fully complied in all material aspects with the requirements of the Public Finance Management Act (PFMA) no.1 of 1999, as amended by Act 29 of 1999, and South African Statements of Generally Accepted Accounting Practice (SA Statements of GAAP).



Mr D Dlamini *(Chairperson)*



6.3

Directors' Responsibilities and Approval

The directors are required in terms of the public finance management act to maintain adequate accounting records and are responsible for the content and integrity of the financial statements and related financial information included in this report.

It is their responsibility to ensure that the financial statements fairly present the state of affairs of the group as at the end of the financial year and the results of its operations and cash flows for the period then ended, in conformity with Generally Accepted Accounting Policies (SA GAAP) and are based upon appropriate accounting policies consistently applied and supported by reasonable and prudent judgments and estimates. The external auditors are engaged to express an independent opinion on the financial statements.

The directors acknowledge that they are ultimately responsible for the system of internal financial control established by the group and place considerable importance on maintaining a strong control environment. To enable the directors to meet these responsibilities, the directors set standards for internal control aimed at reducing the risk of error or loss in a cost effective manner. The standards include the proper delegation of responsibilities within a clearly defined framework, effective accounting procedures and adequate segregation of duties to ensure an acceptable level of risk.

These controls are monitored throughout the group and all employees are required to maintain the highest ethical standards in ensuring the group's business is conducted in a manner that in all reasonable circumstances is above reproach. The focus of risk management in the group is on identifying, assessing, managing and monitoring all known forms of risk across the group. While operating risk cannot be fully eliminated, the group endeavours to minimise it by ensuring that appropriate infrastructure, controls, systems and ethical behaviour are applied and managed within predetermined procedures and constraints.

The directors are of the opinion, based on the information and explanations given by management that the system of internal control provides reasonable assurance that the financial records may be relied on for the preparation of the financial statements. However, any system of internal financial control can provide only reasonable, and not absolute, assurance against material misstatement or loss.

In the opinion of the directors the group has adequate resources to continue in operational existence for the foreseeable future. This opinion is based on the 2017 budget and the current financial position of the group.

The external auditors are responsible for independently reviewing and reporting on the group's financial statements. The financial statements have been examined by the group's external auditors and their report is presented on pages 88 and 89.

The financial statements set out on pages 90 to 117, which have been prepared on the going concern basis, were approved by the directors on 28 July 2017 and were signed on their behalf by:



Dr Len Konar
Chairperson



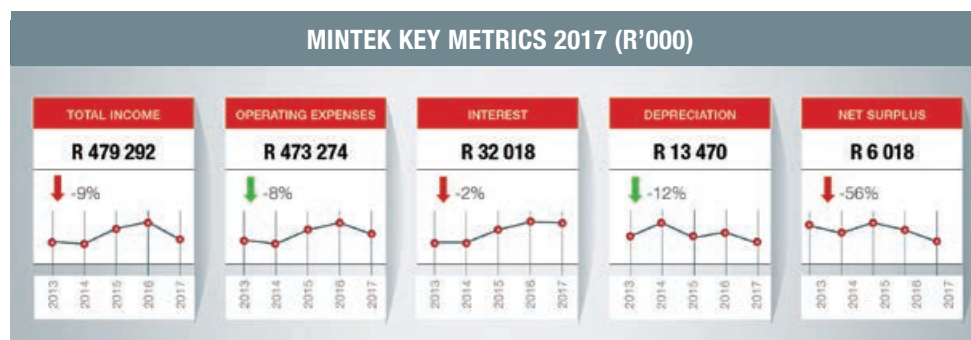
MA Mngomezulu
President & CEO, Mintek
2017

6.4

Directors' Report

Financial Year 2016/2017 Financial Performance Highlights

The 2016/2017 financial year was very challenging on the financial front. The group ended the year with a mere surplus of R6,0m which is 56% lower than the preceding year. The revenue targets were again not achieved due to the tough economic conditions and although this has an indirect correlation on the expenditure spend, it impacted on the bottom line where the target of R11,3m was not achieved.



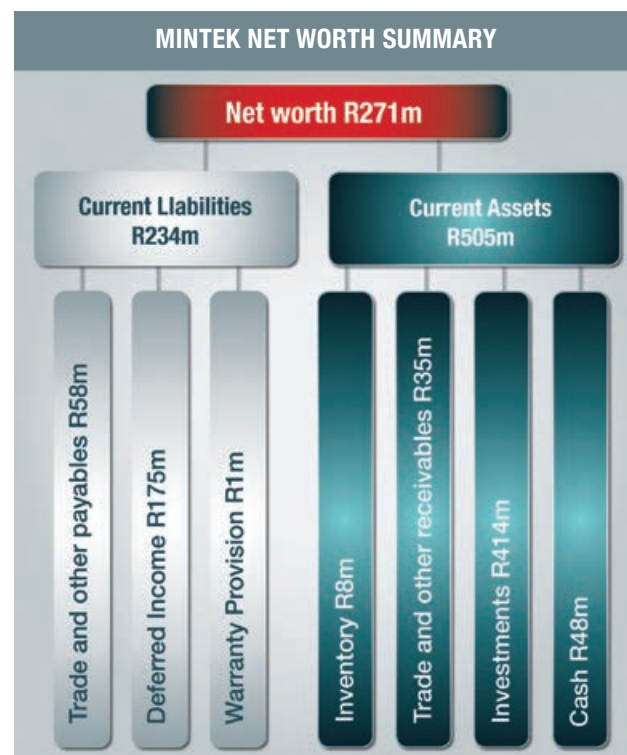
Revenue decreased by 10% from R487.2m to R441.2m in 2016/17 FY with a corresponding decrease of 8% in operating expenditure. The significant decrease in revenue is mainly due to the continued reduction in the demand for mining research that we have seen in recent years.

State grant as a % of revenue increased from 61% to 65% whilst commercial revenue declined by 22%. Mintek's other income mainly comprises of interest received from short term investments and rental income. Interest received has been generated as a result of the investment of cash received from government grants and funding of projects from private sector clients and it amounted to R32.0m in 2017 (2016 : R32.8m).

The Mintek post retirement obligation had an actuarial gain of R1.0m compared to the R3.3m gain for the prior year due to several settlements made to retired employees.

Employee costs as % of revenue increased by 4% to R308.4m compared to R312.2m in 2016.

Net surplus as a % of revenue decreased to a marginal 1% compared to the 3% in the previous year.



Mintek's liquidity position deteriorated slightly as the current ratio decreased from 2.20 to 2.16. Debtors days decreased slightly from 52 to 45 days due to the lower commercial income generated in the financial year. The decrease in net working capital from R286.0m to R271.3m still reflects adequate liquid assets to meet short term obligations as they fall due.

Investments amounted to R413.7m and the related interest income earned for 2017 amounted to R32.0m. Mintek continues to exercise caution with its short term investments given the uncertainty and volatility in the mining industry.

Capital asset acquisitions mainly related to office refurbishments, purchase of equipment for research and cash generating machinery. This decreased by 7% from R59m to R55m. Depreciation decreased by R1.9m to R13.5m due to ageing asset base that is coming to the end of its useful life.

The re-assessment of useful lives of assets with zero book value increased to R4.9m in 2017 compared to R2.7m for the previous year resulting in a lower depreciation for the current year.

Accounting Policies

There were no significant changes to the accounting policies during the year. Mintek will be converting from Generally Accepted Accounting Practices (GAAP) reporting to Generally Recognised Accounting Practice (GRAP) Standards from 1 April 2018 as per Directive 12 issued by the Accounting Standards Board during the previous financial year.

Outlook for FY2018

Although mining production in South Africa increased 1.7% year-on-year in April 2017, the impact of the downgrading of South Africa's credit status and the implementation of the new mining charter could reduce the immediate demand for research and development work even further. Mintek will continue to focus on undertaking state funded research and development activities as such state funded intervention contributes in positioning the industry to take advantage of the next cyclical upturn.





Report of the Auditor General of South Africa

Report of the Auditor-General to Parliament on the Mintek group

REPORT ON THE AUDIT OF THE CONSOLIDATED AND SEPARATE FINANCIAL STATEMENTS

Opinion

1. I have audited the consolidated and separate financial statements of the Mintek group and its subsidiary set out on pages 92 to 119, which comprise the consolidated and separate statement of financial position as at 31 March 2017, the consolidated and separate statement of comprehensive income, statement of changes in equity, and the statement of cash flows for the year then ended, as well as the notes to the consolidated and separate financial statements, including a summary of significant accounting policies.
2. In my opinion, the consolidated and separate financial statements present fairly, in all material respects, the consolidated and separate financial position of Mintek group as at 31 March 2017, and its financial performance and cash flows for the year then ended in accordance with South African Statements of Generally Accepted Accounting Principles (SA Statements of GAAP) and the requirements of the Public Finance Management Act of South Africa, 1999 (Act No. 1 of 1999) (PFMA).

Basis for Opinion

3. I conducted my audit in accordance with the International Standards on Auditing (ISAs). My responsibilities under those standards are further described in the auditor-general's responsibilities for the audit of the consolidated and separate financial statements section of my report.
4. I am independent of the public entity in accordance with the International Ethics Standards Board for Accountants' *Code of ethics for professional accountants* (IESBA code) and the ethical requirements that are relevant to my audit in South Africa. I have fulfilled my other ethical responsibilities in accordance with these requirements and the IESBA code.
5. I believe that the audit evidence I have obtained is sufficient and appropriate to provide a basis for my opinion.

Responsibilities of the Accounting Authority for the Consolidated and Separate Financial Statements

6. The board of directors, which constitutes the accounting authority is responsible for the preparation and fair presentation of the consolidated and separate financial statements in accordance with the SA Statements of GAAP, the requirements of the PFMA, and for such internal control as the accounting authority determines is necessary to enable the preparation of consolidated and separate financial statements that are free from material misstatement, whether due to fraud or error.
7. In preparing the consolidated and separate financial statements, the accounting authority is responsible for assessing the Mintek group and its subsidiary's ability to continue as a going concern, disclosing, as applicable, matters relating to going concern and using the going concern basis of accounting unless the intention is to liquidate the public entity or to cease operations, or there is no realistic alternative but to do so.

Auditor-General's Responsibilities for the Audit of the Consolidated and Separate Financial Statements

8. My objectives are to obtain reasonable assurance about whether the consolidated and separate financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes my opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with the ISAs will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these consolidated and separate financial statements.
9. A further description of my responsibilities for the audit of the consolidated and separate financial statements is included in the annexure to the auditor's report.

REPORT ON THE AUDIT OF THE ANNUAL PERFORMANCE REPORT

Introduction and Scope

10. In accordance with the Public Audit Act of South Africa, 2004 (Act No. 25 of 2004) (PAA) and the general notice issued in terms thereof I have a responsibility to report material findings on the reported performance information against predetermined objectives for selected objectives presented in the annual performance report. I performed procedures to identify findings but not to gather evidence to express assurance.
11. My procedures address the reported performance information, which must be based on the approved performance planning documents of the public entity. I have not evaluated the completeness and appropriateness of the performance indicators included in the planning documents. My procedures also did not extend to any disclosures or assertions relating to planned performance strategies and information in respect of future periods that may be included as part of the reported performance information. Accordingly, my findings do not extend to these matters.
12. I evaluated the usefulness and reliability of the reported performance information in accordance with the criteria developed from the performance management and reporting framework, as defined in the general notice, for the following selected objectives presented in the annual performance report of the public entity for the year ended 31 March 2017:

Objectives	Pages in the Annual Performance Report
Objective 2: Research and develop efficient mineral processing technologies and value added products and services	19 - 20
Objective 3: Promote the mineral-based economies of rural and marginalised communities	20
Objective 5: Develop human capital and organisational skills to build world class R&D excellence	23 - 25

13. I performed procedures to determine whether the reported performance information was properly presented and whether performance was consistent with the approved performance planning documents. I performed further procedures to determine whether the indicators and related targets were measurable and relevant, and assessed the reliability of the reported performance information to determine whether it was valid, accurate and complete.
14. I did not identify any material findings on the usefulness and reliability of the reported performance information for the following objectives:
 - Objective 2: Research and develop efficient mineral processing technologies and value added products and services
 - Objective 3: Promote the mineral-based economies of rural and marginalised communities
 - Objective 5: Develop human capital and organisational skills to build world class R&D excellence

Other Matter

15. Although I identified no material findings on the usefulness and reliability of the reported performance information for the selected objectives, I draw attention to the matter below.

Achievement of Planned Targets

16. Refer to the annual performance report on pages 18 to 25 for information on the achievement of planned targets for the year and explanations provided for the under and overachievement of certain targets.

REPORT ON AUDIT OF COMPLIANCE WITH LEGISLATION

Introduction and Scope

17. In accordance with the PAA and the general notice issued in terms thereof I have a responsibility to report material findings on the compliance of the public entity with specific matters in key legislation. I performed procedures to identify findings but not to gather evidence to express assurance.
18. I did not identify any instances of material non-compliance with specific matters in key legislation, as set out in the general notice issued in terms of the PAA.

OTHER INFORMATION

19. The Mintek group and its subsidiary's accounting authority is responsible for the other information. The other information does not include the consolidated and separate financial statements, the auditor's report and those selected objectives presented in the annual performance report that have been specifically reported on in the auditor's report.
20. My opinion on the financial statements and findings on the reported performance information and compliance with legislation do not cover the other information and I do not express an audit opinion or any form of assurance conclusion thereon.
21. In connection with my audit, my responsibility is to read the other information and, in doing so, consider whether the other information is materially inconsistent with the consolidated and separate financial statements and the selected objectives presented in the annual performance report, or my knowledge obtained in the audit, or otherwise appears to be materially misstated. If, based on the work I have performed on the other information obtained prior to the date of this auditor's report, I conclude that there is a material misstatement of this other information, I am required to report that fact. I have nothing to report in this regard.

INTERNAL CONTROL DEFICIENCIES

22. I considered internal control relevant to my audit of the consolidated and separate financial statements, reported performance information and compliance with applicable legislation; however, my objective was not to express any form of assurance thereon. I did not identify any significant deficiencies in internal control.

Auditor - General

Pretoria
31 July 2017



6.6

Annexure - Auditor General's Responsibility for the Audit

1. As part of an audit in accordance with the ISAs, I exercise professional judgement and maintain professional scepticism throughout my audit of the consolidated and separate financial statements, and the procedures performed on reported performance information for selected objectives and on the public entity's compliance with respect to the selected subject matters.

Financial Statements

2. In addition to my responsibility for the audit of the consolidated and separate financial statements as described in the auditor's report, I also:
 - Identify and assess the risks of material misstatement of the consolidated and separate financial statements whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for my opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.
 - Obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the public entity's internal control.
 - Evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by the board of directors, which constitutes the accounting authority.
 - Conclude on the appropriateness of the board of directors, which constitutes the accounting authority's use of the going concern basis of accounting in the preparation of the financial statements. I also conclude, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the Mintek group and its subsidiary's ability to

continue as a going concern. If I conclude that a material uncertainty exists, I am required to draw attention in my auditor's report to the related disclosures in the financial statements about the material uncertainty or, if such disclosures are inadequate, to modify the opinion on the financial statements. My conclusions are based on the information available to me at the date of the auditor's report. However, future events or conditions may cause a company to cease to continue as a going concern

- Evaluate the overall presentation, structure and content of the financial statements, including the disclosures, and whether the financial statements represent the underlying transactions and events in a manner that achieves fair presentation.
- Obtain sufficient appropriate audit evidence regarding the financial information of the entities or business activities within the group to express an opinion on the consolidated financial statements. I am responsible for the direction, supervision and performance of the group audit. I remain solely responsible for my audit opinion.

Communication with those Charged with Governance

3. I communicate with the accounting authority regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that I identify during my audit.
4. I also confirm to the accounting authority that I have complied with relevant ethical requirements regarding independence, and communicate all relationships and other matters that may reasonably be thought to have a bearing on my independence and here applicable, related safeguards.

6.7 Audited Financial Statements

Consolidated Statements of Financial Position as on 31 March 2017

		MINTEK GROUP		MINTEK	
Figures in Rand	Note(s)	2017	2016	2017	2016
Assets					
Non-Current Assets					
Property, plant and equipment	2	248 478 101	230 175 371	248 478 101	230 175 371
Intangible assets	3	1 985 443	1 720 076	1 985 443	1 720 076
Investments in subsidiaries	4	-	-	100	100
		250 463 544	231 895 447	250 463 644	231 895 547
Current Assets					
Inventories	5	7 970 481	7 002 424	7 970 481	7 002 424
Trade and other receivables	6	35 359 248	40 307 612	35 359 248	40 307 612
Short term investments	7	413 675 429	457 658 378	413 675 429	457 658 378
Cash and cash equivalents		48 301 404	18 589 702	48 301 404	18 589 702
		505 306 562	523 558 116	505 306 562	523 558 116
Total Assets		755 770 106	755 453 563	755 770 206	755 453 663
Equity and Liabilities					
Equity					
Reserves		148 306 174	149 836 771	148 306 174	149 836 771
Retained income		349 357 294	341 808 848	309 842 351	302 293 905
		497 663 468	491 645 619	458 148 525	452 130 676
Liabilities					
Non-Current Liabilities					
Retirement benefit obligation	8	24 114 428	26 284 506	24 114 428	26 284 506
Current Liabilities					
Loans from group companies	9	-	-	39 515 043	39 515 043
Trade and other payables	10	57 488 163	67 134 810	57 488 163	67 134 810
Deferred income	11	175 447 940	169 869 646	175 447 940	169 869 646
Provisions	12	1 056 107	518 982	1 056 107	518 982
		233 992 210	237 523 438	273 507 253	277 038 481
Total Liabilities		258 106 638	263 807 944	297 621 681	303 322 987
Total Equity and Liabilities		755 770 106	755 453 563	755 770 206	755 453 663

Consolidated Statements of Comprehensive Income as on 31 March 2017

		MINTeK GROUP		MINTeK	
<i>Figures in Rand</i>	Note(s)	2017	2016	2017	2016
Continuing operations					
Revenue	13	441 222 016	487 203 247	441 222 016	487 203 247
Other operating income	14	6 052 326	6 760 807	6 052 326	6 760 807
(Deficit) / surplus on exchange differences		(2 774 092)	1 543 140	(2 774 092)	1 543 140
Investment income	15	32 017 660	32 836 026	32 017 660	32 836 026
Employee costs	16	(308 444 589)	(312 225 124)	(308 444 589)	(312 225 124)
Operating expenses		(93 096 557)	(95 578 470)	(93 096 557)	(95 578 470)
Finance costs	17	(3 602 187)	(3 429 288)	(3 602 187)	(3 429 288)
Auditors remuneration	18	(2 075 243)	(2 567 259)	(2 075 243)	(2 567 259)
Fees for services	19	(54 878 724)	(90 653 142)	(54 878 724)	(90 653 142)
Depreciation, amortisation and impairments	20	(13 469 832)	(15 385 155)	(13 469 832)	(15 385 155)
Reassessment of assets useful lives	20	4 876 697	2 728 171	4 876 697	2 728 171
Loss on sale of assets		(858 478)	(788 754)	(858 478)	(788 754)
Actuarial gain		1 048 852	3 352 389	1 048 852	3 352 389
Surplus for the year		6 017 849	13 796 588	6 017 849	13 796 588
Other comprehensive income:					
Items that will not be reclassified to profit or loss:					
Revaluation surplus		-	23 662 691	-	23 662 691
Other comprehensive income for the year net of taxation		-	23 662 691	-	23 662 691
Total comprehensive income		6 017 849	37 459 279	6 017 849	37 459 279

Consolidated Statements of Changes in Equity as on 31 March 2017

MINTEK GROUP			
<i>Figures in Rand</i>	Revaluation reserve	Retained income	Total equity
Balance at 01 April 2015	127 528 399	326 657 941	454 186 340
Surplus for the year	-	13 796 588	13 796 588
Depreciation on revaluation of land and buildings	22 308 372	1 354 319	23 662 691
Total comprehensive income for the year	22 308 372	15 150 907	37 459 279
Balance at 01 April 2016	149 836 771	341 808 848	491 645 619
Surplus for the year	-	6 017 849	6 017 849
Depreciation on revaluation of land and buildings	(1 530 597)	1 530 597	-
Total comprehensive income for the year	(1 530 597)	7 548 446	6 017 849
Balance at 31 March 2017	148 306 174	349 357 294	497 663 468

MINTEK			
<i>Figures in Rand</i>	Revaluation reserve	Retained income	Total equity
Balance at 01 April 2015	127 528 399	287 142 998	414 671 397
Surplus for the year	-	13 796 588	13 796 588
Depreciation on revaluation of land and buildings	22 308 372	1 354 319	23 662 691
Total comprehensive income for the year	22 308 372	15 150 907	37 459 279
Balance at 01 April 2016	149 836 771	302 293 905	452 130 676
Surplus for the year	-	6 017 849	6 017 849
Depreciation on revaluation of land and buildings	(1 530 597)	1 530 597	-
Total comprehensive income for the year	(1 530 597)	7 548 446	6 017 849
Balance at 31 March 2017	148 306 174	309 842 351	458 148 525

Consolidated Statements of Cash Flows as on 31 March 2017

		MINTEK GROUP		MINTEK	
<i>Figures in Rand</i>	Note(s)	2017	2016	2017	2016
Cash flows from operating activities					
Cash receipts from customers		458 339 300	511 453 061	458 339 300	511 453 061
Cash paid to suppliers and employees		(472 560 851)	(498 080 821)	(472 560 851)	(498 080 821)
Cash (used in) / generated from operations	21	(14 221 551)	13 372 240	(14 221 551)	13 372 240
Interest received		31 324 518	32 059 094	31 324 518	32 059 094
Finance costs		(6 210)	(5 290)	(6 210)	(5 290)
Net cash from operating activities		17 096 757	45 426 044	17 096 757	45 426 044
Cash flows from investing activities					
Additions to property, plant and equipment	2	(55 117 858)	(59 054 569)	(55 117 858)	(59 054 569)
Sale of property, plant and equipment	2	-	560 000	-	560 000
Additions to intangible assets		(441 495)	(641 456)	(441 495)	(641 456)
Funding received towards purchasing of property, plant and equipment	2	27 539 643	46 468 250	27 539 643	46 468 250
Decrease/(increase) in investments		43 982 949	(19 810 258)	43 982 949	(19 810 258)
Net cash from investing activities		15 963 239	(32 478 033)	15 963 239	(32 478 033)
Cash flows from financing activities					
Post-retirement health care - settlement		(3 348 294)	(2 010 670)	(3 348 294)	(2 010 670)
Total cash movement for the year		29 711 702	10 937 341	29 711 702	10 937 341
Cash at the beginning of the year		18 589 702	7 652 361	18 589 702	7 652 361
Total cash at end of the year		48 301 404	18 589 702	48 301 404	18 589 702

Accounting Policies as on 31 March 2017

1. Presentation of Financial Statements

The financial statements have been prepared in accordance with South African Generally Accepted Accounting Practices, the Public Finance Management Act and Treasury Guidelines. The financial statements have been prepared on an accrual basis in accordance with historical cost basis except for certain assets and liabilities at fair value, and incorporate the principal accounting policies set out below. They are presented in South African Rand.

These accounting policies are consistent with the previous period.

For purposes of these financial statements, all references to 'Company' refers to Mintek, the public entity.

1.1 Basis of Consolidation

The consolidated financial statements incorporate the financial statements of the company and all entities, controlled by the company.

Control exists when the company has the power to govern the financial and operating policies of an entity so as to obtain benefits from its activities.

All intra-group transactions, balances, income and expenses are eliminated in full on consolidation.

1.2 Property, Plant and Equipment

The cost of an item of property, plant and equipment is recognised as an asset when:

- it is probable that future economic benefits associated with the item will flow to the company; and
- the cost of the item can be measured reliably.

Property, plant and equipment are initially measured at cost.

Costs include costs incurred initially to acquire or construct an item of property, plant and equipment and costs incurred subsequently to add to, replace part of, or service it. If a replacement cost is recognised in the carrying amount of an item of property, plant and equipment, the carrying amount of the replaced part is derecognised.

Land and buildings are carried at revalued amount, being the fair value at the date of revaluation less any subsequent accumulated depreciation on buildings

only and subsequent accumulated impairment losses. Revaluations are made with sufficient regularity such that the carrying amount does not differ materially from that which would be determined using fair value at the end of the reporting period.

When an item of property, plant and equipment is revalued, any accumulated depreciation at the date of the revaluation is restated proportionately with the change in the gross carrying amount of the asset so that the carrying amount of the asset after revaluation equals its revalued amount.

Any increase in an asset's carrying amount, as a result of a revaluation, is recognised to other comprehensive income and accumulated in the revaluation surplus in equity. The increase is recognised in other comprehensive income to the extent that it reverses a revaluation decrease of the same asset previously recognised in the Statement of Comprehensive Income.

Any decrease in an asset's carrying amount, as a result of a revaluation, is recognised in the Statement of Comprehensive Income in the current period. The decrease is recognised in other comprehensive income to the extent of any credit balance existing in the revaluation surplus in respect of that asset. The decrease recognised in other comprehensive income reduces the amount accumulated in the revaluation surplus in equity.

The revaluation surplus in equity related to a specific item of property, plant and equipment is transferred directly to retained earnings when the asset is been utilised.

The useful lives of items of property, plant and equipment have been assessed as follows:

Item	Average useful life
Land	Infinite
Buildings	50 years
Plant and machinery	5 - 10 years
Furniture and fixtures	5 - 10 years
Motor vehicles	5 years
Office equipment	5 - 10 years
IT equipment	3 - 5 years

The residual value, useful life and depreciation method of each asset are reviewed at the end of each reporting period. If the expectations differ from previous estimates, the change is accounted for as a change in accounting

estimate.

The depreciation charge for each period is recognised in the Statement of Comprehensive Income unless it is included in the carrying amount of another asset.

The gain or loss arising from the derecognition of an item of property, plant and equipment is included in the Statement of Comprehensive Income when the item is derecognised. The gain or loss arising from the derecognition of an item of property, plant and equipment is determined as the difference between the net disposal proceeds, if any, and the carrying amount of the item.

1.3 Intangible Assets

An intangible asset is recognised when:

- it is probable that the expected future economic benefits that are attributable to the asset will flow to the entity; and
- the cost of the asset can be measured reliably.

Intangible assets are initially recognised at cost.

Expenditure on research (or on the research phase of an internal project) is recognised as an expense when it is incurred.

Intangible assets are carried at cost less any accumulated amortisation and any accumulated impairment losses.

Gains or losses arising from derecognition of an intangible asset are measured as the difference between the net disposal proceeds and the carrying amount of the asset and are recognised in the statement of comprehensive income when the asset is derecognised.

Amortisation is provided to write down the intangible assets, on a straight-line basis, to their residual values as follows:

Item	Useful life
Computer software	3 - 5 years

1.4 Investments in Subsidiaries

In the Mintek financial statements, investments in subsidiaries are carried at cost less any accumulated impairment. The cost of an investment in a subsidiary is the aggregate of:

- the fair value, at the date of exchange, of assets given, liabilities incurred or assumed, and equity

- instruments issued by the company; plus
- any costs directly attributable to the purchase of the subsidiary.

An adjustment to the cost of a business combination contingent on future events is included in the cost of the combination if the adjustment is probable and can be measured reliably.

1.5 Financial Instruments

Classification

The group classifies financial assets and financial liabilities into the following categories:

- Financial assets at fair value through the Statement of Comprehensive Income - held for trading
- Held-to-maturity investment
- Loans and receivables
- Financial liabilities measured at amortised cost

Classification depends on the purpose for which the financial instruments were obtained / incurred and takes place at initial recognition. Classification is re-assessed on an annual basis, except for derivatives and financial assets designated as at fair value through the Statement of Comprehensive Income, which shall not be classified out of the fair value through the Statement of Comprehensive Income category.

Initial Recognition and Measurement

Financial instruments are recognised initially at fair value when the group becomes a party to the contractual provisions of the instruments.

The group classifies financial instruments, or their component parts, on initial recognition as a financial asset or a financial liability in accordance with the substance of the contractual arrangement.

For financial instruments which are not at cost through the Statement of Comprehensive Income, transaction costs are included in the initial measurement of the instrument.

Subsequent Measurement

Financial instruments at cost through the Statement of Comprehensive Income are subsequently measured at fair value, with gains and losses arising from changes in fair value being included in profit or loss for the period.

Loans and receivables are subsequently measured at

amortised cost, using the effective interest method, less accumulated impairment losses.

Held-to-maturity investments are subsequently measured at amortised cost, using the effective interest method, less accumulated impairment losses.

Gains and losses arising from changes in fair value are recognised in other comprehensive income and accumulated in equity until the asset is disposed of or determined to be impaired.

Financial liabilities at amortised cost are subsequently measured at amortised cost, using the effective interest method.

Derecognition

Financial assets are derecognised when the rights to receive cash flows from the investments have expired or have been transferred and the group has transferred substantially all risks and rewards of ownership.

Impairment of Financial Assets

At each reporting date the group assesses all financial assets, other than those at fair value through the Statement of Comprehensive Income, to determine whether there is objective evidence that a financial asset or group of financial assets has been impaired.

For amounts due to the group, significant financial difficulties of the debtor, probability that the debtor will enter bankruptcy and default of payments are all considered indicators of impairment.

Impairment losses are recognised in the Statement of Comprehensive Income.

Impairment losses are reversed when an increase in the financial asset's recoverable amount can be related objectively to an event occurring after the impairment was recognised, subject to the restriction that the carrying amount of the financial asset at the date that the impairment is reversed shall not exceed what the carrying amount would have been had the impairment not been recognised.

Reversals of impairment losses are recognised in the Statement of Comprehensive Income except for equity investments classified as available-for-sale.

Impairment losses are also not subsequently reversed for available-for-sale equity investments which are held at cost because fair value was not determinable.

Where financial assets are impaired through use of an allowance account, the amount of the loss is recognised in the Statement of Comprehensive Income within operating expenses. When such assets are written off, the write-off is made against the relevant allowance account. Subsequent recoveries of amounts previously written off are credited against operating expenses.

Loans to/(from) Group Companies

These include loans to and from the holding company and the subsidiary.

Loans to group companies are classified as loans and receivables.

Loans from group companies are classified as financial liabilities measured at amortised cost.

Trade and Other Receivables

Trade receivables are measured at initial recognition at fair value, and are subsequently measured at amortised cost using the effective interest rate method. Appropriate allowances for estimated irrecoverable amounts are recognised in the Statement of Comprehensive Income when there is objective evidence that the asset is impaired. Significant financial difficulties of the debtor, probability that the debtor will enter bankruptcy or financial reorganisation, and default or delinquency in payments are considered indicators that the trade receivable is impaired. The allowance recognised is measured at the carrying amount.

The carrying amount of the asset is reduced through the use of an allowance account, and the amount of the loss is recognised in the Statement of Comprehensive Income within operating expenses. When a trade receivable is uncollectable, it is written off against the allowance account for trade receivables. Subsequent recoveries of amounts previously written off are credited against operating expenses in the Statement of Comprehensive Income.

Trade and Other Payables

Trade payables are initially measured at fair value, and are subsequently measured at amortised cost, using the effective interest rate method.

Cash and Cash Equivalents

Cash and cash equivalents comprise cash-on-hand and demand deposits, and other short-term highly liquid investments that are readily convertible to a known amount of cash and are subject to an insignificant risk

Accounting Policies as on 31 March 2017 (continued)

of changes in value. These are initially and subsequently recorded at fair value.

Derivatives

The Group does not use derivative financial instruments including forward rate agreements and forward exchange contracts to hedge exposure rate and foreign fluctuations. It is the Group's policy not to hedge its exposure from foreign currency fluctuations, as it does not consider the impact to be significant. It is the policy of the Group not to trade in derivative financial instruments for speculative purposes.

1.6 Investments

Investments consist of short-term money market instruments initially recorded at cost, which is the fair value of the cash placed with the institution. These investments are surplus funds which are classified as held-to-maturity financial assets. Interest is accrued using the effective interest rate method and included in the Statement of Comprehensive Income on an accrual basis.

1.7 Taxation

Current Tax Assets and Liabilities

Current tax for current and prior periods is, to the extent unpaid, recognised as a liability. If the amount already paid in respect of current and prior periods exceeds the amount due for those periods, the excess is recognised as an asset.

Current tax liabilities/(assets) for the current and prior periods are measured at the amount expected to be paid to/ (recovered from) the tax authorities, using the tax rates (and tax laws) that have been enacted or substantively enacted by the end of the reporting period.

The company is exempt from paying Income Tax in terms of section 10(1) cA(i) of the Income Tax Act no.58 of 1962, but registered for VAT. Mindev is registered for Income Tax.

The tax currently payable is based on taxable profit for the financial year. Mindev's liability for current tax is calculated using tax rates that have been enacted or substantively enacted at the financial year end date.

1.8 Irregular, Fruitless and Wasteful Expenditure

Irregular expenditure means expenditure incurred in

contravention of, or not in accordance with, a requirement of any applicable legislation, including:

- The Public Finance Management Act; or,
- Any provincial legislation providing for procedures in that state owned entity.

Fruitless and wasteful expenditure means expenditure that was made in vain and could have been avoided had reasonable care been exercised. All irregular, fruitless and wasteful expenditure is charged against income in the period in which they are incurred.

1.9 Financing Costs

Interest in Mintek arises from bank overdraft, creditors and post retirement medical aid liability. Financing costs are recognised in the statement of comprehensive income in the period in which they are incurred.

1.10 Leases

A lease is classified as a finance lease if it transfers substantially all the risks and rewards incidental to ownership. A lease is classified as an operating lease if it does not transfer substantially all the risks and rewards incidental to ownership.

Finance Leases – Lessee

Finance leases are recognised as assets and liabilities in the Statement of Financial Position at amounts equal to the fair value of the leased property or, if lower, the present value of the minimum lease payments. The corresponding liability to the lessor is included in the Statement of Financial Position as a finance lease obligation.

The discount rate used in calculating the present value of the minimum lease payments is the company's incremental borrowing rate.

The lease payments are apportioned between the finance charge and reduction of the outstanding liability. The finance charge is allocated to each period during the lease term so as to produce a constant periodic rate on the remaining balance of the liability.

Operating Leases - Lessor

Operating lease income is recognised as an income on a straight-line basis over the lease term.

Initial direct costs incurred in negotiating and arranging operating leases are added to the carrying amount of the leased asset and recognised as an expense over the lease term on the same basis as the lease income.

Income for leases is disclosed under other operating income in the Statement of Comprehensive Income.

Operating Leases – Lessee

Operating lease payments are recognised as an expense on a straight-line basis over the lease term. The difference between the amounts recognised as an expense and the contractual payments are recognised as an operating lease asset. This liability is not discounted.

1.11 Inventories

Inventories are measured at the lower of cost and net realisable value on the weighted average cost method.

Net realisable value is the estimated selling price in the ordinary course of business less the estimated costs of completion and the estimated costs necessary to make the sale.

The cost of inventories comprises of all costs of purchase, costs of conversion and other costs incurred in bringing the inventories to their present location and condition.

The cost of inventories of items that are not ordinarily interchangeable and goods or services produced and segregated for specific projects is assigned using specific identification of the individual costs.

When inventories are sold, the carrying amounts of those inventories are recognised as an expense in the period in which the related revenue is recognised. The amount of any write-down of inventories to net realisable value and all losses of inventories are recognised as an expense in the period the write-down or loss occurs. The amount of any reversal of any write-down of inventories, arising from an increase in net realisable value, are recognised as a reduction in the amount of inventories recognised as an expense in the period in which the reversal occurs.

1.12 Impairment of Assets

The group assesses at each end of the reporting period whether there is any indication that an asset may be impaired. If any such indication exists, the group estimates the recoverable amount of the asset.

Irrespective of whether there is any indication of impairment, the group also:

- tests intangible assets with an indefinite useful life or intangible assets not yet available for use for impairment annually by comparing its carrying amount with its recoverable amount. This impairment test is performed annually.

If there is any indication that an asset may be impaired, the recoverable amount is estimated for the individual asset. If it is not possible to estimate the recoverable amount of the individual asset, the recoverable amount of the cash-generating unit to which the asset belongs is determined.

The recoverable amount of an asset or a cash-generating unit is the higher of its fair value less costs to sell and its value in use.

If the recoverable amount of an asset is less than its carrying amount, the carrying amount of the asset is reduced to its recoverable amount. That reduction is an impairment loss.

An impairment loss of assets carried at cost less any accumulated depreciation or amortisation is recognised immediately in profit or loss. Any impairment loss of a revalued asset is treated as a revaluation decrease. The company assesses at each reporting date whether there is any indication that an impairment loss recognised in prior periods for assets may no longer exist or may have decreased. If any such indication exists, the recoverable amounts of those assets are estimated.

A reversal of an impairment loss of assets carried at cost less accumulated depreciation or amortisation other than goodwill is recognised immediately in the Statement of Comprehensive Income. Any reversal of an impairment loss of a revalued asset is treated as a revaluation increase.

1.13 Share Capital and Equity

An equity instrument is any contract that evidences a residual interest in the assets of an entity after deducting all of its liabilities.

1.14 Employee Benefits

Defined Contribution Plans

Payments to defined contribution retirement benefit plans are charged as an expense as they fall due.

Payments made to retirement benefit schemes are dealt with as defined contribution plans where the group's obligation under the schemes is equivalent to those arising in a defined contribution retirement benefit plan.

For defined contribution plans, the Group pays contribution to privately administered pension insurance plans on a contractual basis. The Group has no further payment obligations once the contributions have been

paid. The contributions are recognised as employee benefit expense when they are due.

Defined Benefit Plans

Actuarial valuations are conducted on an annual basis by independent actuaries separately for each plan.

Actuarial gains and losses are recognised in full in the reporting period it relates to and is the excess over the greater of the present value of the past service obligation at the reporting period before deducting the present value of assumed assets at the same date.

Valuations of these obligations are carried out annually by independent, qualified actuaries using the appropriate mortality tables, long-term estimates of increases in medical costs and appropriate discount rates.

Consideration is given to any event that could impact the funds up to the end of the reporting period where the interim valuation is performed at an earlier date.

Past service costs are recognised immediately to the extent that the benefits are already vested, and are otherwise amortised on a straight line basis over the average period until the amended benefits become vested.

The liability recognised in the Statement of Financial Position in respect of the defined benefit pension plans is the present value of the defined obligation at the Statement of Financial Position date less the fair value of plan assets, together with adjustments for unrecognised past-service costs. The defined benefit obligation is calculated annually by independent actuaries using the projected unit credit method.

Prepaid contributions are recognised as an asset to the extent that a cash refund or a reduction in the future payment is available.

The Group has an obligation to fund the medical aid benefits of all its past employees and dependents of past employee who retired or were in the employment of the Group prior to 1 January 2000. The plan liability is unfunded and fully provided for in the financial statements.

The Group uses the projected unit credit actuarial method to determine the present value of its past service cost. General increases to medical aid contributions were estimated taking into account the projected future changes in the cost of medical services resulting from

both inflation and specific changes to medical costs.

1.15 Provisions and Contingencies

Provisions are recognised when:

- the group has a present obligation as a result of a past event;
- it is probable that an outflow of resources embodying economic benefits will be required to settle the obligation; and
- a reliable estimate can be made of the obligation.

The amount of a provision is the present value of the expenditure expected to be required to settle the obligation.

Where some or all of the expenditure required to settle a provision is expected to be reimbursed by another party, the reimbursement shall be recognised when, and only when, it is virtually certain that reimbursement will be received if the entity settles the obligation. The reimbursement shall be treated as a separate asset. The amount recognised for the reimbursement shall not exceed the amount of the provision.

Provisions are not recognised for future operating losses.

If the company has a contract that is onerous, the present obligation under the contract shall be recognised and measured as a provision.

After their initial recognition contingent liabilities recognised in business combinations that are recognised separately are subsequently measured at the higher of:

- the amount that would be recognised as a provision; and
- the amount initially recognised less cumulative amortisation.

Contingent assets and contingent liabilities are not recognised. Contingencies are disclosed in note 24.

1.16 Government Grants

Government grants are recognised at fair value when there is reasonable assurance that:

- the group will comply with the conditions attaching to them; and
- the grants will be received.

Government grants are recognised as income over the periods necessary to match them with the related costs

Accounting Policies as on 31 March 2017 (continued)

that they are intended to compensate.

A government grant that becomes receivable as compensation for expenses or losses already incurred or for the purpose of giving immediate financial support to the entity with no future related costs is recognised as income of the period in which it becomes receivable.

Government grants related to assets, including non-monetary grants at fair value, are presented in the Statement of Financial Position by setting up the grant as deferred income or by deducting the grant in arriving at the carrying amount of the asset.

Grants related to income are presented as a credit in the Statement of Comprehensive Income (separately).

Where a loan is received from government at below market interest rate, the difference between the fair value of the loan and the amount received is recognised as a government grant.

1.17 Revenue

Revenue from the sale of goods is recognised when all the following conditions have been satisfied:

- the group has transferred to the buyer the significant risks and rewards of ownership of the goods;
- the group retains neither continuing managerial involvement to the degree usually associated with ownership nor effective control over the goods sold;
- the amount of revenue can be measured reliably;
- it is probable that the economic benefits associated with the transaction will flow to the group; and
- the costs incurred or to be incurred in respect of the transaction can be measured reliably.

When the outcome of a transaction involving the rendering of services can be estimated reliably, revenue associated with the transaction is recognised by reference to the stage of completion of the transaction at the end of the reporting period. The outcome of a transaction can be estimated reliably when all the following conditions are satisfied:

- the amount of revenue can be measured reliably;
- it is probable that the economic benefits associated with the transaction will flow to the group;
- the stage of completion of the transaction at the

end of the reporting period can be measured reliably; and

- the costs incurred for the transaction and the costs to complete the transaction can be measured reliably.

When the outcome of the transaction involving the rendering of services cannot be estimated reliably, revenue shall be recognised only to the extent of the expenses recognised that are recoverable.

Service revenue is recognised by reference to the stage of completion of the transaction at the end of the reporting period. Stage of completion is determined by the actual costs in relation to the planned cost of a project. Service fees included in the price of the product are recognised as revenue over the period during which the service is performed.

Contract revenue comprises:

- the initial amount of revenue agreed in the contract; and
- variations in contract work, claims and incentive payments:
 - to the extent that it is probable that they will result in revenue; and
 - they are capable of being reliably measured.

Revenue is measured at the fair value of the consideration received or receivable and represents the amounts receivable for goods and services provided in the normal course of business, net of trade discounts and volume rebates, and value added tax.

Interest is recognised, in the Statement of Comprehensive Income, using the effective interest rate method.

1.18 Translation of Foreign Currencies

Foreign Currency Transactions

A foreign currency transaction is recorded, on initial recognition in Rand, by applying to the foreign currency amount the spot exchange rate between the functional currency and the foreign currency at the date of the transaction.

At the end of the reporting period:

- foreign currency monetary items are translated using the closing rate;
- non-monetary items that are measured in terms of historical cost in a foreign currency are translated

using the exchange rate at the date of the transaction; and

- non-monetary items that are measured at fair value in a foreign currency are translated using the exchange rates at the date when the fair value was determined.

Exchange differences arising on the settlement of monetary items or on translating monetary items at rates different from those at which they were translated on initial recognition during the period or in previous financial statements are recognised in profit or loss in the period in which they arise.

Cash flows arising from transactions in a foreign currency are recorded in Rand by applying to the foreign currency amount the exchange rate between the Rand and the foreign currency at the date of the cash flow.

Notes to the Consolidated Financial Statements as on 31 March 2017

2. Property, Plant and Equipment

MINTEK GROUP AND MINTEK						
Figures In Rand	2017			2016		
	Cost Valuation	Accumulated Depreciation	Carrying Value	Cost Valuation	Accumulated Depreciation	Carry Value
Land	112 334 241	-	112 334 241	112 334 241	-	112 334 241
Buildings	91 686 170	(28 636 186)	63 049 984	91 686 170	(26 466 190)	65 219 980
Plant and machinery	47 213 680	(26 541 151)	20 672 529	32 604 363	(27 240 651)	5 363 712
Furniture and fixtures	8 898 525	(5 328 400)	3 570 125	7 669 424	(4 718 254)	2 951 170
Motor vehicles	7 330	(6 896)	434	7 330	(7 185)	145
Equipment	353 538 395	(329 860 661)	23 677 734	350 733 149	(312 946 079)	37 787 070
Capital assets under construction	25 173 054	-	25 173 054	6 519 053	-	6 519 053
Total	638 851 395	(390 373 294)	248 478 101	601 553 730	(371 378 359)	230 175 371

Reconciliation of the carrying value of property, plant and equipment - Group and Mintek - 2017

	Opening balance	Additions	Disposals	Funded Assets	Transfers	Adjustments	Depreciation	Total
Land	112 334 241	-	-	-	-	-	-	112 334 241
Buildings	65 219 980	-	-	-	-	-	(2 169 996)	63 049 984
Plant and machinery	5 363 712	6 768 559	(3 931)	-	7 851 109	1 314 042	(620 962)	20 672 529
Furniture and fixtures	2 951 170	1 352 507	(13 842)	-	-	260 473	(980 183)	3 570 125
Motor vehicles	145	-	-	-	-	141	148	434
Equipment	37 787 070	26 136 763	(840 705)	(38 248 805)	5 064 081	2 928 267	(9 148 937)	23 677 734
Capital assets under construction	6 519 053	20 860 029	-	10 709 162	(12 915 190)	-	-	25 173 054
	230 175 371	55 117 858	(858 478)	(27 539 643)	-	4 502 923	(12 919 930)	248 478 101

Reconciliation of the carrying value of property, plant and equipment - Group and Mintek - 2016

	Opening balance	Additions	Disposals	Funded Assets	Transfers	Revaluations	Adjustments	Depreciation	Total
Land	91 747 897	-	-	-	-	20 586 344	-	-	112 334 241
Buildings	64 609 111	-	(471 762)	-	-	3 076 348	-	(1 993 717)	65 219 980
Plant and machinery	6 647 021	-	(3 310)	-	-	-	126 837	(1 406 836)	5 363 712
Furniture and fixtures	2 619 655	1 150 707	(17 595)	-	-	-	255 616	(1 057 213)	2 951 170
Motor vehicles	74	-	-	-	-	-	145	(74)	145
Equipment	30 742 490	36 938 640	(856 087)	(23 498 881)	2 670 788	-	1 983 027	(10 192 907)	37 787 070
Capital assets under construction	11 193 988	20 965 222	-	(22 969 369)	(2 670 788)	-	-	-	6 519 053
	207 560 236	59 054 569	(1 348 754)	(46 468 250)	-	23 662 692	2 365 625	(14 650 747)	230 175 371

Other information

Details of properties

Funding received during the current financial year for the purchase of assets is R27,539,643 (R46,468,250 for 2016). Capital assets under construction relates to the construction of plants and the renovation of buildings. These assets were under construction at year-end and are not ready for use yet. A register containing the information required by Regulation 25(3) of the Companies Regulations, 2011 is available for inspection at the registered office of the company. Funded assets with a total acquisition value of R270,430,012 (2016 - R256,931,529) are still in use.

Mintek reassessed the useful life of all zero value assets due to the fact that they are still in use and have future economic value. The useful lives were extended based on the assumptions that assets will be replaced in the next two years due to a capitalisation plan. The original acquisition value for these assets were R29, 853,779 and the resultant depreciation write back was R4,876,697 of which R4,502,923 relates to property, plant and equipment and R373,774 relates to intangible assets (refer to note 20).

2. Property, Plant and Equipment (continued)

	MINTEK GROUP		MINTEK	
Figures In Rand	2017	2016	2017	2016
Carrying value				
Land	112 334 241	112 334 241	112 334 241	112 334 241
Buildings	63 049 984	65 219 980	63 049 984	65 219 980
Plant	20 672 529	5 363 712	20 672 529	5 363 712
Equipment	23 677 734	37 787 070	23 677 734	37 787 070
Vehicles	434	145	434	145
Furniture and fittings	3 570 125	2 951 170	3 570 125	2 951 170
Capital work in progress	25 173 054	6 519 053	25 173 054	6 519 053
	248 478 101	230 175 371	248 478 101	230 175 371
Freehold land and buildings at costs:				
Land and buildings original cost	11 759 900	11 759 900	11 759 900	11 759 900
Revaluation until 31 March 2006	75 373 132	75 373 132	75 373 132	75 373 132
Revaluation 31 March 2008	49 324 836	49 324 836	49 324 836	49 324 836
Additions and transfers 2009	3 068 180	3 068 180	3 068 180	3 068 180
Additions and transfers 2010	12 401 768	12 401 768	12 401 768	12 401 768
Additions and transfers 2011	882 252	882 252	882 252	882 252
Revaluation 31 March 2011	24 485 158	24 485 158	24 485 158	24 485 158
Additions and disposals 2012	1 088 371	1 088 371	1 088 371	1 088 371
Additions 2013	2 600 682	2 600 682	2 600 682	2 600 682
Revaluation and disposal 31 March 2016	23 036 132	23 036 132	23 036 132	23 036 132
Revaluation at cost	204 020 411	204 020 411	204 020 411	204 020 411
Directors' valuation	204 020 411	204 020 411	204 020 411	204 020 411

Portion 175 and portion 226 of the farm Klipfontein, 203-IQ Johannesburg, with buildings thereon and the sectional title of units at Malanshof Heights located at Erf 560 Malanshof. The value of the land and building complexes were estimated at R204,020,411 by Resurgent Projects (Pty) Ltd, an independent valuator, during the financial year ending 31 March 2016. The valuation is done every 5 years and the latest valuation report was issued on 18 April 2016. The key assumptions used were that the value of the property be based as sale of vacant land and buildings for rental investment using various rental income figures for different areas of the Mintek property. These calculated rentals were then capitalised at 13.5%.

The estimated useful lives of depreciable property, plant, equipment and vehicles are as follows:

Item	Average useful life
Land	Infinite
Buildings	50 years
Plant	5 - 10 years
Equipment	5 - 10 years
Computer Equipment	3 - 5 years
Vehicles	5 years
Furniture and fittings	5 - 10 years

3. Intangible Assets

MINTEK GROUP AND MINTEK						
<i>Figures In Rand</i>	2017			2016		
	Cost	Accumulated amortisation	Carrying value	Cost	Accumulated amortisation	Carrying value
Computer software	6 596 944	(4 611 501)	1 985 443	6 155 448	(4 435 372)	1 720 076

Reconciliation of intangible assets - Mintek Group and Mintek - 2017

	Opening balance	Additions	Adjustments	Amortisation	Total
Computer software	1 720 076	441 495	373 774	(549 902)	1 985 443

Reconciliation of intangible assets - Mintek Group and Mintek - 2016

	Opening balance	Additions	Adjustments	Amortisation	Total
Computer software	1 450 482	641 456	362 546	(734 408)	1 720 076

The estimated useful lives of amortisable intangible assets are as follows: 3 - 5 years

4. Interests in Subsidiaries Including Consolidated Structured Entities

MINTEK GROUP				MINTEK	
<i>Figures In Rand</i>		2017	2016	2017	2016
Name of company	Held by	% holding	% holding	Carrying amount	Carrying amount
Mindev (Pty) Ltd	Mintek	100	100	100	100

Mindev is engaged in the commercialization of Mintek's patents and technology through the identification of suitable partners to advance such interests by way of direct investment in equity and through joint ventures. Mintek holds 100% of the issued share capital of Mindev (Propriety) Limited. The carrying amounts of the subsidiary is shown net of impairment losses.

5. Inventories

MINTEK GROUP			MINTEK	
<i>Figures In Rand</i>	2017	2016	2017	2016
Consumables	5 799 382	5 512 314	5 799 382	5 512 314
Finished goods	984 933	1 097 971	984 933	1 097 971
Work-in-progress	1 196 596	409 350	1 196 596	409 350
	7 980 911	7 019 635	7 980 911	7 019 635
Provision for obsolete inventories	(10 430)	(17 211)	(10 430)	(17 211)
	7 970 481	7 002 424	7 970 481	7 002 424
Carrying value of inventories carried at fair value less costs to sell	7 970 481	7 002 424	7 970 481	7 002 424

Consumables are held in stock for daily business requirements. Finished goods relate to products manufactured by the MAC division.

6. Trade and Other Receivables

	MINTEK GROUP		MINTEK	
<i>Figures In Rand</i>	2017	2016	2017	2016
Trade receivables	16 262 377	21 947 238	16 262 377	21 947 238
SARS - VAT	-	1 729 455	-	1 729 455
Prepayments	12 761 960	4 096 802	12 761 960	4 096 802
Unearned interest on fair value debtors (discounting)	36 389	59 714	36 389	59 714
Project work in progress	6 304 757	12 490 077	6 304 757	12 490 077
Other receivables	283 055	280 174	283 055	280 174
Less: Provision for doubtful debts	(289 290)	(295 848)	(289 290)	(295 848)
	35 359 248	40 307 612	35 359 248	40 307 612

Project work-in-progress relates to projects where work has been executed, but not yet billed.

Age analysis

The following is an age analysis of trade receivables at balance sheet date:

0-30 days	13 822 633	16 471 081	13 822 633	16 471 081
31-60 days past due	1 737 042	2 851 363	1 737 042	2 851 363
61-90 days past due	221 534	495 690	221 534	495 690
90+ days past due	481 168	2 129 104	481 168	2 129 104
	16 262 377	21 947 238	16 262 377	21 947 238

The age analysis reflects the categories of overdue debtors.

Fair value of trade receivables

Trade and other receivables	16 262 377	21 947 238	16 262 377	21 947 238
-----------------------------	------------	------------	------------	------------

In terms of IAS 39 outstanding customer invoices are discounted throughout the year to show the deemed interest that Mintek has forfeited. An effective interest rate been used due to the fact that this is a fair representation of the interest that Mintek earns through liquid deposits.

Provision for impairment

Included in the trade receivable balance are debtors which are past the original expected collection date at the reporting date, with a carrying amount of R702,702 (2016: R2,624,794) for which the company has not provided as there has not been a significant change in credit quality and the amounts are still considered recoverable. The company does not hold any collateral over these balances. The average age of outstanding balances is 45 days (2016 : 52 days). A summarised age analysis of due debtors is set out below.

The ageing of amounts due but not impaired is as follows:

60 - 90 days	221 534	495 690	221 534	495 690
More than 90 days	191 878	1 833 256	191 878	1 833 256
	413 412	2 328 946	413 412	2 328 946

Trade and other receivables impaired

The amount of the provision was R289,290, of which R284,655 relates to staff debts, as at 31 March 2017 (2016:R295,848 of which staff debts amounts to R237,213). An amount of R41,088 (2016:R246,544) was written-off as bad debts directly to the Statement of Comprehensive Income during the year under review. The ageing of these trade receivables is as follows:

More than 90 days	289 290	295 848	289 290	295 848
-------------------	---------	---------	---------	---------

Reconciliation of provision for impairment of trade receivables

Opening balance	295 848	198 255	295 848	198 255
Amounts settled	(234 560)	(139 620)	(234 560)	(139 620)
Provision for impairment - Staff debts	228 002	237 213	228 002	237 213
	289 290	295 848	289 290	295 848

In determining the recoverability of a trade receivable, the company considers any change in the credit quality of the trade receivable from the date credit was initially granted up to the reporting date. Accordingly, the directors believe that there is no further credit provision required in excess of the provision for doubtful debts. The maximum exposure to credit risk at the reporting date is the fair value of each class of receivable. The group does not hold any collateral as security.

6. Trade and Other Receivables (continued)

	MINTEK GROUP		MINTEK	
	2017	2016	2017	2016
Currencies				
The carrying amount of trade receivables are denominated in the following currencies				
ZAR	14 421 155	20 053 572	14 421 155	20 053 572
USD	1 744 280	1 016 539	1 744 280	1 016 539
EUR	-	425 514	-	425 514
AUD	96 942	451 613	96 942	451 613
	16 262 377	21 947 238	16 262 377	21 947 238

7. Short Term Investments

	MINTEK GROUP		MINTEK	
	2017	2016	2017	2016
<i>Figures In Rand</i>				
Short term investments - Current Portion	413 675 429	457 658 378	413 675 429	457 658 378

Investments in short-term fixed deposits are held with various reputable financial institutions at market value and interest has been earned at prime overdraft rates less a varied percentage over the year. Fixed investments held with various financial institutions are partly earmarked for the financing of Mintek's liabilities and other capital expenditure. A cession of R 2,155,000 (2016: R2,155,000) is held over these investments. Refer to note 24.

8. Retirement Benefits

	MINTEK GROUP		MINTEK	
	2017	2016	2017	2016
<i>Figures In Rand</i>				
Carrying value				
Post-retirement medical aid	24 114 428	26 284 506	24 114 428	26 284 506
Number of employees	81	92	81	92

Post-retirement medical benefits

Medical cover is provided through a number of different schemes. Post-retirement medical cover in respect of qualifying employees is recognised as an expense over the expected remaining service lives of the relevant employees. Mintek has an obligation to provide medical benefits to certain pensioners and dependents. These liabilities have been provided for in full, calculated on an actuarial basis. These liabilities are unfunded. Periodic valuation of this obligation is carried out by an independent actuary every year, the latest one being 31 March 2017.

The amounts included in the balance sheet arising from Mintek's obligation in respect of post-retirement medical benefits are as follows:

Present value of obligations as at 31 March 2017	24 114 428	26 284 506	24 114 428	26 284 506
--	-------------------	------------	-------------------	------------

8. Retirement Benefits *(continued)*

	MINTEK GROUP		MINTEK	
<i>Figures In Rand</i>	2017	2016	2017	2016
Post-retirement medical benefit obligation				
Fixed investment held with various financial institutions is partly earmarked as financing for post-retirement medical aid liability. Mintek has not assigned a specific fund to hedge the post-retirement medical aid liability.				
Movement in the net liability recognised in the statement of financial position				
Net-past service benefit liability: Beginning of the year	26 284 506	29 405 623	26 284 506	29 405 623
Interest costs	2 400 000	2 400 000	2 400 000	2 400 000
Contributions paid to service providers	(172 932)	(158 058)	(172 932)	(158 058)
Net actuarial gain	(1 048 852)	(3 352 389)	(1 048 852)	(3 352 389)
Settlements	(3 348 294)	(2 010 670)	(3 348 294)	(2 010 670)
Net-past services benefit liability: End of the year	24 114 428	26 284 506	24 114 428	26 284 506
Key assumptions				
Discount rate	9.80 %	10.30 %	9.80 %	10.30 %
Expected increase in medical inflation	8.30 %	8.70 %	8.30 %	8.70 %
Amounts recognised in the statement of comprehensive income are as follows:				
Current Costs	2 400 000	2 400 000	2 400 000	2 400 000
Benefits paid				
Contributions paid	172 932	158 058	172 932	158 058
The results are dependent on the assumptions used. The table below shows how the past service cost as at 31 March 2017 would be impacted by changes to these assumptions.				
Sensitivity analysis on past service cost				
Discount rate increased by 1% p.a.	21 314 428	23 484 506	21 314 428	23 484 506
Discount rate decreased by 1% p.a.	27 514 428	29 784 506	27 514 428	29 784 506
Subsidy inflation increased by 1% p.a.	27 314 428	29 584 506	27 314 428	29 584 506
Subsidy inflation decreased by 1% p.a.	21 314 428	23 484 506	21 314 428	23 484 506
Retirement age 58	25 414 428	27 584 506	25 414 428	27 584 506

9. Loans from Group Companies

	MINTEK GROUP		MINTEK	
<i>Figures In Rand</i>	2017	2016	2017	2016
Subsidiaries				
Mindev (Pty) Ltd	-	-	39 515 043	39 515 043

The loans granted are unsecured and do not have fixed repayment terms.
The carrying amount of the loan to Mintek is denominated in Rands.

10. Trade and Other Payables

	MINTEK GROUP		MINTEK	
<i>Figures In Rand</i>	2017	2016	2017	2016
Trade payables	15 973 953	26 234 966	15 973 953	26 234 966
SARS - VAT	5 784 608	-	5 784 608	-
Other payables	9 865 351	10 377 754	9 865 351	10 377 754
Incentive bonus provision	4 300 000	7 500 000	4 300 000	7 500 000
Accrued leave pay	11 085 845	9 587 161	11 085 845	9 587 161
Accruals	10 410 312	13 402 390	10 410 312	13 402 390
Deposits received - Mintek property rentals	26 798	-	26 798	-
Unpaid interest on fair value - creditors	41 296	32 539	41 296	32 539
	57 488 163	67 134 810	57 488 163	67 134 810

Fair value of trade and other payables

Trade and other payables	57 488 163	67 134 810	57 488 163	67 134 810
--------------------------	------------	------------	------------	------------

In terms of IAS 39 outstanding supplier invoices are discounted throughout the year to show the deemed interest that Mintek has forfeited.
An effective interest rate has been used due to the fact that this is a fair representation of the interest that Mintek earns through liquid deposits.

11. Deferred Income

	MINTEK GROUP		MINTEK	
<i>Figures In Rand</i>	2017	2016	2017	2016
Deferred income	167 581 810	159 278 522	167 581 810	159 278 522
Advance client billing (Unearned income)	7 866 130	10 591 124	7 866 130	10 591 124
	175 447 940	169 869 646	175 447 940	169 869 646

Deferred income arises as a result of contracts undertaken for several government departments and institutions in respect of amounts received in cash not yet accounted for as revenue.
Advance client billing income arises as a result of contracts undertaken in terms of commercial work where invoices are raised based on work that has not been done. The quantum of costs incurred provides the basis for the level of revenue recognised in the period.

12. Provisions

Reconciliation of provisions - Group and Company - 2017	Opening balance	Additions	Reversed during the year	Total
Product warranties	518 982	1 056 107	(518 982)	1 056 107
Reconciliation of provisions - Group and Company - 2016	Opening balance	Additions	Reversed during the year	Total
Product warranties	259 340	518 982	(259 340)	518 982

The provision for product warranties arises from Mintek recognising its probable liability for meeting its obligation in terms of products and services as stipulated in its contracts with its customers.

13. Revenue

	MINTEK GROUP		MINTEK	
<i>Figures In Rand</i>	2017	2016	2017	2016
Components of revenue				
Government grants	284 617 874	295 526 056	284 617 874	295 526 056
State Grant	312 645 218	363 808 772	312 645 218	363 808 772
Prior year carry-over	144 885 763	136 217 510	144 885 763	136 217 510
Less:				
Portion of grant utilised to acquire fixed assets and set-off against infrastructure improvements	(42 270 933)	(59 614 463)	(42 270 933)	(59 614 463)
Portion of grant carried over for committed fixed asset purchases and expenses	(130 642 174) *	(144 885 763) *	(130 642 174) *	(144 885 763) *
Other revenue streams	156 604 142	191 677 191	156 604 142	191 677 191
Products and services	114 395 840	149 477 982	114 395 840	149 477 982
Contract research	42 208 302	42 199 209	42 208 302	42 199 209
	441 222 016	487 203 247	441 222 016	487 203 247

* Included in the carried over amount is R110,940,985 (2016: R104,459,988) that is ringfenced for specific projects relating to the rehabilitation of derelict and ownerless mines, as agreed with the Department of Mineral Resources.

14. Other Operating Income

	MINTEK GROUP		MINTEK	
<i>Figures in Rand</i>	2017	2016	2017	2016
Components of operating income				
Library services	20 947	9 896	20 947	9 896
Breach of contract (employees)	1 304 232	851 459	1 304 232	851 459
Insurance claims received	108 258	806 850	108 258	806 850
Skill Development Levy refunds	499 037	222 477	499 037	222 477
Sundry income	1 497 695	2 295 823	1 497 695	2 295 823
Rental income - properties	2 622 157	2 574 302	2 622 157	2 574 302
	6 052 326	6 760 807	6 052 326	6 760 807

15. Investment Income

	MINTEK GROUP		MINTEK	
<i>Figures In Rand</i>	2017	2016	2017	2016
Short term deposits	31 255 632	31 995 841	31 255 632	31 995 841
Bank balances	68 851	58 911	68 851	58 911
Fair value interest on debtors	693 142	776 932	693 142	776 932
Other interest	34	4 342	34	4 342
	32 017 659	32 836 026	32 017 659	32 836 026

Total interest income, calculated using the effective interest rate, on financial instruments not at fair value through the Statement of Comprehensive Income amounted to R32,017,659 (2016: R32,836,026).

16. Employee Costs

	MINTEK GROUP		MINTEK	
<i>Figures In Rand</i>	2017	2016	2017	2016
Employee remuneration	273 287 651	273 201 870	273 287 651	273 201 870
Overtime	2 061 137	6 163 540	2 061 137	6 163 540
Provision for bonus expense	4 300 000	7 500 000	4 300 000	7 500 000
Training	6 948 615	5 342 128	6 948 615	5 342 128
Medical expenses	1 613 074	1 593 775	1 613 074	1 593 775
Accrued leave provision expense	6 304 718	3 959 763	6 304 718	3 959 763
Bursaries	12 264 233	12 931 345	12 264 233	12 931 345
Board member fees	450 293	386 056	450 293	386 056
Other employee costs	1 214 868	1 146 647	1 214 868	1 146 647
	308 444 589	312 225 124	308 444 589	312 225 124

17. Finance Costs

	MINTEK GROUP		MINTEK	
<i>Figures In Rand</i>	2017	2016	2017	2016
Trade creditors	6 210	5 290	6 210	5 290
Fair value interest on creditors	1 195 977	1 023 998	1 195 977	1 023 998
Retirement benefits	2 400 000	2 400 000	2 400 000	2 400 000
	3 602 187	3 429 288	3 602 187	3 429 288

18. Auditors Remuneration

	MINTEK GROUP		MINTEK	
<i>Figures In Rand</i>	2017	2016	2017	2016
External audit fees	1 895 822	2 396 679	1 895 822	2 396 679
Other audits	179 421	170 580	179 421	170 580
	2 075 243	2 567 259	2 075 243	2 567 259

19. Fees for services

	MINTEK GROUP		MINTEK	
<i>Figures In Rand</i>	2017	2016	2017	2016
Components of fees for services				
Technology services	13 839 042	16 606 634	13 839 042	16 606 634
Facility management	8 632 734	7 891 568	8 632 734	7 891 568
Legal fees	3 140 589	1 781 459	3 140 589	1 781 459
Contract services	789 416	649 294	789 416	649 294
Asbestos rehabilitation	23 328 623	58 685 225	23 328 623	58 685 225
Professional consultancy	5 148 320	5 038 962	5 148 320	5 038 962
	54 878 724	90 653 142	54 878 724	90 653 142

20. Depreciation, Amortisation and Impairments

	MINTEK GROUP		MINTEK	
<i>Figures In Rand</i>	2017	2016	2017	2016
Components of depreciation, amortisation and impairments				
Buildings	2 169 996	1 993 717	2 169 996	1 993 717
Plant	620 962	1 406 836	620 962	1 406 836
Equipment	9 148 937	10 192 907	9 148 937	10 192 907
Vehicles	(148)	74	(148)	74
Furniture and fittings	980 183	1 057 213	980 183	1 057 213
Computer software (intangible assets)	549 902	734 408	549 902	734 408
	13 469 832	15 385 155	13 469 832	15 385 155
Reassessment of assets useful lives	(4 876 697)	(2 728 171)	(4 876 697)	(2 728 171)

Mintek reassessed the useful life of all zero value assets due to the fact that they are still in use and have future economic value. The useful lives were extended based on the assumptions that assets will be replaced in the next two years due to a capitalisation plan. The original acquisition value for these assets were R29,853,779 and the resultant depreciation write back was R4,876,697 (refer to note 2 and 3).

21. Taxation

	MINTEK GROUP		MINTEK	
<i>Figures In Rand</i>	2017	2016	2017	2016

Reconciliation of the tax expense

Reconciliation between applicable tax rate and average effective tax rate.

Applicable tax rate	28.00 %	28.00 %	-	-
---------------------	---------	---------	---	---

No provision for income tax was made for the company during the current financial year as Mintek is exempt in terms of section 10(1)(CA)(i) of the Income Tax Act, No. 58 of 1962; and Mindev is a dormant company. Tax provisions and liabilities are with respect to Mindev and are payable through those entities.

22. Cash (used in) / Generated from Operations

	MINTEK GROUP		MINTEK	
<i>Figures In Rand</i>	2017	2016	2017	2016
Surplus for the year	6 017 849	13 796 588	6 017 849	13 796 588
Adjustments for:				
Depreciation and amortisation	13 469 832	15 385 155	13 469 832	15 385 155
Loss on sale of assets	858 478	788 754	858 478	788 754
Actuarial gains	(1 221 784)	(3 510 448)	(1 221 784)	(3 510 448)
Interest received - investment	(32 017 660)	(32 836 026)	(32 017 660)	(32 836 026)
Finance costs	3 602 187	3 429 288	3 602 187	3 429 288
Fair value adjustment - trade receivables	693 142	776 932	693 142	776 932
Fair value adjustment - trade payables	(1 195 977)	(1 023 998)	(1 195 977)	(1 023 998)
Assets adjustment	(4 876 697)	(2 728 171)	(4 876 697)	(2 728 171)
Changes in working capital:				
Increase in inventories	(968 057)	(1 485 662)	(968 057)	(1 485 662)
Decrease in trade and other receivables	4 948 364	12 531 637	4 948 364	12 531 637
(Decrease)/ increase in trade and other payables	(9 646 647)	2 784 113	(9 646 647)	2 784 113
Increase in deferred income	5 578 294	5 204 436	5 578 294	5 204 436
Increase in provisions	537 125	259 642	537 125	259 642
	(14 221 551)	13 372 240	(14 221 551)	13 372 240

23. Insurance and Risk Management

The insurance and risk management policies adopted by Mintek are aimed at obtaining sufficient cover at the minimum cost to protect its asset base, earning capacity and legal obligations against acceptable losses.

All property, plant and equipment are insured at current replacement value. Risks of a possible catastrophic nature are identified and insured at acceptable risks.

24. Commitments

	MINTEK GROUP		MINTEK	
<i>Figures In Rand</i>	2017	2016	2017	2016
Authorised capital expenditure				
Authorised and contracted for				
Property, plant and equipment	16 905 140	14 361 764	16 905 140	14 361 764
This committed expenditure relates to plant and equipment and will be financed by available, existing cash resources, external grant funding.				
Operational expenditure				
Contracted for	84 249 182	34 127 573	84 249 182	34 127 573
Operating leases for vehicles – as lessee (expense)				
Minumum Lease payments due				
- within one year	503 068	639 004	503 068	639 004
- in second to fifth year inclusive	143 363	769 677	143 363	769 677
	646 431	1 408 681	646 431	1 408 681

25. Contingencies

Mintek has disputed employment contracts with former employees, the aggregate of which is not expected to exceed R679,915 (2016: R355,915). This amount includes estimated legal costs and disbursements and does not factor the success rate of the individual cases.

Cessions in favour of Absa Bank for R2,155,000 (2016: R2,155,000) to meet requirements for credit card and other banking facilities has been registered.

26. Related Parties

	MINTEK GROUP		MINTEK	
<i>Figures In Rand</i>	2017	2016	2017	2016

Controlling entity

The Group comprises of Mintek and its wholly owned subsidiary Mindev (Proprietary) Limited. Mindev is engaged in the commercialisation of Mintek patents and technology through the identification of suitable partners. The Group, in the ordinary course of business, enters into various sale and purchase transactions with related parties.

None of the directors, officers or major shareholders of the Mintek Group or, to the knowledge of Mintek, their families, had any interest, direct or indirect, in any transactions which has affected or will materially affect Mintek or its investment or subsidiary.

Related party transactions

Related party transactions exist within the Group. During the year all sales transactions were concluded at arm's length.

Details of material transactions with related parties not disclosed elsewhere in the financial statements are as follows:

Related party balances

Loan accounts - Owning to related parties

Mindev (Pty) Ltd	-	-	39 515 043	39 515 043
------------------	---	---	------------	------------

Amounts included in Deferred Income regarding related parties

Department of Mineral Resources	130 642 174	144 885 763	130 642 174	144 885 763
Mining Qualification Authority	1 701 425	1 169 196	1 701 425	1 169 196
Department of Science and Technology	34 041 447	11 176 167	34 041 447	11 176 167
National Research Foundation	1 125 108	1 257 923	1 125 108	1 257 923
Technology Innovation Agency	71 657	789 474	71 657	789 474

Amounts included in Trade receivables regarding related parties

Mining Qualification Authority	2 994 454	1 713 470	2 994 454	1 713 470
Water Research Council	622 686	443 026	622 686	443 026
Department of Science and Technology	81 348	78 766	81 348	78 766
National Research Foundation	10 520	-	10 520	-
CSIR	296 800	-	296 800	-
Technology Innovation Agency	-	717 816	-	717 816

Sales to related parties

Department of Mineral Resources	279 995 878	289 564 658	279 995 878	289 564 658
Department of Science and Technology	39 708 603	39 033 208	39 708 603	39 033 208
National Research Foundation	1 517 116	1 758 806	1 517 116	1 758 806
Council of Geoscience	737 593	10 975	737 593	10 975
Mining Qualification Authority	9 729 076	5 270 556	9 726 076	5 270 556
CSIR	689 235	-	689 235	-
Water Research Council	1 638 650	1 165 857	1 638 650	1 165 857
The South African Medical Research Council	170 192	170 192	170 192	170 192

26. Related Parties (continued)

Relationships

Subsidiary	Mindev (Pty) Limited
Parent National Department	Department of Mineral Resources
Other Government Science Departments	Department of Science and Technology and its Entities
Other Government Departments and Entities	Department of Health and its Entities
	Department of Higher Education and Training and its Entities
	Department of Water and Sanitation and its Entities

27. Board Members and Executive Management Remuneration

2017			
Executive Management			
	Basic salary	Performance bonuses and other expenses	Total
Mr MA Mngomezulu	2 927 783	136 030	3 063 813
Mr AD McKenzie	1 776 827	100 325	1 877 152
Mr P Craven (Retired 31/12/2016)	1 395 859	94 866	1 490 725
Mr SA Simelane	1 951 857	77 663	2 029 520
Ms FG Nyanda	1 708 848	67 892	1 776 740
Dr M Makhaola	1 776 827	126 109	1 902 936
Dr DM Powell (Appointed 01/11/2016)	686 040	-	686 040
	12 224 041	602 885	12 826 926

Non-Executive Board members				
	Entity	Fees for services as directors	Other expenses	Total
Dr L Konar	Independent Management Consultant	56 212	-	56 212
Mr MJ Rachidi	Tetelo Computer Services (Pty) Ltd	72 616	-	72 616
Adv D Block (Contract ended 31/05/2016)	Independent Management Consultant	10 976	315	11 291
Mr DS Dlamini	National Arts Council of South Africa	58 204	-	58 204
Dr V Toni Penxa (Contract ended 31/05/2016)	IMS Labs	8 000	1 187	9 187
Dr NS Nhlapo (Contract ended 31/05/2016)	Cape Peninsula University of Technology	3 408	-	3 408
Ms K Mthimunye (Contract ended 31/05/2016)	Independent Management Consultant	7 568	-	7 568
Ms CKN McClain	Closure & Rehabilitation Solutions	44 342	-	44 342
Dr MS Mohlala	Vaal University of Technology	57 432	-	57 432
Dr S Simayi	Coega Development Corporation	23 384	-	23 384
Ms SS Ngwenya	TNC Wealth Partners (Pty) Ltd	49 048	-	49 048
Mr PL Mkhombo	PwC Africa	31 437	-	31 437
		422 627	1 502	424 129

Mr. A Moatshe and Mr. D du Toit were not paid any directors' emoluments during the year under review as they are serving as government employees.

27. Board Members and Executive Management Remuneration *(continued)*

<i>Figures In Rand</i>	MINTeK GROUP		MINTeK	
	2017	2016	2017	2016
Travel	40 646	152 086	40 646	152 086
Independent committee members - fees and travel costs	27 666	16 072	27 666	16 072
Other expenses	19 507	13 547	19 507	13 547
	87 819	181 705	87 819	181 705

2016

Executive Management

	Basic salary	Performance bonuses, labour costs and other expenses	Total
Mr MA Mngomezulu	2 755 372	267 484	3 022 856
Mr AD McKenzie	1 672 194	138 364	1 810 558
Mr P Craven	1 770 119	175 391	1 945 510
Mr SA Simelane	1 836 915	171 169	2 008 084
Ms FG Nyanda	1 608 216	117 363	1 725 579
Dr M Makhaola	1 672 194	215 215	1 887 409
Ms DR Bopape <i>(Resigned 16/07/2015)</i>	440 664	20 578	461 242
	11 755 674	1 105 564	12 861 238

Non-Executive Board members

	Entity	Fees for services as directors	Other expenses	Total
Adv L Makatini	Independent Management Consultant	77 928	-	77 928
Ms ND Zikalala	De Beers Group	43 336	-	43 336
Adv D Block	Independent Management Consultant	82 376	8 438	90 814
Dr V Toni Penxa	IMS Labs	69 384	9 963	79 347
Dr NS Nhlapo	Cape Peninsula University of Technology	35 584	-	35 584
Ms K Mthimunye	Independent Management Consultant	56 784	-	56 784
		365 392	18 401	383 793

Mr. I Patel and Ms. C Leso were not paid any directors' emoluments during the year under review as they are serving as government employees.

28. Financial Instruments

Foreign Currency Risk

Foreign currency risk is the risk that the fair value or future cash flow of a financial instrument will fluctuate because of changes in foreign exchange rates. The group undertakes certain transactions denominated in foreign currencies hence exposure to exchange rate fluctuations arises. Exchange rate exposures are managed by operating a US Dollar based bank account within approved policy parameters and the group does not use derivatives to hedge its exposure.

Credit Risk Management

Financial assets that could subject the group to credit risk consist principally of bank balances and cash, deposits, trade and other receivables, and short-term investments. The Group bank balances and short-term investments are placed with several financial institutions with at least BBB credit ratings as rated in terms of the Fitch Global Rating system. The Group reviews its trade and other receivables at each balance sheet date to ensure adequate allowances for doubtful receivables or loan write-offs are made, the level of this provision is disclosed in note 6. Credit risk with respect to trade receivables is limited to the large number of customers comprising the Group's customer base and their dispersion across different industries and geographical areas. Accordingly the Group does not have significant concentration of credit risk.

The Group considers its short-term investments to be secured and readily available as cash should the need arise for the conversion of the investments.

The carrying amounts of financial assets included in the balance sheet represent the Group's exposure to credit risk in relation to these assets. The Group does not have any significant exposure to any customer or counter party.

Liquidity Risk

Prudent liquidity risk management implies maintaining sufficient cash resources to meet cash flow requirements. Management monitors forecasts of liquidity reserve on the basis of expected cash flow. Analysis of the various requirements is disclosed in note 7 of the financial statements.

Fair Values

As at 31 March 2017 the carrying amount of bank balances and cash, deposits, trade and other receivables, trade and other payables, contracts in progress, advances received and short-term borrowings approximated their fair values due to the short-term nature of these assets and liabilities.

The group does not hedge foreign exchange fluctuations.

Interest Rate Risk

The valuation of interest rate exposure and investment strategies is done on a regular basis. The risk arises from substantial interest-bearing assets at variable interest rates. To minimise exposure to this risk, the Group uses a mixture of variable and fixed interest rates.

29. Irregular Expenditure

	MINTEK GROUP		MINTEK	
<i>Figures In Rand</i>	2017	2016	2017	2016
Reconciliation of irregular expenditure				
Opening balance	-	-	-	-
Irregular expenditure current year	-	294 742	-	294 742
Condoned or written off by relevant authority	-	(294 742)	-	(294 742)
Irregular expenditure awaiting condonement	-	-	-	-
Tender awarded to a company whose tax clearance certificate expired during the awarding process (has been condoned)	-	294 742	-	294 742

6.8 Audited Financial Statements (Mindev)

Mindev (Pty) Ltd Statement of Financial Position as on 31 March 2017

MINDEV (PTY) LTD			
<i>Figures In Rand</i>	Note(s)	2017	2016
Assets			
Current Assets			
Loans to shareholders	2	39 514 943	39 514 943
Equity and Liabilities			
Equity			
Share capital	3	100	100
Retained income		39 514 943	39 514 943
Total Equity		39 514 943	39 514 943

Mindev (Pty) Ltd Statement of Changes in Equity as on 31 March 2017

MINDEV (PTY) LTD			
<i>Figures In Rand</i>	Share capital	Retained income	Total equity
Balance at 01 April 2015	100	39 514 943	39 514 943
Balance at 01 April 2016	100	39 514 943	39 514 943
Balance at 31 March 2017	100	39 514 943	39 514 943

Mindev (Pty) Ltd Accounting Policies



1. Significant Accounting Policies

The principal accounting policies applied in the preparation of these financial statements are set out below. These accounting policies are consistent with the previous period.

1.1 Financial Instruments

Loan to Shareholder

These financial assets are classified as loans and receivables.

1.2 Taxation

Current tax Assets and Liabilities

Current tax for current and prior periods is, to the extent unpaid, recognised as a liability. If the amount already paid in respect of current and prior periods exceeds the amount due for those periods, the excess is recognised as an asset.

Current tax liabilities/(assets) for the current and prior periods are measured at the amount expected to be paid to/(recovered from) the tax authorities, using the tax rates (and tax laws) that have been enacted or substantively enacted by the end of the reporting period.

Tax Expenses

Current and deferred taxes are recognised as income or an expense and included in profit or loss for the period, except to the extent that the tax arises from:

- a transaction or event which is recognised, in the same or a different period, to

Mindev (Pty) Ltd Notes to the Financial Statements as on 31 March 2017

2. Loan to Shareholder

MINDEV (PTY) LTD		
<i>Figures In Rand</i>	2017	2016
Mintek	39 514 943	39 514 943

The loan is interest free and has no repayment terms.

3. Share Capital

MINDEV (PTY) LTD		
<i>Figures In Rand</i>	2017	2016
Aurhorised		
1,000 Ordinary shares of R1 each	1 000	1 000
Issued		
Ordinary	100	100

4. Directors' Emoluments

No emoluments were paid to the directors or any individuals holding a prescribed office during the year.

5. Related Parties

Controlling entity

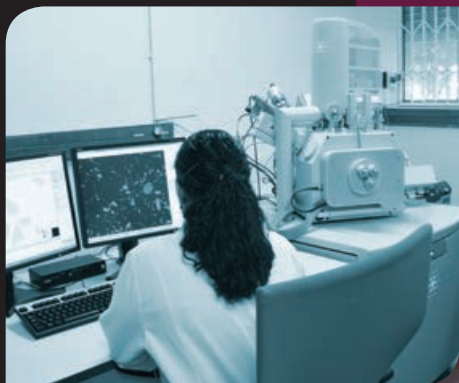
The company is a wholly owned subsidiary Mintek. Mindev is engaged in the commercialisation of Mintek patents and technology through the identification of suitable partners. The company, in the ordinary course of business, enters into various sale and purchase transactions with related parties.

None of the directors, officers or the shareholder of the Mintek Group or, to the knowledge of the company, their families, had any interest, direct or indirect, in any transactions which has affected or will materially affect Mindev.

Related party transactions

Related party transactions exist within the Group. During the year no sales transactions were concluded. Details of material transactions with related parties not disclosed elsewhere in the financial statements are as follows:

MINDEV (PTY) LTD		
<i>Figures In Rand</i>	2017	2016
Relationships		
Holding company	Mintek	
Related party balances		
Loan accounts - Owing by related parties		
Mintek	39 514 943	39 514 943



*A selection of Technologies
& Services offered by Mintek
Mineralogy and the Analytical
Services Division for the Minerals
Industry.*

*From top to bottom: MLA &
QEMScan, XRD X-ray Diffraction
and Optical Microscopy.*

7

Research Outputs

Poster Presentations	122
Oral Presentations	123
Conference Papers	129
Book Chapters	132
Journal Articles	132
Glossary	134

Poster Presentations

1. **Abrahams S, Saku D & Coyanis M.** CALUX® bioassay implementation for the screening and quantification of dioxins and dioxin like compounds. 6th Analytical Science Symposium, 21st October 2016. Mintek, Johannesburg, Gauteng Province South Africa.
2. **Abrahams S.** Determining the interaction between HIV_1 REV and integrase in the presence of an Allosteric integrase Inhibitor. The 25th Congress of the South African Society of Biochemistry and Molecular Biology, 10 – 13 July 2016, East London Convention Centre, East London, Eastern Cape, South Africa.
3. **Babu-Dayal D.** Beneficiation of cassiterite by gravity and magnetic separation. 3rd Young Professionals Conference. 9–10 March 2017. Innovation Hub, Pretoria, Gauteng Province South Africa.
4. **Baloyi J & Ntho T.** Effect of ultrasonic treatment time on the preparation of novel Al Zr pillared clays as catalyst for catalytic wet oxidation of phenol. International Conference on Environment, Materials and Green Technology, November 24-25 2016, VUT Southern Gauteng Science and Technology Park, Sebokeng, Johannesburg, South Africa (ISBN 978-1-77012-141-6).
5. **Bambo M.** Effect of organoclay-copper nanoparticles hybrids on the synthesis of PVDF nanofibers. 7th DST/Mintek NIC Workshop 2017, 25-26 January 2017.
6. **Bambo M, Shapo L, Matabola P & Sikhwivhilu K.** Effect of polymer concentration and nanomaterials incorporation on fiber morphology and diameter. 7th DST/Mintek NIC Workshop 2017, 25-26 January 2017, SA Medical Research Council, University of the Western Cape, Western Cape Province, South Africa.
7. **Banda W, Steenkamp J.** Chemical wear of carbon and silicon carbide-based refractory materials by silicomanganese metal. 11th European Electric Steelmaking Conference & Expo, 25-27 May 2016. Venice (Italy).
8. **Banda W & Lagendijk H.** Techno-economic assessment of the production of cement extender from manganese slags. 3rd Young Professionals Conference. 9–10 March 2017. Innovation Hub, Pretoria, Gauteng Province South Africa.
9. **Chetty J & Banda W.** 2016. Quality control during the installation of carbon based cold ramming paste. 3rd Young Professionals Conference. 9–10 March 2017. Innovation Hub, Pretoria, Gauteng Province South Africa.
10. **Clark W & Corfield A.** Mineralogy in Process Control. 35th International Geological Congress 28 August - 03 September 2016. Cape Town, Western Cape, South Africa.
11. **Dyan B, Tetyana P & Skepu A.** Min-Diagnostics™ - development, commercialization and manufacturing of rapid diagnostic kit. 7th Annual DST/Mintek Nanotechnology Innovation Centre, 25-26 January 2017. The University of the Western Cape, SA Medical Research Council. Western Cape, South Africa.
12. **Gericke M.** Technologies for sulphate removal with valorisation options. IMWA 2016, Annual Conference, 11-15 July 2016. Kubus, Leipzig, Germany.
13. **Langa S.** Arsenic Speciation by Ion Chromatography in water and waste water. 6th Mintek Analytical Symposium. 21 October 2016. Mintek, Gauteng Province, South Africa.
14. **Legodi W.** Cyanide destruction of gold cyanidation pulp with significant nickel content. SAIMM Young Professionals Conference. 9 -10 March 2017, Pretoria, Gauteng Province South Africa.
15. **Lekobotja M, Goso X & Lagendijk H.** Recovery of vanadium from discard titaniferous magnetite slag using the soda ash roast-leach process. 3rd Young Professional Conference 9-10 March 2017 Innovation Hub, Pretoria, Gauteng Province, South Africa.
16. **Matabola P, Mlasi B, Nemaododzi L, Nongauza S & Sikhwivhilu K.** Technology demonstration of capillary ultrafiltration and adsorbent beads on acid mine drainage and car wash effluents. 7th Mintek/DST NIC workshop, 25-26th Jan 2017, Cape Town, Western Cape Province, South Africa.
17. **Maumela M.** The effect of Cast Structures on Texture, Surface Roughness and Formability in AISI 433 Ferritic Stainless Steel. 54th Annual Conference of the Microscopy of South Africa. 5-8 December 2016. Boardwalk Convention Centre Port Elizabeth, Eastern Cape Province South Africa.
18. **Mhlanga N & Skepu A.** Gold-mixed monolayer protected clusters SERS probes: towards nano-diagnostic application. 7th Annual DST/MINTEK NIC Workshop. SA Medical Research Council, 25-26 January 2017. Cape Town, South Africa.
19. **Moeletsi R & Sosibo N.** Beneficiation of feldspar-rich pegmatites for the ceramic industry applications. 35th International Geological Congress. 27- August-2 September 2016. Cape Town, Western Cape Province, South Africa.
20. **Mothupi T.** AMREP feedback on processing AMREP Annual Project Workshop. 9-10 February 2017. Geozentrum, Hannover.
21. **Mphuthi N.** Detection of glucose using NICsens carbon based screen printed electrodes. 7th Annual DST/Mintek Nanotechnology Innovation Centre, 25-26 January 2017. University of the Western Cape, SA Medical Research Council, Western Cape, South Africa.
22. **Mulaudzi M.** Stress corrosion cracking of Ru alloyed LDX2101 stainless steel in NACl

- solution.DST-NRF Centre of Excellence in Strong Materials Workshop. Student Presentation Workshop. 26 May 2016.
23. **Mulaudzi M.** Measurement and monitoring of naphthenic acid and corrosion. DST-NRF Centre of Excellence in Strong Materials Workshop. Student Presentation Workshop. 26 May 2016.
 24. **Njengele Z & Mosebi S.** Analysis of the interaction of BST_2 with HIV_1 Vpu as a potential novel target for HIV treatment. The 25th Congress of the South African Society of Biochemistry and Molecular Biology, 10 – 13 July 2016, East London Convention Centre, East London, Eastern Cape, South Africa.
 25. **Saku D, Mbombi K & Coyanis M.** Acute toxicity testing with MICROTOX® BIOLUMINESCENT VIBRIO FISCHERI. 6th Analytical Science Symposium. Mintek on 21st October 2016, Johannesburg, Gauteng Province, South Africa.
 26. **Shumbula P.** Capping gold selenide: formation of nanobelts. 54th Annual Conference of the Microscopy Society of South Africa. 5-8 December, Boardwalk Convention Centre, Port Elizabeth, Eastern Cape, South Africa.
 27. **Sikhwivhilu K.** Polyethersulphone Nano-composite membrane containing Fe/Pd nanoparticles for catalytic degradation of PCB 77 in water. NanoAfrica 2016 Conference, 3-6 April 2016, UNISA, Florida Campus, Johannesburg, Gauteng Province, South Africa.
 28. **Sikhwivhilu K & Kgatle M.** PH-Responsive Polyethersulfone Membranes grafted with Acrylic Acid derivatives for Water Treatment PERMEA & MELPRO, 15-19 May 2016, Prague, Czech Republic.
 29. **Sitefane M, Maphutha P & Goso X.** The effect of CaO to MgO ratio on the smelting characteristics of vanadium-bearing titaniferous magnetite. 3rd Young Professional Conference 9-10 March 2017 Innovation Hub,

Pretoria, Gauteng Province, South Africa.

30. **Sithole A, Erwee M & Steenkamp J.** A predictive mass and energy balance model for SiMn production in Submerged Arc Furnaces. 3rd Young Professionals Conference. 9–10 March 2017. Innovation Hub, Pretoria, Gauteng Province South Africa.
31. **Sithole P, Goso X & Lagendijk H.** Laboratory scale sulphation roasting test work for copper and cobalt production. 3rd Young Professional Conference, 9-10 March 2017 Innovation Hub, Pretoria. Gauteng Province, South Africa.
32. **Steenkamp J & Hockaday C.** Analysis of electrical energy dissipation in submerged arc furnaces producing silicomanganese. 11th European Electric Steelmaking Conference & Expo. 25-27 May 2016, Venice, Italy.
33. **Steenkamp J.** Identifying barriers faced by key role players in the South African manganese industry. 27th SAIIE Conference 27th - 29th October 2016 Stonehenge in Africa, Northwest Province, South Africa.
34. **Stevenson M & Pattrick G.** Scale-up in electrocatalyst production from laboratory scale to kilogram per batch quantities. Poster Presentation, CATSA 2016 Conference, 06–09 November 2016. Champagne Sports Resort, Drakensburg, KwaZulu-Natal Province, South Africa.
35. **Tlhabane D & Marape G.** The recovery of chrome from spiral tailing dumps. 35th International Geological Congress, 27 Aug – 4 Sep 2016. Cape Town, Western Cape Province, South Africa.
36. **Van Schalkwyk F & Pattrick G.** Structurally engineered nano PtCo cathode catalyst material for H₂ fuelled PEMFCs, 27th Annual Conference of the Catalysis Society of South Africa, CATSA 2016. 6-9 November 2016, Central Drakensberg, KwaZulu-Natal Province, South Africa.

Oral Presentations

1. **Ball M & Masikhwa S.** Mineralogical analysis of MG 1, 2 and 3 seams at Thaba Mine. AMREP workshop, 9th February 2017. Hannover, Germany.
2. **Baloyi J, Ntho T & Ngqalakwezi A.** 1st Africa Energy Materials (AEM-2017) conference. 1st Africa Energy Materials (AEM-2017) Conference, 28-31 March 2017, CSIR International Conference Centre, Pretoria. Gauteng Province, South Africa.
3. **Baloyi H, Phillpotts D & Russell A.** Development of control system for spirals. Southern African Institute of Mining and Metallurgy. The 10th International Heavy Minerals Conference, 16–17 August 2016. Sun City, North West Province, South Africa.
4. **Bambo M.** TEM Use at Mintek. Proceedings of the Microscopy Society of Southern Africa Conference 2016. 5- 8 December 2016, Boardwalk Convention Centre, Port Elizabeth, Eastern Cape Province, South Africa.
5. **Banda W, Steenkamp J & Matinde E.** Chemical wear of carbon and silicon carbide-based refractory materials by silicomanganese metal. 11th European Electric Steelmaking Conference & Expo. 25-27 May 2016. Venice, Italy.
6. **Banda W & Lagendijk H.** Manganese slag valorisation. The 2nd School on Manganese Ferroalloy Production, 27–28 June 2016, Mintek, Johannesburg, Gauteng Province, South Africa.
7. **Bazhko O.** Evaluation of ozonation technology for gold recovery. SAIMM, Hydrometallurgy Conference 2016. 'Sustainable Hydrometallurgical Extraction of Metals'. 1 - 3 August 2016 Conference Belmont Mount Nelson Hotel, Cape Town, Western Cape, South Africa.
8. **Bergmann C.** MMMA Reflux Presentation. MMA Central District Regional Meeting. 13

- May 2016. Mintek, Johannesburg, Gauteng Province, South Africa.
9. **Bergmann C.** Eurasian Resources group visit. SAIMM. 3rd Young Professionals Conference 2017. Unlocking the Future of the African Minerals Industry. Vision 2040. 9-10 March 2017, Innovation Hub, Pretoria, Gauteng Province, South Africa.
 10. **Bisaka K, Thobadi I & Goso X.** Pre-reduction and DC open-arc smelting of carbon based ilmenite pellets. SAIMM. The 10th International Heavy Minerals Conference "Expanding the horizon". 16-17 August 2016. Sun City, North West Province, South Africa.
 11. **Brill S & Carelse C.** Physical and Chemical Characteristics of Nine Diamond Parcels from the Central African Republic – Is Source Discrimination Possible? 35th International Geological Congress. 27th August – 2 September 2016. Cape Town, Western Cape, South Africa.
 12. **Brill S.** Major and trace element characteristics in minerals: applications in conflict mineral and element deportment studies. Mineralogy Division Open Day 20 May 2016, Mintek, Johannesburg, Gauteng Province, South Africa.
 13. **Chetty D.** Tomography: applications in process mineralogy. Mineralogy Division Open Day 20 May 2016, Mintek, Johannesburg, Gauteng Province, South Africa.
 14. **Chetty D.** Applied mineralogy for the responsible utilisation of natural resources. 35th International Geological Congress. 29 August-2 September 2016. Cape Town, Western Cape Province, South Africa.
 15. **Chetty D, Clark W, Bisaka K & Thobadi I.** Process Mineralogy 2017 conference presentation. MEI Process Mineralogy 2017. 20-22 March 2017, Cape Town, Western Cape Province, South Africa.
 16. **Chetty D.** Mineralogy as a tool for smelting optimisation of Kalahari Manganese Ores. SAIMM 2nd School on Manganese Ferroalloy production 27-28 June 2016. Mintek, Johannesburg, Gauteng Province South Africa.
 17. **Chetty D.** AMREP - Mintek overview 2016 - 17AMREP Workshop, 9-10 February 2017 BGR, Hannover, Germany.
 18. **Coetzee L.** Using Automodeller on Pilanesberg Platinum Mine Primary UG2 Milling Circuit. 17th IFAC Symposium on Control, Optimization and Automation in Mining, Mineral and Metal Processing (MMM), August 31 – September 2, 2016, Vienna, Austria.
 19. **Coetzee L.** Applying StarCS RNMPC with Real-Time Optimiser to Pilanesberg Platinum Mines Primary UG2 Milling Circuit. 17th IFAC Symposium on Control, Optimization and Automation in Mining, Mineral and Metal Processing (MMM), August 31 – September 2, 2016, Vienna, Austria.
 20. **Couperthwaite R & Mwamba.** A Cold Spray Coating of an Fe 40 at. % Al Alloy with additions of Ru. Journal of the Southern African Institute of Mining and Metallurgy (SAIMM), pp. 927-934.
 21. **Craven P.** South African mining waste: resource or curse? EU-Advanced Mining Countries RMD event 2016 - Exchange of Best Practices on Mining Policies and Technologies, Brussels, 28-29 June 2016.
 22. **Craven P.** Our View on Minerals Technology Innovation. Annual Deloitte Global Mining Summit, 10 May 2016, Michelangelo Hotel, Sandton Square, Johannesburg, Gauteng Province.
 23. **Erwee M & Reynolds Q.** Getting to grips with simulating oxygen lancing of pyrometallurgical furnace tap-holes. CHPC National Meeting 2016: 10th Annual Conference on High Performance Computing, 5-9 December 2016. East London International Conference Centre, East London, Eastern Cape, South Africa.
 24. **Erwee M & Reynolds Q.** Computational multiphase flow modelling and dimensional analysis study of oxygen lancing of pyrometallurgical furnaces. SACAM 2016. 10th South African Annual conference on Computational and Applied Mechanics organised by the Faculty of Engineering, 3-5 October 2016. North-West University, Potchefstroom, North West Province, South Africa.
 25. **Erwee M & Geldenhuys I.** Exploring options for boron minerals in pyrometallurgical processes: chromite smelting. The 10th International Conference on Molten Slags, Fluxes and Salts, May 22-25, 2016. Grand Hyatt Seattle, Seattle, Washington, USA.
 26. **Ford E & Mudau P.** Through put Improvement in Ball Mill Circuit Using Fine Screening Technology. MMA Central District Regional Meeting. 13 May 2016. Mintek, Johannesburg, Gauteng Province, South Africa.
 27. **Geldenhuys I.** Metal Recovery using DC arc furnaces. 4th By-Product Metals Conference, 15-17 June 2016, Wroclaw, Poland.
 28. **Gericke M.** EWIT: Findings from the Johannesburg case study. EWIT: E-waste Implementation Toolkit Dissemination Workshop, Wastecon 2016 Conference, 19th October 2016. Emperors Place, Johannesburg, Gauteng Province, South Africa.
 29. **Gericke M.** Reflections on Mintek's participation in EUREKA. EUREKA-South Africa (ESASTAP) Workshop, Innovation Hub, Pretoria, 12 December 2016.
 30. **Gericke M.** Development of an e-waste implementation toolkit (EWIT) to support the recycling and secondary raw material recovery strategies in metropolitan areas in Africa. 35th International Geological Congress, 27 August - 2 September 2016, Cape Town, South Africa.
 31. **Goso X.** Review of liquidus surface and

- phase equilibria in $\text{TiO}_2\text{-SiO}_2\text{-Al}_2\text{O}_3\text{-MgO-CaO}$ slag system at Po_2 applicable in fluxed titaniferous magnetite. The 10th International Conference on Molten Slags, Fluxes and Salts, May 22-25, 2016 Grand Hyatt Seattle, Seattle, Washington, USA.
32. **Goso X, Lagendijk H & Erwee M.** Indicative vanadium deportment in the processing of titaniferous magnetite by the roast-leach and electric furnace smelting processes. SAIMM. Hydrometallurgy Conference 2016. 'Sustainable Hydrometallurgical Extraction of Metals'. 1 - 3 August 2016. Belmont Mount Nelson Hotel, Cape Town, Western Cape, South Africa.
 33. **Goso X & Bisaka K.** Scoping Study of the Upgrading of Fluxed and Fluxless Titaniferous Magnetite Slags using the Upgraded Slag Process. SAIMM. Hydrometallurgy Conference 2016. 'Sustainable Hydrometallurgical Extraction of Metals'. 1 - 3 August 2016. Belmont Mount Nelson Hotel, Cape Town, Western Cape, South Africa.
 34. **Govender G, Bushell C & Bazhko O.** SAIMM Mine Safe presentation. 31st August- 1st September 2016. Emperors Palace Convention Centre, Johannesburg, Gauteng Province, South Africa.
 35. **Graham S.** Environmental Monitoring at Mintek. 6th Analytical Science Symposium 2016. Mintek, Johannesburg, Gauteng Province, South Africa.
 36. **Hockaday C.** Submerged-Arc Furnace Electrical Systems. SAIMM 2nd School of Manganese Ferroalloy Production, 27-28 June 2016, Mintek, Johannesburg, Gauteng Province, South Africa.
 37. **Hockaday L.** Solar thermal heat for the minerals processing industry. The 4th Annual STERG SolarPACES Symposium, University of Stellenbosch, 14-15 July 2016. Eastern Cape Province, South Africa.
 38. **Hockaday L.** Opportunities for Concentrated Solar Process Heat in the Minerals Processing Industry. SASEC 2016, 31 October to 2 November 2016, Stellenbosch.
 39. **Hockaday L & Kale A.** Crude TiCl_4 purification: A review of the current state of the art and future opportunities. SAIMM Heavy Minerals Conference 2016, 16 - 17 August 2016, Sun City. Northwest Province, South Africa.
 40. **Jones J.** Pyrometallurgy tests in mineral processing. "1st International Mineral Processing Activists Symposium" & 3rd Workshop of Iron Ore and Base Metals Processing. 25-26 October 2016, Karaj, Iran.
 41. **Jones R.** Some technologies developed at Mintek in South Africa. "1st International MinQuinn Mineral Processing Activists Symposium", 25-26 October 2016, Karaj, Iran.
 42. **Jonck J.** Mintek metallography training to NMMU for Wirsam. NMMU Olympus DSX 510 Training by Mintek. 20-21 September 2016. WIRSAM Offices, 1 King Edward Street, Newton Park, Port Elizabeth, Eastern Cape, South Africa.
 43. **Kabwika Bisaka K, Thobadi I & Goso X.** Pre-reduction and DC-open arc smelting of carbon based ilmenite pellets. 10th Heavy Minerals Conference 2016: "Expanding the horizon" 16-18 August 2016, Sun City, North West Province, South Africa.
 44. **Kapito A.** South African Minerals Research - Advanced Metals Initiative (AMI) Ferrous Metals Development Network (FMDN). 2016 Aerospace Materials for Extreme Environments. 9-13 May 2016. Arlington, VA.
 45. **King I.** New product development: emerging applications of PGMs. Russia and South African Conference Platinum Group Metals. May 2016. Moscow, Russia.
 46. **King I.** New developments aimed at improving the efficiency of PGM ore processing. The Russian and South African Conference: Platinum Group Metals. May 2016. Moscow, Russia.
 47. **Kruger L & McKenzie A.** Mintek - Your partner in unlocking mineral wealth. Investment Dialogue at Africa Down Under Mining Conference: Theme: driving competitiveness and ensuring growth and stability. 9 September, Origins Restaurant, Pan Pacific Hotel, Perth.
 48. **Lagendijk H, Bisaka K & Erwee M.** Solid-state Reduction of South African manganese and chromite ores: effect of an organic binder and B_2O_3 . COM 2016. IMPC (XXVII International Mineral Processing Congress), 11-15 September 2016, Quebec City, Canada.
 49. **Legoale T.** Phytomining: the use of wheat as a hyperaccumulator, pot trials on gold tailings as a substrate. 35th International Geological Congress, 28th August- 2nd September 2016. Cape Town, Western Cape Province, South Africa. South Africa.
 50. **Legoale T.** Gold phytomining as an option for small scale miners. IAIASA Conference, 15-19 August 2016. Port Elizabeth, Eastern Cape Province, South Africa.
 51. **Lydall M.** Mintek overview and potential opportunities for R&D collaboration. China International Technology Transfer Convention. 18 November 2016. Heibei Meeting, Shijiazhuang.
 52. **Mabeba A, Jonck J & Moema J.** The use of vanadium carbides to produce a wear and impact resistant alloy for grinding balls. Ferrous and Base Metals Development Network Conference 2016, 19-21 October 2016, Southern Sun Elangeni Maharani Hotel, Durban, KwaZulu-Natal Province, South Africa.
 53. **Mahumapelo P.** Technical evaluation of coal mined by Small Micro and Medium Enterprises. 35th International Geological Congress. 27 August - 4 August September. Cape Town, Western Cape Province, South Africa.
 54. **Mampuru L & Moema J.** Grain refinement of

- high-chromium white cast iron by addition of vanadium. SAIMM: Ferrous and base metals development network conference 2016. 19 - 21 October 2016. KwaZulu -Natal Province, South Africa.
55. **Mampuru L & Moema J.** Effect of Niobium on the solidification structure and properties of hypoeutectic HCWCI. SAIMM: Ferrous and base metals development network conference 2016. 19 - 21 October 2016. KwaZulu -Natal Province, South Africa.
 56. **Makhafola M.** Mintek as a Strategic Partner in Advanced Materials Innovation – TAMU. International Forum: Multifunctional Materials Systems in Extreme Environments. 2-3 May 2017. Texas A & M University, Texas, USA.
 57. **Makhafola M.** Mintek as a Strategic Partner in Advanced Materials Innovation. International Conference on Advanced Manufacturing 2016. 5 - 6 May 2016. Virginia Tech Research Centre, Arlington, VA.
 58. **Makhafola M & Jordan D.** Cynoprobe on-line, in process cyanide analyser. 7th International Conference & Exhibition on Analytical & Bioanalytical Techniques, September 28 - 30, 2016 Orlando, USA.
 59. **Maphutha P, Sitefane M & Goso X.** The Effect of Magnesia and Alumina Crucible Wear on the Smelting Characteristics of Titaniferous Magnetite. 3rd Young Professional Conference 9-10 March 2017 Innovation Hub, Pretoria, Gauteng Province, South Africa.
 60. **Masia N.** Metallurgical analysis of various welded stainless steel grade plates. Stainless Steel and the Fight against Corrosion Seminar. 22 June 2016. Johannesburg, Gauteng Province, South Africa.
 61. **Masia N, Smit M & Moema J.** Corrosion study using various techniques to measure the corrosivity of sulphate-reducing bacteria. . SAIMM: Ferrous and base metals development network conference 2016. 19 - 21 October 2016. KwaZulu -Natal Province, South Africa.
 62. **Maumela M, Siyasiya CW & Stumpf WE.** The effect of cast structures on texture, surface roughness and formability in AISI 433 ferritic stainless steel. Proceedings of the Microscopy Society of Southern Africa (MSSA). VOL 46 (5-8), 5th - 9th December 2016. Nelson Mandela Metropolitan University, Boardwalk Convention Centre in Port Elizabeth, Eastern Cape Province, South Africa.
 63. **Mathebula S & Makhalemele N.** Mintek's experience on sorting Witwatersrand ore samples using the Rados XRF sorter. SAIMM Young Professionals Conference, 9 - 10 March 2017, Innovation Hub Pretoria, Gauteng Province, South Africa.
 64. **McKenzie A.** Mintek's Mineral Technologies. South Africa Investment Seminar: "Driving competitiveness and ensuring growth and stability". September 2016. China Mining International Convention Centre.
 65. **Modiga A, Rasmeni S & Auchterlonie A.** Market development and support for the SMMEs based in the Northern Cape Province. 35th International Geological Congress, 27 August - 04 September 2016. Cape Town, South Africa.
 66. **Moeletsi R.** Mineral opportunities in the Eastern Cape Province. Eastern Cape Development Corporation Mining Seminar. Queenstown, Eastern Cape Province, South Africa.
 67. **Moema J.** Technical Foundry Intervention Visit to Ghana. 11 September – 17 September 2016. Ghana, West Africa.
 68. **Mokoena K, Moema J & Jonck J.** Effect of zinc equivalent and heat treatment on the mechanical properties of high strength yellow brass. 06 May 2016, Virginia Tech Research Center – Arlington, VA.
 69. **Mokoena S.** Magnesium hydroxide recycle using elutriation. SAIMM. Hydrometallurgy Conference 2016. 'Sustainable Hydrometallurgical Extraction of Metals'. 1 - 3 August 2016 Conference Belmont Mount Nelson Hotel, Cape Town.
 70. **Mothupi T.** Geometallurgical characteristics of PGMs in the Western Bushveld chromitite layers. Mineralogy Division Open Day. Mintek, 20th May 2016. Mintek, Johannesburg, Gauteng Province, South Africa.
 71. **Morudu V, Mulaudzi M & Moema J.** Influence of Temperature on the Metal Dusting of Alloy 800. SAIMM: Ferrous and base metals development network conference 2016. 19- 21 October 2016. KwaZulu -Natal Province, South Africa.
 72. **Morudu V.** Sour-service corrosion (HIC & SSC) susceptibility testing of carbon and low alloy steels using the testing at Mintek. African Corrosion Congress. 25 - 26 July 2016. Midrand, Johannesburg, South Africa.
 73. **Mothupi T.** Platinum Group Minerals in Oxidised Chromitite Layers and Their Behaviour during Chromite Concentration: A Process Mineralogy Approach. 35th International Geological Congress. 27 August – 4 September 2016. Cape Town, Western Cape, South Africa.
 74. **Motsweni V, Smit M & Mwamba IA.** Cathodic modification of 316L steel weld with minor ruthenium additions, Proceeding of the Ferrous (FMDN)Conference 2016, 19- 21 October 2016 · Southern Sun Elangeni Maharani, Durban, Kwa Zulu Natal Province, South Africa. pp. 239-243.
 75. **Muchindu M.** DST/Mintek Nanotechnology Innovation Centre Possible Areas of Collaboration. Joint South Africa-Madagascar Workshop to Implement Plan of Action on Bilateral Cooperation. 13 - 15 June 2016. Antananarivo, Madagascar.
 76. **Mulaudzi M, Kantwela S, Moema J & Papo J.** On the performance of coated type 304 stainless steel to combat metal dusting

- corrosion in the petrochemical Environment. International Forum: Multifunctional Materials Systems in Extreme Environments. 2 - 3 May 2017. Texas A & M University, Texas, USA.
77. **Mulaudzi M.** FMDN Metal Dusting. The Effect of Metal Dusting on Mild Steel and Stainless Steel Grade 304. SASSDA, Stainless Steel and the Fight against Corrosion, 22 June 2016.
 78. Glenhove Conference Centre, Johannesburg, Gauteng Province, South Africa.
 79. **Mwamba A & Papo J.** an Overview: Platinum-Based Super-Alloys as Coating Material for Materials Operating in Extreme Environments. International Forum: Multifunctional Material Systems in Extreme Environments. 2-3 May 2016. Texas A & M University College Station, Texas, USA.
 80. **Ndwandwe T, Smit M & Moema J.** Simplified Technology for Erosion Resistance Testing of Materials Used in Slurry Handling Equipment. African Corrosion Congress. 25 - 29 July 2016. Midrand Conference Centre Johannesburg, South Africa.
 81. **Neale J.** The Mondo Minerals Nickel Sulfide Bioleach Project: construction, commissioning and early plant operation (presentation to ALTA 2016 Conference). ALTA 2016 Conference, 23 -27 May 2016, Perth, Australia.
 82. **Neale J.** Mining Biotechnology - 35 years of progress. (Presentation to Workshop on Biotechnology and Emerging Technologies in Mining). 31 March 2017. Rainbow Towers Hotel, Harare, Zimbabwe.
 83. **Neal J.** Process Test Work (presentation to SAIMM Hydrometallurgy Conference 2016 Workshop). SAIMM Hydrometallurgy Conference 2016 Workshop. 31 July 2016, Belmond Mount Nelson Hotel, Cape Town, Western Cape Province, South Africa.
 84. **Negota N, Rasmeni S, Mogoru J & Chetty D.** Physical and mineralogical characterisation of asbestos mine sites in preparation for rehabilitation. 35th International Geological Congress. 27 August-4 September 2016. Cape Town, Western Cape, South Africa.
 85. **Nkosi S, Nyambeni, N & Goso X.** A comparative study of vanadium recovery from titaniferous magnetite using salt, sulphate and soda ash roast-leach process 3rd Young Professional Conference 9-10 March 2017 Innovation Hub, Pretoria, Gauteng Province, South Africa.
 86. **Ntho T, Moma J, Scurrrell M & Franklyn P.** Gold catalysed reactions. CATSA 2016 Conference. 06 - 09 November 2016. Drakensberg, South Africa,
 87. **Nyamane N.** The Mineralogy Division. Mineralogy Division Open Day 20 May 2016. Mineralogy Division Open Day 20 May 2016, Mintek, Johannesburg, Gauteng Province, South Africa.
 88. **Nyembe S & Sikhwivhilu L.** Sorption of CO and CH₄ gases on the surface of indium phosphide nanowires. 6th International Conference on Nanoscience and Nanotechnology. 3 - 6 April 2016. University of South Africa, Johannesburg, South Africa.
 89. **Nyembe S & Sikhwivhilu L.** Interaction of CO with indium phosphide nanowires: optimization of gas sensor. (Presentation) 6th Annual Gauteng Nanosciences Young Researcher's Symposium (NYRS). 18 November 2016. Mintek, Gauteng Province, South Africa.
 90. **Nyembe S, Sikhwivhilu L, Ntho T, & Shumbula P.** Adsorption of Nitrous oxide, Carbon monoxide and Methane gases on the Surface of Indium Phosphide Nanowires and their electron transport. 7th World Nano Conference, 20 - 21 June 2016. Cape Town, Western Cape Province, South Africa.
 91. **Papo J.** Mintek_Tema Steel_Wafor Technical Visit: AMD Overview. 13th September 2016. Mintek, Randburg, Gauteng Province, South Africa.
 92. **Papo J.** Corrosion and mechanical behaviour of typical rail axle steels in water. African Corrosion Congress. 25-26 July. Corrosion School/Workshop, 27- 29 July 2016. Midrand, Gauteng Province, South Africa.
 93. **Reynolds Q.** Computational modelling of arc-slag interaction in DC furnaces. CHPC National Meeting 2016: 10th Annual Conference on High Performance Computing, 5 - 9 December 2016 East London International Conference Centre, East London, Eastern Cape, South Africa.
 94. **Patrick G & Papo J.** Development and Scale up of Enhanced Oxygen Reduction Reaction (ORR) Pt-based Catalysis for Proton Exchange Membrane (PEM) Fuel Cells. International Conference on Advanced Manufacturing 2016. 5-6 May 2016. Virginia Tech Research Centre, Arlington, VA.
 95. **Pillay S & Mottay R.** Karoo Sandstone Uranium Deposit: to Float or Not to Float? Presentation of Roxanne Naidoo. ALTA 2016. ALTA 2016 Conference. Nickel-Cobalt-Copper, Uranium-REE and Gold-PM Conference & Exhibition. 21 -28 May 2016. Perth, Australia.
 96. **Rashamuse JT & Coyanis M.** Synthesis of diaryl-imidazole-4-carboxylic acid analogues and their biological evaluation as inhibitors of LEDGF/p75 and HIV_1 integrase (IN) interactions. Rhodes Frank Warren Conference (4th - 8th December 2016). Rhode University, Grahamstown, eastern Cape Province, South Africa.
 97. **Rasmeni S, Moeletsi R, Sebola P & Legoale T.** Mining and Beneficiation Potential of the Semi-Precious Gemstone Resources in the Northern Cape Province of South Africa. 35th International Geological Congress. 27 August - 4 September 2016. Cape Town, Western Cape, South Africa.
 98. **Rasmeni S, Ball M & Negota N.** Mineralogical assessment of abandoned asbestos mine

- sites along the Orange River in the Northern Cape Province of South Africa. 2nd European Mineralogical Conference. 11th - 15 September 2016, Rimini, Italy.
- 99.**Rasmeni S.** The Role of mineralogy during asbestos mine rehabilitation. Mineralogy Division Open Day. 20 May 2016. Mintek, Johannesburg, Gauteng Province, South Africa.
- 100.**Reynolds Q.** Virtual prototyping of the Minfurn carbon regeneration furnace. SAIMM New Technology and innovation in the Minerals Industry Colloquium. Driving mining and metallurgical productivity improvement through technology and innovation. 9 – 10 June 2016 Emperors Palace, Johannesburg, Gauteng Province, South Africa.
- 101.**Reynolds Q.** Slag-Metal Settling and Separation Phenomena. Presented at SAIMM 2nd School on Manganese Ferroalloy Production, 27 - 28 June 2016, Johannesburg (South Africa), Gauteng Province, South Africa.
- 102.**Reynolds Q & Erwee M.** Computational modelling of slag foaming in pyrometallurgical furnaces. SACAM 2016. 10th South African conference on Computational and Applied Mechanics hosted by the Faculty of Engineering, North-West University, Potchefstroom, 3 - 5 October 2016.
- 103.**Reynolds Q.** CHPC PETASCALE system launch: multiphysics CFD on Lengau. Launch: CHPC High Performance Computing System. 7 June 2016, CHPC, Rosebank, Cape Town.
- 104.**Jones R, Erwee M & Reynolds Q.** Some approaches to slag resistivity. The 10th International Conference on Molten Slags, Fluxes and Salts, May 22 - 25, Grand Hyatt Seattle, Seattle, Washington, USA.
- 105.**Sebola P.** ICG35 01 Sept 2016. 35th International Geological Congress. 27 August – 4 September 2016. Cape Town, Western Cape, South Africa.
- 106.**Sikhwivhilu L.** Iron based metal organic framework as an effective lead ions (Pb2+) remover from aqueous solution: Thermodynamic and kinetics studies. 5th International Symposium on Energy Challenges and Mechanics - working on small scale, 10 - 14 July 2016, Inverness, Scotland, UK.
- 107.**Sikhwivhilu K.** The DST/Mintek Nanotechnology Innovation Centre Water Unit: Past, Present and Future Requirements. DST/Mintek NIC Water Unit Nodes' Meeting, 22 February 2017, University of Johannesburg, Doornfontein, Johannesburg, Gauteng Province, South Africa.
- 108.**Sikhwivhilu K.** Water Nanotechnology Unit: Overview. 7th annual DST/Mintek Nanotechnology Innovation Centre Workshop, SA Medical Research Council, Cape Town, 25 -26 January 2017. South Africa.
- 109.**Sikhwivhilu L.** Mintek's role in supporting nanotechnology and nanoscience in South Africa. DST/NRF Symposium, 27 - 28 June 2016, CSIR International Convention Centre, Pretoria, Gauteng Province, South Africa.
- 110.**Sikhwivhilu L.** NIC R&D Progress Report for 2016/17: half year. DST/Mintek NIC Steering Committee meeting, Medical Research Council, Cape Town, 24 January 2017, Western Cape, South Africa.
- 111.**Sikhwivhilu L.** NIC R&D Progress overview 2016/17. 7th Annual DST/Mintek Nanotechnology Innovation Centre Workshop, Medical Research Council, 25 - 26 January 2017, Cape Town, Western Cape Province, South Africa.
- 112.**Sikhwivhilu L.** What Nanomaterials can be synthesized at Mintek? Hazard identification of nanomaterials, Workshop organised by NIOH, Faircity Quatermain Hotel, Sandton, Johannesburg, Gauteng Province South Africa.
- 113.**Sikhwivhilu L.** Water Nanotechnology Unit: Overview. Water Research Workshop. CSIR, Pretoria, Gauteng Province South Africa.
- 114.**Sikhwivhilu L.** Fabrication of nanominerals and nanoparticles for the development of nanodevices. All Africa Congress on Pharmacology and Pharmacy. 5 - 7 October 2016, Misty Hills Hotel Conference Centre, Gauteng Province, South Africa.
- 115.**Sikhwivhilu L.** Functional nanomaterials for diagnostics and sensing applications. AFOSR Life Sciences Programme Review - Dayton, Ohio, USA.
- 116.**Sikhwivhilu L.** Functional nanomaterials for diagnostics and sensing applications. University of Dayton, October 31 – 4 November 2016. Dayton, OH.
- 117.**Sikhwivhilu K.** Recent Advances in Nanotechnology for the Water Sector. Skills drought in the Water sector: an NSTF Discussion Forum. 26 - 27 September 2016. Kempton Park, Gauteng Province, South Africa.
- 118.**Singh N.** Climate change and biodiversity: possible impacts of small scale mining activities in South Africa. 2nd UNIVEN-WSU International Research Conference, 5 - 7 October 2016. The Ranch, Polokwane, Limpopo Province, South Africa.
- 119.**Sithole A.** Overview of manganese ferroalloy production. The 2nd School on Manganese Ferroalloy Production, 27 – 28 June 2016, Mintek, Johannesburg, Gauteng Province, South Africa.
- 120.**Sithole G.** Role of chemical analysis in Mineral Processing. 1st International Mineral Processing Activists Symposium & 3rd Workshop of Iron Ore and Base Metals Processing. 25 - 26 October 2016. Iran.
- 121.**Skepu A.** Biolabels Unit Overview. 7th Annual DST/MINTEK NIC Workshop. SA Medical Research Council, 25-26 January 2017. Cape Town, South Africa.
- 122.**Smit S & Magaxeni Z.** Novel cost effective

method for measuring carbon activity. 4th International Conference on Heap Leach Solutions 18 - 20 October 2016, Lima, Peru.

123. **Sosibo N.** Minerals-Based Community Development Projects. 63rd Annual National Mine Safety and Environmental Conference, Baguio City, Philippines.

124. **Steenkamp J.** Lining concepts in manganese ferroalloy. SAIMM. The 2nd School of on Manganese Ferroalloy Production. 27-28 June 2016. Mintek, Johannesburg, Gauteng Province, South Africa.

125. **Steenkamp J.** Working towards an increase in manganese ferroalloy production in South Africa - A research agenda 2016. 10th anniversary of the SiManTi-seminars, 12th - 13th September 2016. Oxford, England.

126. **Steenkamp J, Denton G & Hayman D.** Ferrochromium production: insulating or conductive lining designs. TMS 2017. 26 February - 2 March 2017. San Diego, California, USA.

127. **Strauss J.** Arsenic during pressure oxidation of refractory gold ores and its behaviour during downstream processing. ALTA 2016 Conference. Nickel-Cobalt-Copper, Uranium-REE and Gold-PM Conference & Exhibition. 21 -28 May 2016. Perth, Australia.

128. **Thobadi I.** Overview of manganese ferroalloy production in Southern Africa: Trans alloys. SAIMM. The 2nd School of on Manganese Ferroalloy Production. 27 - 28 June 2016. Mintek, Johannesburg, Gauteng Province, South Africa.

129. **Thobadi I, Bisaka K & Pawlik C.** Extraction of rare earths from iron rich rare-earth deposits. SAIMM Hydrometallurgy Conference 2016, 1 - 3 August 2016, Mount Nelson Hotel & Conference Centre, Cape Town, Western Cape Province, South Africa.

130. **Van Staden P, Petersen J A & Phreeq C.** Model of Heap Leaching. SAIMM Hydro-

metallurgy Conference 2016, Sustainable Hydrometallurgical Extraction of Metals, 1 - 3 August Belmont Mount Nelson Hotel, Cape Town, Western Cape Province, South Africa.

131. **Van Staden P & Phreeq C.** A Model of heap leaching. SAIMM Hydrometallurgy Conference 2016, Sustainable Hydrometallurgical Extraction of Metals, 1 - 3 August Belmont Mount Nelson Hotel, Cape Town, Western Cape Province, South Africa.

132. **Van Staden P.** New mining concept for extracting metals from deep ore deposits using Biotechnology. 04 October 2016. South Africa (SA)-European Union (EU) Marine and Polar Research Collaborations Workshop, 04 October 2016. Cullinan Hotel, Cape Town, South Africa.

133. **Van Rooyen M.** Acid mine drainage water treatment using the SAVMIN™ process. SAIMM. Hydrometallurgy Conference 2016. 'Sustainable Hydrometallurgical Extraction of Metals'. 1 - 3 August 2016 Conference| Belmont Mount Nelson Hotel, Cape Town, Western Cape, South Africa.

134. **Vilakazi S.** Sensor overview. Electrochemistry Workshop. 15 March 2017. Mintek, Johannesburg, Gauteng Province, South Africa.

135. **Vilakazi S.** Sensor nanotechnology overview. 7th Annual DST/Mintek Nanotechnology Innovation Centre, 25 - 26 January 2017. University of the Western Cape, SA Medical Research Council, Western Cape, South Africa.

136. **Yahorava O.** Status of REE activity at Mintek. Presentation to CanMet and CREEN (Canadian REE network) on Mintek REE activities at IMPC2016. 15 September 2016. Québec, Canada.

137. **Yahorava, O.** Viability of phosphogypsum as a secondary resource of rare earth elements. IMPC 2016: XXVIII International

Mineral Processing Congress Proceedings. September 11 - 15, Québec City Convention Center, Canada.

Conference Papers

1. **Baloyi H, Russell A & Phillpotts D.** Measurement of the variability of mineral band position on gravity spiral concentrator with a view to process control. The Southern African Institute of Mining and Metallurgy. The Tenth International Heavy Minerals Conference. 16 - 17 August 2016, Sun City, North West Province, South Africa. pp. 143 - 158.
2. **Banda W & Steenkamp J.** Chemical wear of carbon and silicon carbide-based refractory materials by silicomanganese metal. 11th European Electric Steelmaking Conference & Expo. 25 - 27 May 2016 Venice (Italy).
3. **Bazhko O & Yahorava O.** Evaluation of ozonation technology for gold recovery. SAIMM. Hydrometallurgy Conference 2016, Sustainable Hydrometallurgical Extraction of Metals, 1- 3 August Belmont Mount Nelson Hotel, Cape Town, South Africa.
4. **Bazhko O & Yahorava O.** Viability of phosphogypsum as a secondary resource of rare earth elements. IMPC 2016: XXVIII International Mineral Processing Congress Proceedings - ISBN: 978-1-926872-29-2 Published by the Canadian Institute of Mining, Metallurgy and Petroleum.
5. **Bisaka K & Erwee M.** Solid-state reduction of South African manganese and chromite ores: effect of an organic binder and B₂O₃. COM 2016 (Conference of Metallurgists) hosted with the IMPC (XXVII International Mineral Processing Congress), 11 - 15 September 2016, Quebec City, Canada. ISBN: 987-1-926872-29-2. pp 1-16 of "Pyrometallurgy II" section. Process Developments for Recovery of Uranium and Molybdenum in Karoo. 21 - 28 May 2016, Australia, 236-252.

6. **Bisaka K, Thobadi I & Pawlik C.** Extraction of rare-earths from iron-rich rare-earth deposits. Hydrometallurgy Conference 2016: Sustainable Hydrometallurgical Extraction of Metals, 1 - 3 August 2016. Cape Town, Western Cape Province, South Africa.
7. **Coetzee L.** Applying StarCS RNMPIC with real-time optimiser to Pilanesberg Platinum Mines Primary UG2 Milling Circuit. 17th IFAC Symposium on Control, Optimization and Automation in Mining, Mineral and Metal Processing (MMM), August 31 – 2 September, 2016, Vienna, Austria.
8. **Coetzee L.** Using StarCS Automodeller to model Pilanesberg Platinum Mine Primary UG2 milling circuit. 17th IFAC Symposium on Control, Optimization and Automation in Mining, Mineral and Metal Processing (MMM), August 31 – 2 September, 2016, Vienna, Austria.
9. **Couperthwaite R, Cornish A. & Mwamba A.** Cold-spray coating of an Fe-40 at.% Al alloy with additions of ruthenium”, AMI Ferrous and Base Metals Development Network Conference, 19-21 October 2016, Durban
10. **Erwee M, & Reynolds Q.** Computational multiphase flow modelling and dimensional analysis study of oxygen lancing of pyrometallurgical furnaces. SACAM 2016. 10th South African Annual conference on Computational and Applied Mechanics organised by the Faculty of Engineering, North-West University, Potchefstroom, 3-5 October 2016. North West Province South Africa.
11. **Ford E, Mudau P, Hinde A, Jain A & Barkhuysen N.** Evaluating the potential for throughput improvement associated with adopting Derrick fine screening technology in a PGM slag ball milling circuit. Comminution 2016 Conference, Cape Town, South Africa.
12. **Geldenhuys I.** The exact art subtle science of DC. The Journal of the Minerals, Metals & Materials Society. November 2016.
13. **Gericke M.** Proceedings SUM2016, Third Symposium on Urban Mining and Circular Economy, 23 - 25 May 2016, Old Monastery of St. Augustine, Bergamo, Italy.
14. **Goso X.** Review of liquidus surface and phase equilibria in TiO_2 - SiO_2 - Al_2O_3 - MgO - CaO slag system at Po2 applicable in fluxed titaniferous magnetite. The 10th International Conference on Molten Slags, Fluxes and Salts, May 22-25, 2016. Grand Hyatt Seattle, Seattle, Washington, USA.
15. **Goso X & Bisaka K.** Scoping study of the upgrading of fluxed and fluxless titaniferous magnetite slags using the upgraded slag process. Hydrometallurgy Conference 2016: Sustainable Hydrometallurgical Extraction of Metals, 1-3 August 2016. Cape Town, Western Cape Province, South Africa.
16. **Goso X, Lagendijk H & Erwee M.** Indicative vanadium deportment in the processing of titaniferous magnetite by the roast-leach and electric furnace smelting processes. Hydrometallurgy Conference 2016: Sustainable Hydrometallurgical Extraction of Metals, 1-3 August 2016. Cape Town, Western Cape Province, South Africa.
17. **Hockaday L, Dinter F & Harms T.** Opportunities for concentrated solar process heat in the minerals processing industry. SASEC 2016, 31 October to 2 November 2016. Stellenbosch, South Africa.
18. **Hockaday L & Kale A.** Crude TiCl_4 purification: a review of the current state of the art. Southern African Institute of Mining and Metallurgy. The Tenth International Heavy Minerals Conference Sun City, 16 – 17 August 2016. Sun City, North West Province, South Africa. pp 63-74.
19. **Jonck J & Moema J.** Investigation of the ‘tiger skin’ defect on indefinite chill rolls. Ferrous 2016. SAIMM: Ferrous and base metals development network conference 2016. 19 -21 October 2016. KwaZulu-Natal Province, South Africa.
20. **Langa S.** Determination of thorium and uranium in urine by ICP-MS. 6th Mintek Analytical Symposium. The Environment. 21st October 2016. Mintek, Johannesburg, Gauteng Province, South Africa.
21. **Mabeba A, Jonck J & Moema J.** The use of vanadium carbide in an impact-resistant alloy for grinding balls. SAIMM: Ferrous and base metals development network conference 2016. 19 - 21 October 2016. KwaZulu-Natal Province, South Africa.
22. **Makamu S.** Guidelines for Retreatment of SA gold tailings: MINTEK’s learnings, WasteCon 2016 Emperors Palace 17 - 21 October 2016.
23. **Mampuru L, Maruma G, & Moema J.** Grain refinement of 25 wt% high-chromium white cast iron by addition of vanadium. SAIMM: Ferrous and base metals development network conference 2016. 19 - 21 October 2016. KwaZulu-Natal Province, South Africa.
24. **Maphutha P, Sitefane M & Goso X.** The effect of magnesia and alumina crucible wear on the smelting characteristics of titaniferous magnetite. 3rd Young Professional Conference 9 - 10 March 2017. Innovation Hub, Pretoria, Gauteng Province, South Africa. pp. 157-168.
25. **Marandela M, Xaba N & Cornish L.** Measurement and monitoring of naphthenic acid corrosion in a crude oil refinery's crude distillation fired heaters. SAIMM: Ferrous and base metals development network conference 2016. 19 - 21 October 2016. KwaZulu-Natal Province, South Africa.
26. **Maruma G, Mampuru L & Moema J.** Effect of niobium on the solidification structure and properties of hypoeutectic high-chromium white cast irons. SAIMM: Ferrous and base metals development network conference 2016. 19 - 21 October 2016. KwaZulu -Natal Province, South Africa.

27. **Masia N, Smit M & Moema J.** Corrosion study using various techniques to measure the corrosivity of sulphate-reducing bacteria. SAIMM: Ferrous and base metals development network conference 2016. 19 - 21 October 2016. KwaZulu -Natal Province, South Africa.
28. **Maumela M.** The effect of cast structures on texture, surface roughness and formability in AISI 433 ferritic stainless steel. Proceedings of the Microscopy Society of Southern Africa (MSSA). VOL 46 (5-8), 5th - 9th December 2016. Nelson Mandela Metropolitan University, Boardwalk Convention Centre in Port Elizabeth, Eastern Cape Province, South Africa. pp. 20.
29. **Moila A & Chetty D.** The Application of process mineralogy on a tailings sample from a beach placer deposit containing Rare Earth Elements (REE). 3rd Young Professional Conference 9 - 10 March 2017 Innovation Hub, Pretoria, Gauteng Province, South Africa.
30. **Mokoena S & Pawlik C.** Demonstration of magnesium hydroxide recycle technology using an elutriation technique. Hydrometallurgical Extraction of Metals, 1 - 3 August 2016. Cape Town, Western Cape Province, South Africa.
31. **Morudu V, Smit M, Maruma & Moema J.** Hydrogen induced cracking (HIC) and SSCC susceptibility testing of pipeline alloys using Mintek test rig. African Corrosion Congress. 25 - 26 July 2016. Corrosion School/Workshop. Midrand, Gauteng Province, South Africa.
32. **Morudu V, Mulaudzi M & Moema J.** Influence of temperature on the metal dusting of Alloy 800. SAIMM: Ferrous and base metals development network conference 2016. 19 -21 October 2016. KwaZulu -Natal Province, South Africa.
33. **Mottay R, Bazhko O, Yahorava O & Pillay S.** Process development for the recovery of uranium and molybdenum in Karoo. ALTA Conference. 21 - 28 May 2016, Australia.
34. **Motsweni V, Smit M & Mwamba A.** Cathodic modification of 316L stainless steel welds with minor ruthenium addition. SAIMM: Ferrous and base metals development network conference 2016. 19 - 21 October 2016. KwaZulu -Natal Province, South Africa.
35. **Xaba N, Cornish L & Mulaudzi M.** Measurement and monitoring of naphthenic acid corrosion in a crude oil refinery's crude distillation fired heaters.SAIMM: Ferrous and base metals development network conference 2016. 19 - 21 October 2016. KwaZulu -Natal Province, South Africa.
36. **Ndwandwe T, Smit M & Moema J.** Simplified technology for erosion resistance testing of materials. African Corrosion Congress. 25-26 July Corrosion School. Midrand, Gauteng Province, South Africa.
37. **Neale J.** The Mondo Minerals Nickel Sulfide Bioleach Project: construction, commissioning and early plant operation. Proceedings of ALTA 2016 Nickel-Cobalt Copper Sessions. 23-25 May 2016. Perth, Australia.
38. **Nkosi S, Goso X & Nyambeni N.** A comparative study of vanadium recovery from titaniferous magnetite using salt, sulphate and soda ash roast-leach process. 3rd Young Professional Conference, 9 - 10 March 2017. Innovation Hub, Pretoria. pp. 191-200.
39. **Papo J, Klenam D E P, Jonck J, Chown, L.H & Cornish L.** A Fatigue of railway axle steels subjected to uniaxial tension fatigue tests. SAIMM: Ferrous and base metals development network conference 2016. 19 - 21 October 2016. KwaZulu-Natal Province, South Africa.
40. **Papo J, Smit M, Klenam D, Chown L & Cornish L.** Corrosion and Mechanical Behaviour of Typical Railway Axle Steels in Water. AfriCORR 2016 African Corrosion Congress. 25 - 29 July 2016. Midrand Conference Centre, Gauteng Province, South Africa.
41. **Pillay S.** Karoo sandstone uranium deposit: to float or not to float? ALTA 2016. 20 - 27 May 2016. Perth, Australia.
42. **Reynolds Q & Erwee M.** Computational modelling of slag foaming in pyrometallurgical furnaces. SACAM 2016. 10th South African conference on Computational and Applied Mechanics hosted by the Faculty of Engineering, North-West University, Potchefstroom, 3 - 5 October 2016.
43. **Sitefane M, Maphutha P & Goso X.** The effect of CaO to MgO ratio on the smelting characteristics of vanadium-bearing titaniferous magnetite. 3rd Young Professional Conference 9 - 10 March 2017 Innovation Hub, Pretoria, Gauteng Province, South Africa. pp. 467-480.
44. **Sithole P, Goso X & Lagendijk H.** Laboratory-scale sulphation roasting test work for copper and cobalt production. 3rd Young Professional Conference 9 - 10 March 2017 Innovation Hub, Pretoria, Gauteng Province, South Africa. pp. 485-497.
45. **Sithole V & Ford E.** Investigation into the effect of repeated and single particle impact on bond crushability work index measurement. Bond Crushability Work Index measurement. SAIMM. 3rd Young Professional Conference 9 - 10 March 2017 Innovation Hub, Pretoria, Gauteng Province, South Africa.
46. **Shumbula P, Nyembe S & Tetyana P.** Studies on the stability size and shape of copper nanoparticles. Proceedings of the Microscopy Society of South Africa Proceedings. 5-9 December 2016. Nelson Mandela Metropolitan University. Boardwalk Convention Centre in Port Elizabeth, Eastern Cape Province, South Africa.
47. **Shumbula P.** Capping gold selenide: formation of nanobelts. Proceedings of the Microscopy Society of South Africa Proceedings. 5-9

December 2016. Nelson Mandela Metropolitan University. Boardwalk Convention Centre in Port Elizabeth, Eastern Cape Province, South Africa.

48. **Smit S & Magaxeni Z.** Novel cost effective method for measuring carbon activity. 4th International Conference on Heap Leach Solutions 2016, October 18-20, 2016, Lima, Peru, page 81-91.
50. **Steenkamp J.** Identifying barriers faced by key role players in the South African Manganese industry. SAIE27 Proceedings: through the Looking Glass (Industrial Engineering South Africa Conference), 25th - 27th October 2016. Stonehenge, Free State Province, South Africa.
50. **Steenkamp J, Denton G & Hayman D.** Insulating or conductive lining designs for electric furnace smelting? Applications of process engineering principles in materials processing, energy and environmental technologies, an EPD Symposium in Honor of Professor Ramana G. Reddy (hosted as part of TMS 2017), February 26th to March 2nd 2017, pp. 209 – 220.
51. **Steenkamp J & Hockaday C.** Analysis of electrical energy dissipation in submerged-arc furnaces producing silicomanganese. 11th European Electric Steelmaking Conference and Expo. 25 - 27 May 2016, Venice (Italy).
52. **Sosibo N.** Technology support for small scale mining. Small scale mining conference. 7 September 2016. Polokwane, Limpopo Province, South Africa.
53. **Sosibo N, Nhlengethwa K & Ledwaba P.** When policy is not enough: prospects and challenges of artisanal and small scale mining in South Africa. Journal of Sustainable Development Law and Policy. vol 7 no. 1. pp. 25-42.
54. **Strauss J, Bazhko O & Yahorava O.** Arsenic during pressure oxidation of refractory

gold ores and its behaviour in downstream processing. ALTA 2016 Proceedings. Gold-PM Conference. 21 - 28 May 2016. Perth, Australia.

55. **Tetyana P, & Shumbula P.** Synthesis characterisation and toxicity studies of water soluble copper sulphide nanoparticles Proceedings of the Microscopy Society of South Africa Proceedings. 5 - 9 December 2016. Nelson Mandela Metropolitan University. Boardwalk Convention Centre in Port Elizabeth, Eastern Cape Province, South Africa.
56. **Thobadi I, Bisaka K & Goso X.** Pre-reduction and DC open-arc smelting of carbon-based pellets. Southern African Institute of Mining and Metallurgy. The Tenth International Heavy Minerals Conference. 16 – 17 August 2016. Sun City, Northwest Province, South Africa.
57. **Van Rooyen M.** Acid mine drainage water treatment using the SAVMIN™ process. SAIMM. Hydrometallurgy Conference 2016, Sustainable Hydrometallurgical Extraction of Metals, 1 - 3 August Belmont Mount Nelson Hotel, Cape Town, South Africa.
58. **Van Staden P.** A PhreeqC model of heap leaching. SAIMM. Hydrometallurgy Conference 2016, Sustainable Hydrometallurgical Extraction of Metals, 1 - 3 August Belmont Mount Nelson Hotel, Cape Town, South Africa.

Book Chapters

1. **Chetty D & Gutzmer J.** Smelting of ores from the northern Kalahari Manganese Deposit. Book Chapter: In: Becker, M., Wightman, E.M. and Evans, C.L. (Eds) Process Mineralogy. 2016. JKMRC Monograph series in mining and mineral processing, No. 6.
2. **Ntho T.** Gold catalysed reactions. Book Chapter: Chapter 2 in Mishrar NK(ed) Catalytic Application of Nano-Gold Catalysts.
3. **Vilakazi S.** Gold nanoparticle based colo-

rimetric sensors for dopamine. Book Chapter;C7: Advances in sensors: Reviews 3: Sensors, Transducers, and Signal Conditioning and wireless sensors networks. International Frequency Sensor Association Publishing.

Journal Articles

1. **Bambo, MF, Krause RWM & Moutloali R.M.** Facile Method for the Synthesis of Copper Nanoparticles Supported on the Organoclay Journal of Biomaterials and Nanobiotechnology, 2017, 8, 144-158.
2. Material Journal of Biomaterials and Nanobiotechnology, 2017, 8, pp. 144-158.
3. **Couperthwaite R & Mwamba A.** Cold-spray coating of an Fe-40 wt.% Al alloy with additions of ruthenium. The Journal of the Southern African Institute of Mining and Metallurgy. Vol. 116, October 2016. pp. 927-934.
4. **Geldenhuys I.** The Exact art and subtle science of DC. JOM: the journal of the Minerals, Metals & Materials Society. November 2016.
5. **Jonck J, Moema J, Jooste J & Van Tonder P.** Investigation of the 'tiger skin' defect on indefinite chill rolls. The Journal of the Southern African Institute of Mining and Metallurgy. vol. 116, October 2016. pp. 907-913.
6. **Jones R & Erwee M.** Simulation of ferro-alloy smelting in DC arc furnaces using Pyrosim and FactSage. CALPHAD: Computer Coupling of Phase Diagrams and Thermochemistry 55 (2016)20.
7. **Mampuru L, Maruma G & Moema J.** Grain refinement of 25 wt% high chromium-vanadium. The Journal of the Southern African Institute of Mining and Metallurgy. vol. 116, October 2016. pp. 969-971.
8. **Mampuru L, Moema J, Maruma G, Mosima E & Maja M E.** Effect of niobium on the solidification structure and properties of hypoeutectic high chromium white cast irons.

- The Journal of the Southern African Institute of Mining and Metallurgy. vol. 116, October 2016. pp. 981-986.
9. **Matabola P.** Fabrication and assessment of ZnO modified polyethersulfone membranes for fouling reduction of bovine serum albumin. International Journal of Polymer Science. January 2017.
 10. **Mokoena L, Patrick G & Scurrall M K.** Catalytic activity of gold-perovskite catalysts in the oxidation of carbon monoxide. Gold Bulletin 2016. 49:35–44.
 11. **Njengele Z & Mosebi S.** Expression purification and characterization of a full-length recombinant HIV_1 Vpu from inclusion bodies. Protein Expression and Purification 128 (2016) pp. 109 – 114.
 12. **Nyembe S, Shumbula P & Sikhwivhilu L.** Platonic gold nanocrystals: formation of icosahedron and decahedron nanostructures through twinning mechanism. Journal of Nanoscience and Nanotechnology, Issue 9, vol. 16, (2016) 9832-9837.
 13. **Papo J & Smit M.** Corrosion and mechanical behaviour of railway axle. African Corrosion Journal. Vol. 2, issue 1 2016. pp. 1-10.
 14. **Pebane M.** The significance of magmatic erosion for bifurcation of UG1 chromitite layers in the Bushveld Complex. Ore Geology Reviews. February 2017.
 15. **Pebane M & Latypov, R.** The significance of magmatic erosion for bifurcation of UG1 chromitite layers in the Bushveld Complex. Ore Geology Reviews (2017).
 16. **Robertson R.** Development of an integrated heap leach flow and mineral leach model. Hydrometallurgy. Volume 169, May 2017, pp. 79–88.
 17. **Reynolds Q.** Computational modelling of arc-slag interaction in DC furnaces. Journal of the Minerals, Metals & Materials Society (JOM). Vol. 69, No. 2, 2017. pp. 351-357.
 18. **Shumbula P.** Synthesis and characterization of sucrose and glucuronic acid-capped CdS nanoparticles from HDA-capped via ligand exchange. Digest Journal of Nanomaterials and Biostructures, vol 12, no 1, 2017. pp. 195-204.
 19. **Sikhwivhilu L.** Colloidal synthesis of CuIn_{0.75}Ga_{0.25}Se₂ nanoparticles and their photovoltaic performance Open Phys. 2016; 1 Corrosion and Mechanical Behaviour of Railway Axle. 4:420–425.
 20. **Sikhwivhilu L.** Modified electro-spun polyvinyl alcohol nanofibers used as super adsorbing material for lead ions in aqueous solution. Journal of Residuals Science & Technology, vol. 13, no. 3, July 2016. pp. 233-242.
 21. **Sikhwivhilu L.** Novel PVA/MOF nanofibers: fabrication, evaluation and adsorption of lead ions from aqueous solution. Nanoscale Research Letters 2016 11:414. pp. 2-13.
 22. **Sikhwivhilu L.** Novel super adsorbents (PVA AND PVA/Cu-MOF NANOFIBRES) as effective lead ions remover in aqueous solution. Digest Journal of Nanomaterials and Biostructures, vol. 11, no. 2, April - June 2016, pp. 425 – 434.
 23. **Sikhwivhilu L.** The effect of structural properties of Cu₂Se/polyvinylcarbazole nanocomposites on the performance of hybrid solar cells. Journal of Nanomaterials, vol. 2016, pp. 1-8.
 24. **Sosibo N.** The status of artisanal and small-scale mining sector in South Africa_ tracking progress. The Journal of the Southern Africa Institute of Mining and Metallurgy, 2017, 117(1), pp. 33-40.
 25. **Sosibo N.** When policy is not enough: Prospects and challenges of artisanal and small-scale mining in South Africa. Journal of Sustainable Development, Law & Policy, Volume 7 Issue 1, 2016, pp. 21-42.
 26. **Sosibo N.** Cathode ray tube recycling in South Africa recycling 2017. Recycling 2017. Vol. 2 no. 4. Pp. 1-18.
 27. **Steenkamp J. & Hayman D.** Tap-hole life cycle design criteria: A case study based on silicomanganese production. Journal of Metals 2016. vol. 68, no. 6, pp. 1547–1555.
 28. **Van Staden P.** Comparative assessment of heap leach production data –1: a procedure for deriving the batch leach curve. Minerals Engineering. Volume 101, February 2017, Pages 47–57.
 29. **Van Staden P.** Comparative assessment of heap leach production data – 2: heap leaching kinetics of Kipoi HMS Floats Material, Minerals Engineering. Volume 101, February 2017, pp. 58-70.

Glossary

AEMFC	African Exploration Mining and Finance Corporation
ALF	Advanced Leach Facility
AMD	Advanced Materials Division
AMI	Advanced Metals Initiative
ARC	Audit and Risk Committee
ASSM	Artisanal and Small Scale Mining
AVE	Advertising Value Equivalent
BEE	Black Economic Empowerment
CANSA	Cancer Association of South Africa
CEO	Chief Executive Officer
CoEW	Cobalt Electrowinning
CRM	Certified Reference Materials
CSFR	Client Satisfaction Frequency Rate
CSR	Corporate Social Responsibility
DMR	Department of Mineral Resources
DRC	Democratic Republic of Congo
DST	Department of Science and Technology
DTI	Department of Trade and Industry
e-Waste	Electronic Waste
EAP	Employee Assistance Programme
EIFR	Environmental Incident Frequency Rate
EWIT	E-waste Implementation Toolkit
GAAP	Generally Accepted Accounting Practice
GDP	Graduate Development Programme
HIFR	Health Incidence Frequency Rate
HMD	Hydrometallurgy Division
HRC	Human Resources Committee
HRD	Human Resources Division
HSS	High Speed Steel
HySA	Hydrogen and Fuel Cells Programme
IA	Internal Audit
IMS	iNgcaphephe Metallurgical Services
IP	Intellectual Property
ICT	Information Communications Technology
KPIs	Key Performance Indicators
LTIFR	Lost Time Injury Frequency Rate

MaC	Measurement and Control
MESU	Minerals Economics and Strategy Unit
METF	Minerals Education Trust Fund
MHP	Mixed Hydroxide Product
MoU	Memorandum of Understanding
MQA	Mining Qualifications Authority
MTC	Metals Technology Centre
MTEF	Medium Term Expenditure Framework
NIC	Nanotechnology Innovation Centre
NIM	National Institute for Metallurgy
NRF	National Research Foundation
PCB	Printed Circuit Boards
PDFR	Public Dissatisfaction Frequency Rate
PDP	Professional Development Programme
PFMA	Public Finance Management Act
PGMs	Platinum Groups Metals
PLP	Preform Line Products
PMDN	Precious Metals Development Network
R&D	Research and Development
REE	Rare Earth Elements
RMC	Risk Management Committee
RSC	Risk Steering Committee
SACREF	South African Centralised Refinery
SADC	Southern African Development Community
SAF	Submerged-arc furnace
SAQA	South African Qualifications Authority
SASSETA	Safety and Security SETA
SEDA	Small Enterprise Development Agency
SETA	Sector Education and Training Authority
SHEQ	Safety, Health, Environment and Quality
SMMEs	Small, Medium and Micro Enterprises
SPEs	Screen Printed Electrodes
SPPIA	Standards for the Professional Practice of Internal Auditing
SSMB	Small Scale Mining and Beneficiation
STEM	Science, Technology, Engineering and Mathematics
TC	Technical Committee
TCTC	Total Cost to Company

ToR	Terms of Reference
UCT	University of Cape Town
WIL	Work Integrated Learning
XRT	X-ray Transmission

Auditor

Auditor General South Africa, Pretoria,
South Africa

Mintek Address Details

MINTEK
200 Malibongwe Drive, Randburg 2194, South Africa
Private Bag X3015, Randburg 2125, South Africa
Tel: +27 11 709 4111 Fax: +27 11 793 2413
Website: www.mintek.co.za

Company Secretariat

Ms. Gugulethu Nyanda
RP247/2017
ISBN: 978-0-621-45720-9

CONTACT DETAILS

CEO's Office	Ms. Lucy Legodi	011-709 4959
Internal Auditor	Ms. Nosipho Mthalane	011-709 4796
External Auditors	Auditor General South Africa (AGSA)	012-426 8000
GM's Secretary	Ms. Christa Scheepers	011-709 4908
GM's Secretary	Ms. Evah Motsego	011-709 4906
Mintek Switchboard		011-709 4111

General Managers

Business Development
Research & Development
Technology
Finance
Corporate Services

Contact Person

Dr. David Powell
Dr. Makhapa Makhafola
Mr. Alan McKenzie
Mr. Sakhi Simelane
Ms. Gugulethu Nyanda

Tel. No.

011-709 4620
011-709 4906
011-709 4959
011-709 4906
011-709 4908

Divisions

Advanced Materials
Analytical Services
Biotechnology
Engineering & Maintenance Services
Finance
Human Resources & Training
– Bursars & SET promotions
Hydrometallurgy
Information & Communications
Information Communications Technology
Measurement & Control
Mineral Economics & Strategy Unit
Minerals Processing
Mineralogy
Mintek Conferences Centre
Mintek Library
Pyrometallurgy
Safety, Health, Environment & Quality
Small-Scale Mining & Beneficiation

Contact Person

Dr. Jones Papo
Mr. Joe Baloyi
Ms. Mariekie Gericke
Mr. Boni Hewu
Ms. Hester Pretorius
Mr. Hendrick Morobane
Mr. Hendrick Morobane
Dr. Leon Krüger
Mr. Haveline Michau
Mr. Hennie Venter
Mr. Paul Brereton-Stiles
Mr. Godfrey Mothapo
Mr. Bernard Joja
Ms. Nosiphiwo Mzamo
Mr. Elvis Tshweneyame
Ms. Maphefo Maleto
Ms. Isabel Geldenhuys
Ms. Mpendulo Ginindza
Mr. Nirdesh Singh

Tel. No.

011-709 4471
011-709 4368
011-709 4442
011-709 4781
011-709 4698
011-709 4373
011-709 4373
011-709 4656
011-709 4256
011-709 4103
011-709 4355
011-709 4304
011-709 4295
011-709 4163
011-709 4275
011-709 4435
011-709 4622
011-709 4330
011-709 4335

