Symposium Invitation

Welcome to the 6th Mintek Analytical Science Symposium

The Environment

Friday, 21st October 2016
Mintek Auditorium

Mintek, together with SASS invites you to the annual analytical symposium

Programme

Morning Session:	Programme Director – Mr Graham Sithole
07:00 – 08:00:	Registration (Tea / Coffee)
08:00 – 08:10:	Opening and Welcome CEO & President of Mintek: (Mr Abiel Mngomezulu)
08:10 – 08:20:	Message from SASS (Prof Rob McCrindle)
08:20 – 08:25:	Auditorium Orientation (Mr Graham Sithole)

ISO 9001 QUALITY MANAGEMENT SYSTEM
ISO 14001 ENVIRONMENTAL MANAGEMENT SYSTEM
ISO 17025 TESTING AND CALIBRATION LABORATORY
OHSAS 18001 OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM

SASS · SOUTH AFRICAN · SASS SPECTROSCOPIC SOCIETY

MINTEK
A global leader in mineral and metallurgical innovation

08:25 – 08:50

Title: BROMINATED FLAME RETARDANTS IN INDOOR AND OUTDOOR ENVIRONMENT IN SOUTH AFRICA: ANY NEED TO WORRY?

Presenter: **Prof. Okechukwu Jonathan Okonkwo**

The extensive use of chemical flame retardants to meet Flammability Standards provides an example of the need to first consider the environmental impacts of fire safety interventions before any implementation. Flame retardants have been used in products with possible high levels of human exposure. In order to assess the presence and levels of BFRs in indoor and outdoor environment, dust from consumer goods, surface water, groundwater, landfill leachates and sediment are used to illustrate their levels and risks.

08:50 – 09:15

Title: WASTE, WATER AND CARBON FOOTPRINT AS STREAMLINED INDICATORS FOR SUSTAINABILITY IN RESEARCH AND DEVELOPMENT SECTOR

Presenter: **Mr Landu Landu**

How do executive management select and employ streamlined indicators to facilitate R&D activities and provide a service is a matter of sustainability interest and practical significance. Waste, water and carbon footprint measures how much water and energy an R&D organisation consumes and the amount of waste generated during R&D value chain. Waste, water footprint and carbon footprint are well-known indicators with sound public perception to assess environmental performance and further improve the SHEQ aspect of the business. A research council may not necessarily use huge quantities of natural resources and human capital comparable with other large scale companies. However, any given R&D organisation, in its daily activities still, consumes electricity, produce wastes, emit carbon, provide human capital development, etc. From this perception such an organisation is no different in its accountability with respect to sustainability achievement and standards. As a relatively small contributor to water scarcity as well as greenhouse gas (GHG) emissions, immense potential exists in the R&D sector for decreasing environmental impacts generated from R&D and consumption activities as required for SHEQ in any organisation of this kind. In this paper, waste, water and carbon footprints are reviewed for R&D operations to evaluate the applicability of sustainability concept for the services that the organisation provides to the public and private entities. The results demonstrated well comprehensiveness and practicality of waste, water and carbon footprints as efficient indicators to sustainability of the R&D activities in line with the vision stipulated in the National Development Plan and compliance to the National Environmental Management Act, 1998 (Act No. 107 of 1998) of the country.

09:15 – 09:40

Title: LASER ABLATION ICP-MS AS A METHOD TO QUANTIFY PRECIOUS METALS IN ALLOYS PRODUCED FROM ELECTRONIC WASTE

Presenter: **Ms Candice Benesha Carelse**

As part of its initiatives in urban mining, Mintek is assessing ways to recover metals from electronic waste. One of these methods is pyrometallurgical, the aim being to smelt printed circuit boards in a furnace, and to collect precious and other metals in the alloy that forms. To better understand precious metal distribution in these alloys, a method was developed to quantify Au and Ag, using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS). Particular attention was paid to Cu-rich areas, owing to the high affinity of Au for Cu.

Two Cu-Sn phases, a Pb-phase, a Cu-Fe phase, a Fe-Si phase and a Fe-Cu phase were distinguished in alloys from tap samples, using scanning electron microscopy and electron probe microanalysis (EPMA). Results from EPMA show that Au and Ag are present in phase concentrations of up to 1100 ppm and 1.2% respectively, with detection limits of 200 ppm Au and 300 ppm Ag. The LA-ICP-MS method successfully quantified Au and Ag down to concentration levels of 39 and 340 ppm, respectively. Uncertainties range from 4.80% relative to 3.93% relative over the concentration range 39 ppm - 340 ppm Au. For Ag, uncertainties range from 4.38% relative to 5.9% relative over the concentration range 340 ppm - 2.6%. Gold is underestimated by LA-ICP-MS compared with EPMA; this is attributed to the low Au content of the calibration standard. Silver concentrations compare well between EMPA and LA-ICP-MS. The method shows promise for similar analysis of alloys in general.

09:40 – 10:05

Title: VIABILITY OF PRECIOUS METALS AND BASE METALS RECOVERY FROM e-waste

Presenter: **Ms Zizile Mhlambiso**

E-waste is an emerging global urban mining issue, driven by the rapidly increasing quantities of complex end-of-life electronic equipment. Waste management of e-waste has led to recycling to recover precious metals and some economically feasible base metals. This study is focused on producing a representative, uniform 85% less than 75 micron sub-sample for analytical determinations to support the recycling metallurgical processes. The primary preparation step was the focus to ensure the required particle size of the sample. The mass of the sub- sample was 1.47 Kg which was pulverised and separated into a fine and a coarse fraction using a 1.7mm screen. This was followed by rotary splitting with a 10 unit Eriez rotary splitter. The coarse fraction was further rotary split into 10 units, 5 units recombined to form a single split of 110 g. Hence, two splits of 110 g from the coarse fraction. The fine fraction was rotary split into 10 units of which 2 units was recombined to give 5 final split units of 250 g. The fine and coarse fractions were ashed at 900oC for 6 hours to decompose the material thereby enabling pulverising to a grind-size of -75 µ. Particle size determination was 92% of the fine fraction passed 75 µ and 85% of the course fraction passed 75 µ. After ashing the mass loss was approximately 35% for the fine and 21% for the coarse aliquots respectively. The fine aliquots produced low relative standard deviations (RSD); gold 3.22%, palladium 6.34%, platinum 6.17% and copper 2.24% for 25 determinations. The coarse fraction aliquots gave higher RSD's than the fine fraction for; gold 7.92%, palladium 16.5%, platinum 58% and copper was slightly lower at 0.02%. The total determinations for the coarse fraction were 6. The reproducible measurements obtained verified that the primary preparation procedure produced a homogenous sample that can be sub-sampled for analytical determinations.

10:05 – 10:30

Mid-Morning Refreshments

10:30 - 10:55

Title: AIRBORNE SEMI-VOLATILE ORGANIC POLLUTANTS IN SOUTH AFRICAN PLATINUM MINES

Presenter: Prof Patricia Forbes

Elevated levels of atmospheric semi-volatile organic compounds (SVOCs), including toxic polycyclic aromatic hydrocarbons (PAHs), may arise in underground mines due to the use of diesel machinery in confined environments. These PAHs may be present in the underground atmosphere either in the gas phase or adsorbed onto the surface of particles, primarily diesel particulate matter. It is important to sample both phases in order to elucidate the potential PAH occupational exposure levels, as the health impacts of each phase is different. A small, portable denuder device was employed to sample the air in three underground platinum mines, which consisted of two multi-channel silicone rubber traps in series, separated by a quartz fibre filter with a small, battery operated, portable sampling pump (Geldenhuys et al., 2015). The primary trap collected gas phase SVOCs, including PAHs, whilst the filter sampled particle phase analytes. The secondary trap downstream of the filter collected any SVOCs which may have blown off the particles on the primary trap at sample volumes below that of the breakthrough volume. Samples were taken at various locations in shafts where diesel is used, as well as in non-diesel shafts. Each component of the denuder was analysed by thermal desorption-GCxGC-TofMS, which showed that PAHs (mainly naphthalene and the mono-methylated naphthalene derivatives) were primarily present in the gas phase. Particle phase PAHs (primarily fluoranthene and pyrene) were found in the highest concentrations in the diesel exhaust samples. This was the first such study of mining atmospheres in South Africa

10:55 – 11:20

Title: ACUTE TOXICITY TESTING WITH LUMINISCENT VIBRIO FISCHERI

Presenter: Dr Duduetsang Saku

Microtox® acute toxicity testing offers a rapid, efficient and affordable way of regular monitoring or screening for toxicity during the treatment of effluent plants, leachates or acid mine drainage. Costly chemical analysis are limited and cannot provide chemical toxicity effects on biota. Microtox® technology is based on luminescent marine bacteria, Vibrio fischeri; an organism that is globally recognized as the overall best representative species for aquatic organisms. V fischeri is treated with a suspected toxicant in aqueous media at different concentrations. In a 'healthy' state the luminescence is recorded and compared to the luminescence after interaction with toxicants. This provides a measure of the overall acute toxicity that can be reported as EC50. Microtox® is however not limited to environmental samples such as water, soil or soil sediments. Its efficiency in reporting acute toxicity can be used in production facilities to monitor on-going processes in order to predict environmental impact of final products and/or their waste. This method can also assist in the selection of environmentally benign materials during production through rapid toxicity tests of these materials, with results available within 24 hours. Acute toxicity information provided by Microtox®, promotes cheaper in-house waste disposal/treatment alternatives instead of using waste disposal companies.

11:20 – 11:45

Title: APPLICATION OF ACID BASE ACCOUNTING TO PREDICT POST-MINING DRAINAGE QUALITY IN COALFIELDS OF THE MAIN KAROO BASIN AND SELECTED SUB-BASINS

Presenter: **Dr Lindani Ncube**

Acid Base Accounting (ABA) is a tool used to assess the total amount of acidity or alkalinity contained in a specific rock sample, and is based on the total S concentration and the carbonate content of the sample. A preliminary ABA test was conducted on twelve sandstone and seven coal samples taken from coalfields representing; the Main Karoo Basin (Highveld, Vryheid and Molteno/Indwe Coalfields) and the Sub-basins (Witbank and Waterberg Coalfields). The results obtained, indicates that sandstones and coal from the Main Karoo Basin have the potential of generating acid mine drainage (AMD) as they contain sufficient pyrite to generate acid, with the final pH values of the samples turning acidic upon complete oxidation. Sandstone from collieries representing the Main Karoo Basin are characterised by elevated contents of reactive S%. All the studied samples are characterised by an acid potential (AP) that is less than the neutralizing potential (NP) except for two samples. The results obtained indicate that the sandstones from the Main Karoo Basin are prone to acid generation as compared to sandstones from the Sub-basins. However, the coal has a relatively low potential of generating any acid. The application of ABA in this study contributes to an understanding of the complexities governing water-rock interactions. In general, the coalfields from the Main Karoo Basin have much higher potential to produce AMD during mining than the coalfields in the Sub-Basins.

11:45 – 12:10

Title: COPPER MINING, PRODUCTION AND POOR MINE WASTE TREATMENT, DISPOSAL METHODS AND THEIR THREATS TO THE ENVIRONMENT IN UGANDA

Presenter: **Mr Turyamureeba Sam Frank**

The paper deals with copper mining, production and mine waste management in Uganda. Large amounts of mine wastes generated by the copper mining industry and the process of beneficiation of minerals have posed a big threat to the environment. These have led to air, soil, water pollution and many other hazardous effects to the environment as well as wild and human lives. This paper broadly addresses the different types of mine wastes generated during the entire mining process right from the mineral extraction and beneficiation processes. It provides a comprehensive review of the different mine wastes generated by the different mining methods like surface mining (open cast), underground mining among others and the Chemicals/ reagents used in the extraction process of minerals from the earth's crust and by products. It also gives the details about the amount of waste materials generated in extracting different minerals like copper and cobalt metals, copper and nickel hydroxides. It also discusses the tailings generated by the milling, mineral beneficiation processes and their different methods of disposal. This paper also reviews the impacts of these mine wastes on the environment and how they are threats to wild and human lives. It also discusses the most efficient methods of dealing with this global concern by people all over the world and how their cumulative effects may be minimized. It outlines some suggestions/ recommendations on possible mitigation measures.

12:10 – 12:35

Title: URANIUM AS A POTENTIAL HEALTH HAZARD AS WELL AS AN ECONOMIC ASSET IN THE LOUIS MOORE TAILINGS DUMPS, NEAR GIYANI, LIMPOPO PROVINCE

Presenter: **Mr Ndinannyi Kenneth Singo (Phd. Candidate)**

In the Limpopo province alone over 800 abandoned and derelict mines have produced an enormous quantity of rock waste dumps and tailings and other associated mining infrastructure collectively known as mine residue areas. In the Louis Moore tailings, no attention has been paid to the extent of heavy metals and other trace elements concentrations and their potential impacts on the environment and human health. There was also an urgent need to try and identify the economic potential of rehabilitating such mine residue areas. Thus, the focus of this study was to undertake a conceptual study on the reclamation of mine residues. The main aims of the study were to establish, whether it will be possible to reclaim the mining residues in an economically viable way, and to identify possible hazards associated with them. The methodology of the study comprised four phases:
In the initial phase, the main aim was to obtain first-hand information about key sampling sites. Legal land access permissions were requested from the relevant land custodians. The second phase involved a reconnaissance survey. This was conducted to ensure that field activities such as drilling, logging and sampling are safe and productive. In the third phase, a total of ten (10) auger holes were drilled in the tailings. These were logged and sampled. A combined 47 samples were taken to the University of Johannesburg laboratory for analysis. In the fourth phase, samples were analysed for leachable element abundances by ICP OES.

Geochemical analyses and subsequent modelling of the diverse residues were central to achieve the outcomes. From the geochemical assayed results of U, in Louis Moore, the mean concentration of U were found to be 30 ppm. To quantify the potential economic importance and impacts of these metals, geochemical and resource modelling was employed. This revealed that U residual in Louis Moore Mine is currently at 25.65 tonnes.

The outcomes pointed in principle to the viability of reworking the tailings; however, at the same time a potential environmental risk is identified. Both aspects will require establishing the mineralogical form in which uranium occurs. Should the reworking of the U in the Louis Moore be feasible, this would assist in generating enough money to fund the rehabilitation costs of this mine and possibly secondary tailings being used for other purposes as they may continue posing potential danger to human health and environment.

12:35 – 13:30
Lunch

Afternoon Session: Programme Director – Dr Johann Fischer

13:30 - 13:55

Title: MONAZITE AS A NUCLEAR WASTE FORM FOR ENCAPSULATING ACTINIDES:
A MINERALOGICAL STUDY OF NATURAL MONAZITE FROM STEENKAMPSKRAAL

Presenter: **Ms Gabrielle Ficq**

South Africa is planning to expand nuclear energy by building additional nuclear power plants. One consequence of nuclear power is production of high-level radioactive waste, which requires environmentally safe sequestration. Environmentally safe sequestration depends in part on the long-term robustness of the waste-form used to encapsulate the waste. One waste-form under consideration is based on monazite (cerium phosphate, together with thorium silicate through coupled substitution). It is therefore important to assess whether a monazite-based waste-form safely encapsulates the radioactive elements without mobilisation during alteration processes. There have been studies documenting changes in chemical composition during alteration of monazite and the resultant breakdown mineral phases; one such study has identified secondary microcrystalline mineral phases compatible with the actinides, otherwise complete loss of these radioactive elements apparently is the result (Read and William, 2001). A natural analogue of a high-level radioactive waste repository is the Mesoproterozoic-age Steenkampskraal orebody located in the Western Cape (South Africa). Steenkampskraal contains abundant monazite (and apatite); as such the orebody presents an opportunity to study the accumulative long-term effects of alteration and subsequent mobility of uranium and thorium from monazite. This study examined thin sections of monazite ore from the Steenkampskraal orebody using a petrographic microscope and a scanning electron microscope (SEM) to identify mineral assemblages and any observable effects of alteration. An electron microprobe (EMPA) was used to determine the compositions of unaltered and altered monazite in order to comparatively assess the loss of uranium and thorium. The results of this study indicate no observable changes in actinide concentrations between unaltered and altered monazite.

13:55 – 14:20

Title: MANAGEMENT OF WASTE GENERATED FROM HYDROMETALLURGICAL PROCESSES

Presenter: **Alice Mabunda**

MINTEK works in conjunction with the mining industry to develop technology that will be beneficial for recovery and purification of precious metals from ores by hydrometallurgical processes such as, Leaching and Precipitation, Ion exchange, Solvent extraction, Electro wining, Cyanide destruction, and Cyanide analysis .Hydrometallurgy is solution based chemical and metallurgical processes for the extraction and recovery of precious metals from ores. The solution includes acidic, basic and organic medium.

Waste generated from the processes in hydrometallurgy is generally classified as hazardous. There are challenges regarding waste management as we deal with different hazardous material however we intend to be able to minimize and treat all waste that we generate in the future. The wastes is pre-treated and analysed before sent to the effluent plant for further treatment and disposal. Treatment methods used are precipitation and neutralization using lime.

There are hazards and risks that are associated with waste generated from the processes indicated above. Waste generated can be toxic, corrosive, flammable, radioactive, harmful and poisonous depending on the specific process used. Waste that is incorrectly managed can kill people, animals and aquatic species and negative impact on the environment.

Management of waste generated from different metallurgical processes at HMD is established and maintained by identifying and classifying the waste, the treatment method to be used prior to disposal, training of people handling waste as required by legislation, providing them with proper personal protective equipment, establishing safe working procedures and ensure enforcement of such procedure and compliance to all legislation and municipal by laws.

14:20 – 14:45

Title: IMPLEMENTING THE NEW WASTE REGULATIONS: LESSONS, CHALLENGES AND OPPORTUNITIES; WASTE GENERATORS PERSPECTIVE

Presenter: **Ms Mpendulo Ginindza**

There is increasing concern about environmental pollution and natural resource conservation. Governments are taking action by introducing regulations that will address these concerns. The Constitution states that everyone has the right to have an environment that is not harmful to his or her health (Government of South Africa, 1996). The Waste Act requires that waste must be managed in accordance with the hierarchy of waste management (Government of South Africa, 2008). The regulations under the Act have helped to simplify the legal aspects and requirements of avoiding, reducing and managing waste.

In 2013 the Waste classification and management regulations including National norms and standards for storage of waste came into effect. Responsibilities of waste generators, transporters and managers are clearly marked out. Legal obligations around waste classification and safety data sheet development that previously fell on waste managers have been shifted to waste generators. Prohibitions and restrictions on the disposal of waste to landfill have been also been introduced and waste generators are expected to comply within the specified times.

As we implement these regulations we come across challenges, lessons and opportunities. One of biggest challenges which have already been identified in the waste industry is that of the shortage of skills and expertise in this area. Opportunities in the R&D sector are to find solutions for waste generated in R&D activities as well as provide solutions and services to industry. This will require working with stakeholders to comply with legislation in order to manage waste effectively, and make South Africa a better place for current and future generations.

14:45 – 15:10

Title: SIMPLIFYING THE WASTE ACT FOR THE WASTE GENERATOR

Presenter: **Ms Belinda Berry**

- Outline of the legal requirements for waste management in South Africa:
  - o Summary Waste Legal Framework in South Africa
  - o Waste Information System (SAWIS)
  - o Storage of Waste
  - o Document and Manifest Requirements
  - o Landfill Classes and Waste Types
  - o Assessment and Classification of waste – Analytical and GHS requirements
- A look at some typical waste streams generated by the mining/metallurgical industry and the legal requirements associated with these wastes.

15.10 – 15.20: Closing (Mr Alan McKenzie)
15.20 – 15.30: Vote of Thanks (Mr Joe Baloyi)
15.30 – 17.00: Refreshments and networking

Posters

1. Title: IMPLEMENTATION OF THE CALUX BIOASSAY FOR SCREENING AND QUANTIFICATION OF DIOXINS

Dr Mabel Coyanis

Abstract: Mintek is implementing the Dioxin Responsive cell base CALUX® (Chemical Activated Luciferase gene eXpression) bioassay for the detection and quantitation of dioxins and dioxin-like compounds. The assay is based on the collective toxic response produced by more than 250 chemically related toxic dioxin derivatives. The test has fast turn-around times, is highly sensitive, and holds a good correlation with expensive dioxin confirmatory methods (HRGC/HRMS).

The DR-CALUX bioassay is accepted by international regulatory bodies for the screening of dioxins present in a wide variety of matrices, from fly ash, dust, soil, sediments, water waste, stack gas, air, animal fat, human breast milk, animal stock feed, fish, food control, etc. It has been validated and approved for dioxin screening in Japan (JIS K 0311), in the US (EPA 4435, Dioxins/dl-PCBs in soil, sediments or ashes), and is routinely used in the European Union and in Australia (NSW Dep of Primary Industries) on the control of animal feed for the agricultural sector and human food.

By the provision of a cost effective alternative screening test for dioxins, Mintek aims to encourage dioxin compliance testing in South Africa, helping to protect the environment, its populations and natural resources from uncontrolled harmful emissions.

2. Title: PASSIVE TREATMENT PLANT USED FOR TREATING EFFLUENT MINE WATER FROM THE DOUGLAS DISCHARGE POINT AT eMALAHLENI, MPUMALANGA: PILOT STUDY

Ms Boitumelo Murishe Penelope

Abstract: The aftermath of coal mining in the Highveld coalfields in Mpumalanga province has triggered serious environmental issues that demonstrated the need to develop remediation technologies that are practicable, efficient, cost effective and environmentally friendly in a wide range of physical settings. Passive treatment is increasingly gaining favour over active treatment technologies for the long-term remediation of polluted mine water owing to its efficiency in removing contaminants at a reasonably low cost.

However, the application of passive treatment in South Africa has been limited and detailed understanding of specific processes affecting water quality is needed. In this study, a Dispersed Alkaline Substrate system (consisting of an anaerobic and aerobic system) was constructed as a pilot system to treat acid mine drainage (AMD) from an abandoned coal mine in eMalahleni, Mpumalanga.

The Dispersed alkaline substrate system is a mixture of wood shavings, limestone (fine grained) and manure. Inflow-outflow water quality analyses demonstrated substantial metal and Sulfates removal in the whole system for SO42-, Al, Fe, Ni and Zn. The system was operated at low flow rates in order to achieve longer residence time in the reactive tanks. There was minimal of Mn in the system and this may be attributed to the presence of Fe in the oxidation pond and aeration pond, which tend to compete for oxygen consumption.

Posters

3. Title: IMPLEMENTATION OF THE CALUX BIOASSAY FOR SCREENING AND QUANTIFICATION OF DIOXINS

Mr Sandile Langa

Abstract: : Multiple acute and chronic toxicity of arsenic species and its mobilisation from geological deposits into ground and drinking water resources are one of the greatest threats to human health.
Arsenic speciation analysis, mostly done by liquid chromatography, is a challenging task which requires an intense high quality work with respect to extraction, preservation, separation, detection and validation. A growing number of As-species and low regulatory limits (10 µg/L) may require more than one speciation method preferably performed by species specific procedures and detectors. Generally, arsenic compounds have no significant market value, but they need to be removed from process streams because of environmental or process specific purposes
However the focus on this project is on ion chromatographic separations, the most frequently used methods. Based on IC-principles the methods applied are critically discussed and recommendations given which should result in more robust and reliable As-speciation.
The equipment used was Metrohm ion chromatograph fitted with a 20 µL and 100 µL sample loop for mg/L and µg/L levels respectively, Metrosep Asap 4/5 guard column (5 x 4.0 mm) and Metrosep A supp separator column (250 x 4.0 mm) were used. The experiment was conducted using an eluent of 3.2 mM sodium carbonate and 2.0 mM sodium hydrogen carbonate at 0.7 mL/min flow rate. The ion chromatography consisted of two detectors: conductivity detector and the UV-vis detector. Software used for data acquisition was MagIC Net.

4. Title: DETERMINATION OF THORIUM AND URANIUM IN URINE BY ICP-MS

Mr Sandile Langa

Abstract: Thorium and Uranium quantification is important to monitor human exposure to these elements. Urine samples were analysed to determine exposure. ICP-MS was used for quantitative determination of Th and U concentration in urine. The samples were stored and preserved by adding 5% nitric acid. A 10X dilution of urine sample was acidified with 5% ultra - pure nitric acid then shaken vigorously followed by the addition of 100 µL iridium (Ir) as an internal STD into a 15 mL sample vials.
The prepared samples were then digested in a; water bath (900C) for 30 minutes and the left to cool to room temperature, versus ultrasonic bath for 30 minutes. The method had a detection limit of 1ppt in urine for both Thorium and uranium with a relative standard deviation (SD) of less than 20%.

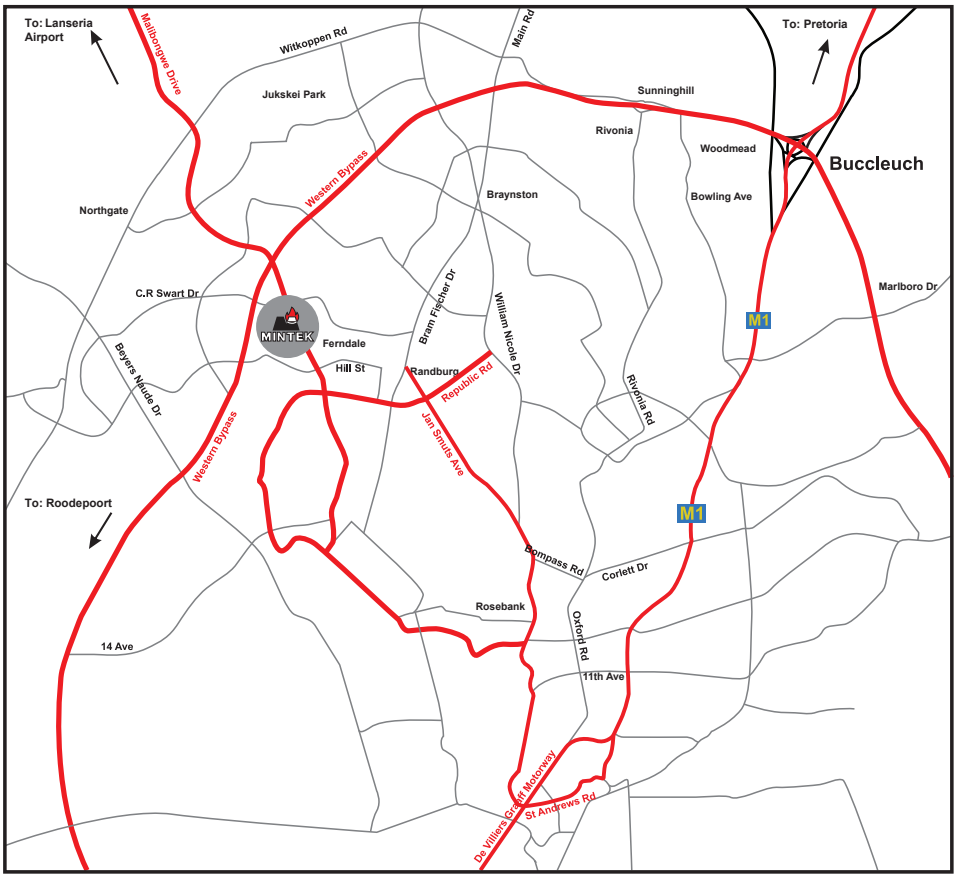
Registration

Early bird: Ends on 30 September 2016 – R825
Normal registration: Starts on 1 October 2016 – R935
Students: R715 (proof of student registration to be emailed or faxed)
SASS Member: R803
Registration: Online: http://www.mintek.co.za/2016/05/18/6th-annual-symposium/ for the symposium registration-form via Mintek website or alternatively, complete the attached form and send to email (see contact) or fax to +27 11 709 4006
Closing date for registration: 19 October 2016

Exhibitions

Exhibitors: A space of about 2m x 2m floor space will be provided for your displays, standard table with, MINTEK table cloth, two chairs and entrance into the symposium presentations with luncheon and refreshments for two people only.
Price per stall: R3 260 excl. VAT.
Closing date: 19 October 2016

Directions to Mintek: 200 Malibongwe Drive, Randburg
(See map below)



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Physical Address: 200 Malibongwe Drive, Strijdom Park, Randburg

GPS Co: 26° 5' 20.3 "S 27° 58' 49.81 "E

DIRECTIONS

FROM: N1 and N1 Western Bypass

1. Drive on the N1 towards Johannesburg
2. At the Buccleuch interchange (104), keep left and follow the sign N3 Germiston/Durban
3. Keep right at the fork, following the sign Roodepoort/Bloemfontein/N1 and merge onto N1 Western Bypass
4. Take the Malibongwe Drive offramp (R512/Randburg), Turning left into Malibongwe Dr
5. Turn right into Mintek (200 Malibongwe Drive)

FROM: M1 Johannesburg

1. Take exit 14B for Saint Andrews Road toward Parktown/Johannesburg
2. Turn right into St Andrews Rd
3. Turn right into Jan Smuts Ave and drive along Jan Smuts Ave until you reach Republic Rd
3. Turn left into Republic Rd
4. Turn right into Malibongwe Dr
5. Turn left into Mintek (200 Malibongwe Drive)

GPS Co-ordinates: 26o 5' 20.3 "S 27o 58' 49.81 "E

For further information contact:

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ANALYTICAL SCIENCE SYMPOSIUM

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STUDENT: ☐

STUDENT No:

(Fax Proof of Registration to Number Below)

SASS MEMBER: ☐

SASS MEMBER No:

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