ACKNOWLEDGEMENTS

The SAIOH Council and Conference Organising Committee, on behalf of SAIOH members, would like to thank all the presenters of this year’s Conference for their valuable contribution to the SAIOH Vision of “Ensuring healthy working environments in Africa through excellence in Occupational Hygiene” and the SAIOH Strategic Objective for 2018 to “Promote the Occupational Hygiene Profession”.

SAIOH takes this opportunity to thank the exhibitors and/or sponsors of this year’s Conference:

EXHIBITORS

- AMS Haden
- Apex
- Aquaticoh
- Envirocon
- Fellowes Beswick
- H.A.S.S
- Noise Clipper
- Safety and Allied Products
- Schauenburg Systems
- SKC
- Ultimate Optical
- WaveControl
- Anglo American: Mining Forum Launch speaker gifts and key rings
- BarNel Designs: Water bottles, caps and mouse pads
- Biograde: Speaker and keynote speaker gifts, SAIOH Awards and cash donation
- Envirocon: Occupational Hygienist of the Year Award
- Ergomax: Mining Forum Launch Function costs
- Occupational Hygiene Monitoring Services: Speaker gifts
- Safety and Allied Products: Pens and note pads
- Specialist Asbestos Training Services: Speaker gifts
- Vine Promotions: Printing of badges
FOREWORD

The Conference is aimed at practitioners in Occupational Hygiene and related fields, who have a special interest in the discipline of Occupational Hygiene more specifically, as well as in the field of Occupational Health more broadly – incorporating health, safety and environmental professionals, supervisors, risk assessors, medical and nursing practitioners, and representatives of SAIOH stakeholder organisations, across various sectors (government, corporate, academia, industry).

In the following pages you will find the programme for the Professional Development Course (PDC) Sessions (23 and 24 October – two days), the Launch of the SAIOH Mining Forum (24 October – one day) and the Scientific Conference (25 and 26 October – one and a half days), along with the abstracts of all presentations – three PDCs, six international keynote addresses (one at the Launch of the Mining Forum and five within the Scientific Conference), four presentations from SAIOH stakeholder and sister organisations (SASOM, SASOHN, Department of Labour) within the Scientific Conference, a special session dedicated to ‘All Things SAIOH PCC’ (presented by Council / PCC members), and 33 papers (oral and poster presentations) spread across the programmes of the Launch of the Mining Forum and the Scientific Conference.

The bio-sketches of the presenters of PDCs and keynote addresses are also included. The presentation abstracts are arranged in the order of the programme, with the poster abstracts included at the end.

- Attendance at the SAIOH Annual Conference is accredited for 1 SAIOH CPD point per day (1.5 SAIOH CPD points for full attendance)
- Attendance at the PDC session(s) is accredited for 0.5 SAIOH CPD point
- Attendance at the Launch of the SAIOH Mining Forum is accredited for 1 SAIOH CPD point

While every effort has been made to present the programme as indicated, SAIOH cannot be held liable for changes that occur due to circumstances beyond SAIOH’s control
### SAIOH PROFESSIONAL DEVELOPMENT COURSE (PDC) PROGRAMME – TUESDAY, 23 OCTOBER 2018

<table>
<thead>
<tr>
<th>Time</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:00 – 09:00</td>
<td>Registration (Tea/Coffee and breakfast snack on arrival) - Exhibitor and Poster Viewing</td>
</tr>
<tr>
<td>09:00 – 16:00</td>
<td><strong>PDCs IN PARALLEL – Full Day Sessions</strong></td>
</tr>
<tr>
<td></td>
<td><strong>PDC 1</strong></td>
</tr>
<tr>
<td></td>
<td>Testing the performance of local exhaust ventilation (LEV) systems to achieve adequate control of employee exposures. Mr Adrian Sims - Managing Director, Vent-Tech Ltd, Bristol (UK)</td>
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<tr>
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<td><strong>OR</strong></td>
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<td></td>
<td><strong>PDC 2</strong></td>
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<tr>
<td></td>
<td>Electromagnetic fields (EMFs): Measurement and control of human exposure to non-ionising radiation. Mr Aymen Jemni – Application Engineer, Wavecontrol S.L., Barcelona (Spain)</td>
</tr>
<tr>
<td>12:00 – 13:00</td>
<td>Lunch</td>
</tr>
</tbody>
</table>

### SAIOH PROFESSIONAL DEVELOPMENT COURSE (PDC) PROGRAMME – WEDNESDAY, 24 OCTOBER 2018

SECOND OFFERING (will run in parallel with the launch of the SAIOH Mining Forum)

<table>
<thead>
<tr>
<th>Time</th>
<th>Activities</th>
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<tbody>
<tr>
<td>08:00 – 09:00</td>
<td>Registration (Tea/Coffee and breakfast snack on arrival) - Exhibitor and Poster Viewing</td>
</tr>
<tr>
<td>09:00 – 16:00</td>
<td><strong>PDCs IN PARALLEL – Full Day Sessions</strong></td>
</tr>
<tr>
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<td><strong>PDC 1</strong></td>
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<tr>
<td></td>
<td><strong>PDC 2</strong></td>
</tr>
<tr>
<td></td>
<td>Electromagnetic fields (EMFs): Measurement and control of human exposure to non-ionising radiation. Mr Aymen Jemni – Application Engineer, Wavecontrol S.L., Barcelona (Spain)</td>
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<tr>
<td></td>
<td><strong>OR</strong></td>
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<tr>
<td></td>
<td><strong>PDC 3</strong></td>
</tr>
<tr>
<td></td>
<td>Noise control engineering – Proven and effective solutions. Mr Dennis P Driscoll - President and Principal Consultant, Associates in Acoustics, Inc. Denver, Colorado (USA)</td>
</tr>
<tr>
<td>12:00 – 13:00</td>
<td>Lunch</td>
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</tbody>
</table>
# Launch of the SAIOH Mining Forum

## SAIOH Annual Conference Mining Forum Programme – Launch of the SAIOH Mining Forum – Wednesday, 24 October 2018

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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</thead>
<tbody>
<tr>
<td>Date</td>
<td>Wednesday, 24 October 2018</td>
</tr>
<tr>
<td>Venue</td>
<td>Champagne Sports Resort, Central Drakensberg, KZN</td>
</tr>
<tr>
<td>07:30 – 08:15</td>
<td>Registration (Tea/Coffee and breakfast snack on arrival) - Exhibitor and Poster Viewing</td>
</tr>
</tbody>
</table>

### 08:15 – 13.10 Plenary Session 1

**Session Chair:** Sean Chester – SAIOH PCC Chair

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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</thead>
<tbody>
<tr>
<td>08:15 – 08:30</td>
<td>Welcome and Opening + Safety Brief</td>
</tr>
<tr>
<td>08:30 – 09:00</td>
<td>Official launch of the SAIOH Mining Forum – Aims and Objectives</td>
</tr>
<tr>
<td>09:00 – 09:45</td>
<td>International Keynote Presentation: Dr Brian Davies AM (University of Wollongong, Australia) – Diesel particulate matter (DPM) control strategies in the mining industry</td>
</tr>
<tr>
<td>09:45 – 11.00</td>
<td>Oral Presentations</td>
</tr>
<tr>
<td>09:45 – 10:15</td>
<td>Status of occupational health in the South African Mining Industry (SAMI) – Constance Kekana &amp; Duduzile Lekoba (Department of Mineral Resources - DMR)</td>
</tr>
<tr>
<td>10:15 – 10:45</td>
<td>Diesel particulate matter (DPM) and crystalline silica exposure in the South African Mining Industry (SAMI) – Cecilia Pretorius (Council for Scientific and Industrial Research - CSIR)</td>
</tr>
<tr>
<td>10:45 – 11:00</td>
<td>Questions / Discussion (15 mins)</td>
</tr>
<tr>
<td>11:00 – 11:30</td>
<td>Tea/Coffee, Snacks and Exhibitor and Poster Viewing</td>
</tr>
<tr>
<td>11:30 – 13:10</td>
<td>Oral Presentations</td>
</tr>
<tr>
<td>12:00 – 12:30</td>
<td>Educational changes to support Occupational Hygiene needs in South Africa – Dr Derk Brouwer, Daniel Masekameni &amp; Goitsemang Keretsete (Wits University)</td>
</tr>
<tr>
<td>12:30 – 13:00</td>
<td>Dust control in underground mines – Mr Martinus van der Bank (Mine Ventilation Society of South Africa - MVSSA)</td>
</tr>
<tr>
<td>13:00 – 13:10</td>
<td>Questions / Discussion (10 mins)</td>
</tr>
<tr>
<td>13:10 – 14:00</td>
<td>Lunch and Exhibitor and Poster Viewing</td>
</tr>
<tr>
<td>14:00 – 16:30</td>
<td>Plenary Session 2 – Session Chair: Deon J Van Vuuren - SAIOH PCC Senior Chief Examiner</td>
</tr>
<tr>
<td>14:00 – 16:30</td>
<td>Oral Presentations</td>
</tr>
<tr>
<td>14:00 – 14:30</td>
<td>Occupational hygiene in the Botswana mining industry: The Debswana perspective - Keneilwe Matjola (Debswana Mines)</td>
</tr>
<tr>
<td>14:30 – 15:00</td>
<td>Occupational hygiene research in the South African Mining Industry (SAMi) - Julize van Niekerk (Mine Health and Safety Council - MHSC)</td>
</tr>
<tr>
<td>15:00 – 15:20</td>
<td>Tea/Coffee, Snacks and Exhibitor and Poster Viewing</td>
</tr>
<tr>
<td>15:20 – 15:50</td>
<td>Real-time monitoring and predictive analysis in mining – Prof Cas J Badenhorst &amp; Johannes J van Staden (Anglo American)</td>
</tr>
<tr>
<td>15:50 – 16:30</td>
<td>Interactive session, Questions / Discussion – Close of Mining Forum Launch</td>
</tr>
</tbody>
</table>

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**SAIOH Mining Forum Launch Social Event**

**Date:** Wednesday, 24 October 2018  
**Venue:** TBC  
**Time:** 18:00 – Late
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>07:30 – 08:15</td>
<td>Registration (Tea/Coffee and breakfast snack on arrival) - Exhibitor and Poster Viewing</td>
</tr>
</tbody>
</table>
| 08:15 – 12:05 | **Plenary Session 1**  
  Session Chairs: Stefan Linde (North West (Potchefstroom) Branch) & Liandi Viljoen (North West (Rustenburg) Branch) |
| 08:15 – 08:30 | Welcome and Opening + Safety Brief  
  Julie Hills – SAIOH President 2018 |
| 08:30 – 09:15 | **INTERNATIONAL KEYNOTE PRESENTATION 1:**  
  Dr Sally Spankie (Institute of Occupational Medicine (IOM), Scotland) - Working with REACH – Over a decade of helping companies to meet their regulatory obligations |
| 09:15 – 09:35 | Applying the hierarchy of control to informal work environments – Karen du Preez (National Institute for Occupational Health - NIOH) & Jeanneth Manganyi (NIOH & Wits University) |
| 09:35 – 09:55 | Control of respirable crystalline silica and carbon dioxide gas in people carriers – Brandon Nothling & Sean Chester (Apex Environmental) |
| 09:55 – 10:25 | Tea/Coffee, Snacks and Exhibitor and Poster Viewing |
| 10:25 – 11:05 | **Oral Presentations – Control of Chemical Stressors**  
  10 minutes - Using 21st century exposure science to inform control of exposure - Goitsemang Keretetse, Daniel Masekameni & Dr Derk Brouwer (Wits University)  
  15 minutes - Informed decision-making on administrative controls to reduce exposure to particles: Scientific basis of reduction of exposure duration – Dr Derk Brouwer, Daniel Masekameni & Goitsemang Keretetse (Wits University)  
  15 minutes - Anticipation of exposure control of emerging technologies through workplace material and process design - Daniel Masekameni, Goitsemang Keretetse & Dr Derk Brouwer (Wits University) |
| 11:05 – 11:50 | **INTERNATIONAL KEYNOTE PRESENTATION 2:**  
  Mr Adrian Sims (Vent-Tech Ltd, UK) – Testing of local exhaust ventilation (LEV) systems: Status and practice in the UK |
| 11:50 – 12:05 | Questions / Discussion (15 mins) |
| 12:05 – 13:00 | Lunch and Exhibitor and Poster Viewing |
| 13:00 – 16:25 | **Plenary Session 2**  
  Session Chairs: Riaan le Roux (Western Cape Branch) & Daniel Masekameni (Gauteng South Branch) |
| 13:00 – 13:45 | **INTERNATIONAL KEYNOTE PRESENTATION 3:**  
  Mr Dennis P Driscoll (Associates in Acoustics, USA) – Hearing loss prevention: What are the barriers and what does it take to succeed? |
| 13:45 – 15:00 | **Oral Presentations – Control of Physical Stressors**  
  13:45 – 14:05 - Thermal imaging: A visual identification method to aid noise control techniques – Leon Pretorius (Apex Environmental)  
  14:05 – 14:25 - Are industry implemented Hearing Conservation Programmes (HCPs) effective? An industry evaluation – Oscar Rikhotso, Dr JL Harmse & Prof JC Engelbrecht (Tshwane University of Technology - TUT)  
  14:25 – 14:45 - People implement controls – Garth Hunter (Engen Petroleum)  
  14:45 – 15:00 - Questions / Discussion (15 mins) |
| 15:00 – 15:30 | Tea/Coffee, Snacks and Exhibitor and Poster Viewing |
| 15:30 – 16:25 | **Oral Presentations – Challenges of implementing Health Surveillance as part of a company’s control and exposure reduction programme**  
  Occupational health service providers defined for South Africa – Prof Daan J Kocks (SASOM Chair) & Dr Adriaan Combrinck (SASOM Treasurer) |
<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>15:50 – 16:10</td>
<td>The decrease of biological lead levels at a lead nitrate plant in South Africa – Susanne Martinuzzi (SASOHN Representative)</td>
</tr>
<tr>
<td>16:10 – 16:25</td>
<td>Questions / Discussion (15 mins) – Close of programme – Day 1</td>
</tr>
<tr>
<td>16:25 – 16:45</td>
<td>Comfort Break</td>
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<tr>
<td>16:45 – 18:00</td>
<td>SAIOH Annual General Meeting</td>
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<td></td>
<td>Julie Hills (SAIOH President) and Celia Keet (SAIOH Vice-President and Treasurer)</td>
</tr>
</tbody>
</table>

**SAIOH GALA DINNER AND ANNUAL AWARDS EVENING, WITH A PERFORMANCE BY THE DRAKENSBERG BOYS CHOIR**

**DATE:** Thursday, 25 October 2018  
**VENUE:** TBC  
**TIME:** 19:00 – LATE  
**DRESS CODE:** SEMI-FORMAL

---

**The Drakensberg Boys Choir:**  
Champions at the 2018 World Choir Games in Tshwane, South Africa  
Category: Scenic Pop  
Score: 95.5 %

*Source: [http://dbchoir.com](http://dbchoir.com)*
# SAIIOH ANNUAL CONFERENCE MAIN PROGRAMME – DAY 2

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>07:00 – 08:15</td>
<td>Special SAIIOH Branch Representatives Breakfast Meeting (by invitation)</td>
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## SAIIOH ANNUAL CONFERENCE MAIN PROGRAMME - FRIDAY, 26 OCTOBER 2018

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>Date</td>
<td>Friday, 26 October 2018</td>
</tr>
<tr>
<td>Venue</td>
<td>Champagne Sports Resort, Central Drakensberg, KZN</td>
</tr>
<tr>
<td>07:30 – 08:30</td>
<td>Registration (Tea/Coffee and breakfast snack on arrival) - Exhibitor and Poster Viewing</td>
</tr>
</tbody>
</table>

### Plenary Session 3
Session Chairs: Peter-John (Jakes) Jacobs (KwaZulu-Natal North Coast Branch) & Tshepiso Mantjane (Mpumalanga Branch)

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>08:30 – 09:15</td>
<td>INTERNATIONAL KEYNOTE PRESENTATION 4: Dr Brian Davies AM (University of Wollongong, Australia) - Learnings from the development, implementation and maintenance of a control strategy for diesel particulate matter (DPM)</td>
</tr>
<tr>
<td>09:15 – 10:25</td>
<td>Oral Presentations – Special Session – Stakeholders - Inspectorate and partner views on adequate control</td>
</tr>
<tr>
<td>09:15 – 09:35</td>
<td>Exposure of workers to hazardous biological agents (HBAs) in the health care sector – Kaiser Lubisi (Department of Labour - DoL)</td>
</tr>
<tr>
<td>09:35 – 09:55</td>
<td>Prohibited use of compressed air – Elize Lourens (Department of Labour - DoL)</td>
</tr>
<tr>
<td>09:55 – 10:15</td>
<td>The science fiction of OH monitoring: Moderate predictability of welding fume quantification – J Deon Swanepoel (Aquaticoh), Prof Cas J Badenhorst (Anglo American) &amp; Johannes J van Staden (Anglo American)</td>
</tr>
<tr>
<td>10:15 – 10:25</td>
<td>Questions / Discussion (10 mins)</td>
</tr>
<tr>
<td>10:25 – 10:45</td>
<td>Tea/Coffee, Snacks and Exhibitor and Poster Viewing</td>
</tr>
<tr>
<td>10:45 – 11:30</td>
<td>INTERNATIONAL KEYNOTE PRESENTATION 5: Mr Aymen Jemni (Wavecontrol S.L., Spain) – Human body exposure to electromagnetic fields (EMFs)</td>
</tr>
<tr>
<td>11:30 – 11:45</td>
<td>‘5 Minutes, 5 Slides’ – Mini Oral Presentations</td>
</tr>
<tr>
<td>11:30 – 11:35</td>
<td>Occupational hygienists’ involvement in the development of emergency plans – Harold Gaze (Occutech cc)</td>
</tr>
<tr>
<td>11:35 – 11:40</td>
<td>The advantage of different methods of evaluating solar ultraviolet radiation (UVR) exposure in implementing control measures – Karlien Linde (University of Limpopo - UL) &amp; Cynthia Ramotsehoa (North-West University – NWU)</td>
</tr>
<tr>
<td>11:40 – 11:45</td>
<td>Managing occupational exposures to hazardous chemical substances (HCSs) in a laboratory environment using occupational hygiene statistics – Gabriel Mizan (NIOH &amp; Wits University)</td>
</tr>
<tr>
<td>11:45 – 13:00</td>
<td>Special Session – “All Things SAIIOH PCC”</td>
</tr>
<tr>
<td>11:45 – 13:00</td>
<td>PCC – Special ‘Surprise Event’</td>
</tr>
<tr>
<td>12:30 – 12:45</td>
<td>Questions / Discussion (15 mins)</td>
</tr>
<tr>
<td>12:45 – 13:00</td>
<td>Wrap-up of Proceedings, Student Awards, Vote of Thanks and Conference Closure</td>
</tr>
</tbody>
</table>

SAIOH President 2019 and SAIOH KZN Branch Chair
Farewell – Travel Safely

<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>13:00 –</td>
<td>Lunch</td>
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</tbody>
</table>

*SAIOH*
 POSTER PRESENTATIONS

Venue: Exhibition Hall

Sub-theme – Using Data to Inform Control

- A systematic review on occupational exposure to chalk-dust particles and health effects: Knowledge gaps in South Africa – Thokozani Mbonane et al (University of Johannesburg - UJ)

- Skin and respiratory exposure to 11 metals in precious metals refineries – Stefan Linde et al (North-West University - NWU)

Sub-theme – Control of Chemical Stressors

- A systematic review on correlation between lead exposure, intelligence quotient (IQ) and academic performance in developing countries: A South African perspective – N Ntenje et al (University of Johannesburg - UJ) – Student Poster

- The design and management of risk control systems for health – Kevin Renton (NIOH & Wits University)

- Control of isocyanate exposure in the motor vehicle repair industry – Ntokozo Mkhize et al (Durban University of Technology – DUT) – Student Poster

Sub-theme – Control of Physical Stressors

- Blood parameter responses in mice (Mus musculus) exposed for one week to an electromagnetic field – Henry Gleimius et al (Central University of Technology - CUT)

- Assessment of noise levels in the thermodynamic laboratory at the University of Johannesburg – Phoka Rathebe et al (University of Johannesburg - UJ)

- Evaluation of noise levels to which forklift operators are exposed, at a fresh produce market in South Africa – David Rangongo (NIOH)

Sub-theme – Mining

- Control of heat stress in South African mines - Sanele Mdlalose et al (Durban University of Technology - DUT) – Student Poster
BIO-SKETCHES

of

PDC and KEYNOTE PRESENTERS

&

ABSTRACTS

of all

PRESENTATIONS

(in the order listed in the programme)
Mr Adrian Sims
Managing Director: Vent-Tech Ltd, Bristol, UK
CEng. BSc. (Hons) CoC (Control) MFOH(S) MILEVE FIPLANTE

Qualifications

- Specialist Member of the British Occupational Hygiene Society (BOHS)
- Member of Institute of Local Exhaust Ventilation Engineers (ILEVE)
- ILEVE accredited for:
  - Local Exhaust Ventilation (LEV) Design, Commissioning, Testing and Installation of LEV Systems
- Managing Director of Vent-Tech Ltd, Bristol, UK

Professional Career

- Building services engineer with nearly 30 years’ experience in the industry as consultant and contractor specialising in the design of mechanical building services systems
- Spent several years working for an industrial centrifugal fan manufacturer
- Managing Director of Vent-Tech Ltd (17 years) carrying out the design, installation, testing and commissioning of specialist LEV systems
- Has designed and commissioned systems to control hazardous substances handling for many types of chemicals and industrial processes
- Has consulted on COSHH Control issues to a range of blue chip clients, which have included Airbus, Rolls Royce, The Royal Mint, Toyota, Bombardier, Marshall Aerospace, Premier Foods, Genzyme, AstraZeneca, Johnson Apparelmaster, Bob Martin, Tiffany’s, Mission Foods and Aunt Bessie’s, to name a few

Academic Expertise

Accredited examiner and tutor for the BOHS PCert Courses:-

- P601 Examination and Testing of Local Exhaust Ventilating Plant
- P602 Design of Local Exhaust Ventilating Plant
- P603 Personal Protective Equipment (PPE)
- P604 Performance and Evaluation of LEV Systems
- W201 Basic Principles in Occupational Hygiene
- IP601 Examination and Testing of Local Exhaust Ventilating Plant – International Module

Career Highlights

- BOHS Certificate of Competence in Control of Hazardous Substances – 2013
- Society of Operations Engineers – Plant Engineer of the Year 2015
- Current Vice-Chair of the ILEVE

Facilitator of the Professional Development Course (PDC1) on “Testing the performance of local exhaust ventilation (LEV) systems to achieve adequate control of employee exposures”

International Keynote Presenter
Mr Aymen Jemni  
Application and Sales Engineer  
Wavecontrol S.L., Barcelona, Spain

Qualifications

- Electronic and Electro-technique engineering degree - ENIT
- Master of Science in Information and Communication Technologies – Polytechnic University of Catalonia

Professional Career

Current Position:

- Application and Sales Engineer at Wavecontrol S.L., Barcelona, Spain

Previous Position:

- Investigation Engineer at the Microelectronic Institute of Barcelona, Spain

Career Highlights

- Extensive experience in field service and application engineering related to Electromagnetic Field (EMF) exposure for both workers and general public gained by working closely with telecommunication regulators, service laboratories specialised in EMF assessment and standard and normative specialists
- Special training with the Welding Institute (TWI), UK, a participating organisation in the redaction of the EU EMF Directive Guide
- Extensive hands-on experience with EMF measurement in different applications and sectors

-----------------------------------------------------------------------------------------------------------------------------

- Facilitator of the Professional Development Course (PDC2) on “Electromagnetic fields (EMFs): Measurement and control of human exposure to non-ionising radiation”
- International Keynote Presenter
Mr Dennis P. Driscoll  
President and Principal Consultant: Associates in Acoustics, Inc., Denver (USA)

Qualifications
- Bachelor of Science and Master of Science in Mechanical Engineering
- Licensed Professional Engineer
- Board Certified Noise Control Engineer

Professional Career

Current Position:
- President and Principal Consultant: Associates in Acoustics, Inc., Denver, Colorado, USA (1988 to present time)

Previous Position:
- Noise Control Engineering Coordinator and Hearing Conservation Programme Manager, BP Corporation (1980 - 1988)

Affiliations with Professional Organisations
- Fellow Member of the American Industrial Hygiene Association (AIHA), 1981 to present
- Board Member of the Council for Accreditation in Occupational Hearing Conservation (CAOCH), August 1992 to 1998
- Full Member of the Acoustical Society of America (ASA), 1978 to present
- Full Member of the National Hearing Conservation Association (NHCA), 1985 to present
- President of the National Hearing Conservation Association, 1996 -1997

Career Highlights
- *Henry F. Smyth, Jr. Award*, Academy of Industrial Hygiene, 2013
- 2003 Industrial Hygienist of the Year, AIHA Rocky Mountain Section
- Top-rated Professional Development Course Instructor at the AIHA Conference and Exposition (AIHce) on more than 14 occasions
  - Both the #1 and #2 rated Professional Development Courses at the 2002 (San Diego) and 2003 (Dallas) AIHce. Courses were #1 - Noise Control Engineering and #2 - Community Noise
- *Outstanding Lecture Award on Noise*, AIHce (2001, 1999, 1997), sponsored by the AIHA Noise Committee
- *Michael Beall Threadgill Award for Outstanding Leadership and Distinguished Service, NHCA*, February 2000
- *NHCA’s Outstanding Lecture Award, 1999* NHCA 24th Annual Conference

Fun Facts
- 800 noise control engineering and/or noise exposure survey reports written for industrial clients
- 350 noise control engineering, hearing conservation, and community noise seminars presented at professional association conferences and/or client locations
- 65 conference platform presentations, not including workshops or seminars
- 20 peer reviewed articles and book chapters / 17 lay articles and media interviews on noise-related issues
- 30 countries visited for noise control and/or hearing conservation services

- Facilitator of the Professional Development Course (PDC3) on “Noise control engineering – Proven and effective solutions”
- International Keynote Presenter
Dr Brian Davies AM, PhD

Qualifications

- BSc, University of New South Wales (NSW), Australia
- PhD, University of Victoria, Australia

Professional Career

Current Position:

- Honorary Principal Fellow, University of Wollongong, Wollongong, NSW, Australia

Previous Positions:

- Associate Professor, University of Wollongong, Wollongong, NSW, Australia
- Director, Australian Environmental Health Services Pty Ltd
- Chief Occupational Hygienist, BHP Pty Ltd

Affiliations with Professional Organisations

- Fellow & Past President, Australian Institute of Occupational Hygienists
- Past President, International Occupational Hygiene Association (IOHA)
- Founding Member, Occupational Hygiene Training Association (OHTA)

Career Highlights

- Recipient of the 2010 IOHA Lifetime Achievement Award
- In 2005 awarded the Member of the Order of Australia (AM) by the Governor General of Australia (For service to occupational health and hygiene, particularly in relation to the coal industry, and through the Australian Institute of Occupational Hygienists).
- Recipient of 2003 William Steiger Memorial Award. Presented by the American Conference of Governmental Industrial Hygienists (ACGIH) to honour individuals whose efforts have contributed to advancements in Occupational Safety and Health. (First non-North American to receive this award).
- Recipient of 2002 Yant Award. Presented by the American Industrial Hygiene Association (AIHA) for outstanding contribution to the field of Occupational Hygiene.

Keynote Presenter (Mining Forum Launch and SAIOH Annual Conference)
Dr Sally Spankie, PhD

Qualifications

- PhD (Chemistry), Heriot-Watt University, Riccarton Campus, Edinburgh, Scotland
- BSc Hons (Chemistry), Edinburgh University, Edinburgh, Scotland

Professional Career

Current Position:
Sally has been (re-)working as a Research Scientist at the Institute of Occupational Medicine (IOM) from 2009 to the present time. She has been involved in conducting occupational hygiene research and consultancy specifically in the area of exposure assessment to hazardous substances e.g. metals, inorganics, monomers, solvents, lubricants, paints, grain and nanomaterials. Many of the research and large consultancy projects are multi-disciplinary and serve internationally-based clients (Europe, South Africa and South Korea). This has included workplace dermal, inhalation and particle size distribution monitoring; assessment and application of models to estimate exposure for regulatory, lung deposition and aggregate exposure assessment purposes and human health exposure assessments to inform companies’ product stewardship activities and regulatory compliance under the Registration, Evaluation and Authorisation of Chemicals (REACH) Regulations. More recently Sally has become involved in company training activities.

Previous Positions:
- Sally has spent much of her professional career (1993 - 2008) working in Africa. She lectured in inorganic chemistry at the University of Malawi for four years, supervised honours students and vocational students in industry, and was involved in taking practical chemistry to rural schools.
- During her ten years at the University of Natal / KwaZulu-Natal (UKZN), Sally worked on various science access programmes and was course coordinator for chemistry on the Science Foundation Programme and the Chemistry Augmented Programme. She introduced occupational hygiene onto the Chemical Technology Degree Programme syllabus and provided academic support. She supervised applied chemistry research projects (at honours and masters level, in industrial monitoring for the areas of environmental auditing, waste minimisation analyses and occupational hygiene), across various industrial sectors. The research was geared to assist local companies achieve environmental and financial savings through waste minimisation and compliance with occupational exposure limits through personal exposure monitoring.
- Before coming to Africa, Sally worked for the IOM in Edinburgh. She took her Preliminary Certificate and Certificate of Operational Competence qualifications in occupational hygiene while first working there.

Career Highlights

- Attended, presented two papers and chaired a session at the 7th International Symposium on Nanotechnology, Occupational and Environmental Health in Waterberg, South Africa (2015)
- Visited the Clydach Nickel Refinery in Swansea, Wales, to help inform REACH exposure scenario development (2009)
- Presented a paper at the 22nd International Conference on Solid Waste Management and Technology, Philadelphia, USA (2007)
- Selected to participate in the Cleaner Metal Finishing Production Project’s Study Tour to Denmark in 2002, funded by the Danish Cooperation for Environment and Development (DANCED)

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- International Keynote Presenter
Testing the performance of local exhaust ventilation (LEV) systems to achieve adequate control of employee exposures

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Keywords: local exhaust ventilation (LEV), design, testing

Background:
International and South African legislation for Hazardous Chemical Substances requires employers to ensure that chemical emissions are controlled. In many instances the best way to do this is by providing and ensuring effectiveness of local exhaust ventilation (LEV) systems.

Methods:
This Professional Development Course (PDC) will focus on:

- Discussing the various types of the most critical part of any LEV system, the extraction hood
- Helping course participants to decide on the minimum performance that the main types of extraction hood would need in order to adequately control employee exposures
- Outlining appropriate performance requirements for the other elements of LEV systems
- Outlining the methods and the testing equipment that are needed in order to test the actual performance of an LEV system
- Discussing a number of real-life case studies to aid in the interpretation of test data from actual LEV systems.

Sub-theme: Professional Development Course 1
Electromagnetic fields (EMFs): Measurement and control of human exposure to non-ionising radiation

Mr Aymen Jemni
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Keywords: electromagnetic fields (EMFs), assessment, exposure, instrumentation, control

Background:
Introduction to non-ionising radiation and electromagnetic fields (EMFs) and their health effects on the human body and how to best control exposure to EMFs.

Methods:
Normative, standards and guidelines for EMFs including standards of the International Commission on Non-Ionising Radiation Protection (ICNIRP) and the European Union (EU) Directive 2013/35/EU on the minimum health and safety requirements regarding the exposure of workers to EMFs.

Application and Sectors – Where are EMF health risks most prevalent?

Instrumentation – How to quantify exposure to EMFs using international best practice and relate this to EU and ICNIRP exposure standards?

Results:
A better understanding of non-ionising radiation, its health effects, how to accurately quantify exposure and relate sampling results to exposure standards and control exposure to EMFs.

Conclusions:
Occupational hygiene professionals are better equipped to assess the health risks associated with EMF exposure and better understand control measures to reduce exposure risk scenarios.

Sub-theme: Professional Development Course 2
Noise control engineering - Proven and effective solutions

Mr Dennis P. Driscoll
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Professional Engineer and Board Certified Noise Control Engineer
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Keywords: noise survey, noise mechanisms, design, specific equipment, case histories

Prerequisites:
As a prerequisite, students must be familiar with the fundamentals of noise and basic terminology, such as A-weighted sound levels, decibel addition, octave-band frequencies, noise dose, and employee time-weighted average noise exposure.

Course Outcomes:
Upon completion of the course, attendees will be able to apply the noise control concepts to:
- Conduct a noise control survey, identify the noise generating mechanisms, and prioritise items for noise control.
- Develop feasible engineering controls through effective implementation of the Principles of Noise Control.
- Complete noise control design and retrofit applications for a variety of industrial equipment, such as pneumatic or compressed air systems, electric motors, fans or blowers, pipelines, panel radiated noise, etc.
- Work effectively with design contractors, acoustical product suppliers, and consultants to achieve the stated noise criteria or goals.

Course Outline:

Course Description:
The most effective way to prevent occupational noise-induced hearing loss is through effective implementation of engineering noise controls. With some advanced education and training, it is feasible for industrial hygienists with a basic knowledge of the fundamentals of noise to develop noise control solutions; establish noise control priorities; identify and select optimum products for retrofitting equipment; work effectively with design engineers to implement a pro-active approach to noise control; and predict the impact new equipment will on the existing noise levels.

Instructional Methods and Learning Aids:
The instructional method will involve presentation of multiple case histories to present the principles of noise control, and describe the various noise control applications and options for specific industrial equipment. Noise control demonstrations will be used to reinforce the concepts and proper use of acoustical materials. Several spreadsheet routines will be provided to students and demonstrated throughout the lectures.

Several spreadsheet programmes and significant references for noise control will be provided to each student, as well as demonstrated throughout the course.

Sub-theme: Professional Development Course 3
Diesel particulate matter (DPM) control strategies in the mining industry

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Keywords: diesel particulate matter (DPM), control, strategies, mining

Background:
Diesel particulate matter (DPM) is a known carcinogen which is prevalent in the exhaust of diesel engines operating in the mining industry. Considerable research has taken place into the control of DPM, however no single simple control strategy currently exists for operating diesel fleets.

This presentation aims to provide insight into the effectiveness of a range of different control strategies and the issues associated with their implementation.

Methods:
The discussion will cover a range of DPM control strategies from ventilation to new technology engines but will focus on emissions based maintenance (EBM) as this provides a practical means by which to reduce worker exposure to DPM at its source.

EBM can be an effective strategy in several ways, one of which is its ability to drive cultural change if implemented effectively.

Results:
A range of results will be presented, highlighting the effectiveness and problems of individual DPM control strategies used on / in service diesel vehicles in the mining industry.

Conclusions:
Effective control strategies for DPM generated by mining vehicles currently exist but for maximum effectiveness they need to be viewed as a critical part of the equipment, so when they require maintenance, it happens immediately.

Such an approach will result in lower workplace DPM exposures and if an EBM is in place, may result in productivity gains.

Sub-theme: Keynote Presentation – Mining Forum Launch
Status of occupational health in the South African Mining Industry (SAMI)

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Keywords: mining, occupational health, compliance, intervention effectiveness

Background:
The Department of Mineral Resources (DMR) through the Chief Inspector of Mines as required by the Mine Health and Safety Act, 1996 (Act 29 of 1996), as amended in terms of Section 49(1)(j), is required to report on the status of health and safety at mines and the activities of the Mine Health and Safety Inspectorate (MHSI). The MHSI, established in terms of the MHSA 1996, as amended, has the responsibility of protecting the health and safety of persons working at mines or those who are affected by mining activities.

Methods:
On an annual basis, the MHSI receives, collates, analyses and follows up with mines with regard to:

i) Occupational hygiene personal exposures trends;
ii) Occupational disease trends, including fatalities due to occupational disease; and
iii) Fire incidence trends.

This is done in order to be informed about the prevailing situation of the South African Mining Industry (SAMI) with regard to the compliance to the legislative framework and identification of problem areas. The analysis gives an indication of the effectiveness of the mine interventions to prevent future occurrences (no repeats). The data and their interpretation are also used to inform the research needs of the SAMI.

Results:
Occupational diseases reduced from 8753 in 2007 to 4632 in 2017. Exposures reduced as follows: airborne pollutants above the occupational exposure limit (OEL) from 13.63% in 2006 to 4.73% in 2017; noise levels above the A classification band (≥105dB (A)), from 9.38% in 2006 to 0.96% in 2017. Thermal heat exposures: fire related fatalities for 2018, provincial data (6); heat related fatalities for 2018, provincial data (5).

Conclusions:
The health and safety of mine workers remain crucial for the sustainability of the SAMI. The DMR will continue to enforce applicable laws to protect mine workers from health and safety hazards in their respective workplaces.

Sub-theme: Oral Presentation (Mining Forum Launch)
Diesel particulate matter (DPM) and crystalline silica exposure in the South African Mining Industry (SAMI)

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Keywords:

Notes:

Sub-theme: Oral Presentation (Mining Forum Launch)
With the South African Mining Industry’s (SAMI) vision of ‘Zero Harm’, together with the commitment made by mining companies towards achieving the agreed Noise Milestones, the elimination of noise hazards associated with mining led to the development of the ‘Industry-wide Buy and Maintain Quiet Initiative’ (IBMQI).

The IBMQI is a standing decision from the mining companies to procure new equipment and maintain existing machinery to ensure compliance with the relevant noise emission requirements. The IBMQI further emphasises that it is substantially more cost effective for the mining companies within the SAMI to embark on an industry-wide initiative, as opposed to individual companies' reactive engineering developments and other controls.

The Initiative focuses on noise source management as a primary control towards the management of noise hazards at the design phase, based on a collective demand from SAMI, to motivate manufacturers and suppliers to place significant focus on noise reduction as part of their product development. The departure point for the Initiative was the conducting of a literature review of all previous research on noise reduction in mining equipment, with specific focus on alterations or enhancements resulting in the reduction of noise emissions as part of shifting the industry’s focus towards the management and control of noise at source.

The IBMQI Framework considers three focus areas, viz. Measurement and Standards, Research, and Procurement, with subcommittees established as part of ensuring the required IBMQI deliverables within each focus area. The key deliverables include, among others:

- **Measurement and Standards Subcommittee:**
  - Noise measurement methodology guideline
  - Compiling a noise source inventory
  - Noise risk assessment/screening and identification of critical noise sources
  - IBMQI & noise awareness booklets for manufacturers, practitioners, employees and employers

- **Research Consolidation Subcommittee:**
  - Review previous and current research and inform future research
  - Identify/review applicable technology

- **Procurement Subcommittee:**
  - Prioritisation of critical equipment
  - Review critical noise equipment and noise reduction-target setting

Sub-theme: Oral Presentation (Mining Forum Launch)
Tertiary Training & Learning (T&L) programmes in the field of occupational hygiene (OH) in South(ern) Africa are scarce and often under-resourced; this affects the quality of the OH professionals in general. The Wits - Anglo American endowment ‘Chair in Occupational Hygiene’, which comprises staff salaries and student bursaries, has significantly enhanced capacity and quality of OH T&L at the Wits School of Public Health (WSPH).

Capacity building, as one of the major tasks of the Chair, is effected by capacity building with regard to education and research, by expansion of teaching and especially supervision. This has resulted in increase of occupational research at Masters (MPH – Masters in Public Health) and Doctoral (PhD) level. A number of these research projects are focussed on the mining industry, e.g. control of respirable crystalline silica dust in quarries, exposure and control of diesel exhaust and radio frequencies in underground mines, whereas various other projects will indirectly benefit health prevention in this sector.

The development of the occupational hygiene discipline within WSPH to internationally accepted norms and standards was identified as another major task. In this regard the current OH T&L (MPH-OH) was evaluated. The conclusions reached, i.e. that adjustments are imperative, have already been implemented, via the development of two new T&L programmes. The MPH ‘Exposure and Health’ programme will focus on management of broader occupational and environmental risk management. The new MScMED ‘Exposure Science’ degree will start next year and will focus on the understanding of the cascade of processes resulting in exposure, in order to prevent or to control exposure better.

The ‘transformation’ of ‘Occupational Hygiene’ into ‘Exposure Science’ is key to keep pace with industrial and societal requirements in the field of prevention of exposure-induced diseases.

Sub-theme: Oral Presentation (Mining Forum Launch)
Dust control in underground mines

Marthinus van der Bank
Mine Ventilation Society of South Africa (MVSSA)

Keywords:

Notes:

Sub-theme: Oral Presentation (Mining Forum Launch)
Occupational hygiene in the Botswana mining industry: The Debswana perspective

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Keywords: diamond mining, safety and sustainable development, occupational hygiene, occupational health stressors

Background:
Debswana Diamond Company (Pty) Ltd is a partnership between the Government of the Republic of Botswana and the De Beers Group of Companies. The company’s primary objective is diamond mining and associated processes. The Occupational Hygiene (OH) discipline is a relatively new and scarce field in the mining industries, and in Botswana at large.

As part of the Debswana Mining Company strategy, the occupational hygiene function under the Safety and Sustainable Development Department provides support services to the entire value chain.

The Botswana legislation is in its infancy stages in terms of defining how mining and other industries should manage their occupational hygiene hazards and risks. Realising this, Debswana found it fit to initiate, develop and implement an OH management programme in its operations in order to manage reputational, legal, financial and health impacts associated with exposure to occupational health stressors.

Methods:
Desk top assessment of literature, reports, and meetings with key stakeholders

Results:
The development of a ‘mature and robust’ OH programme, and improved employee health, productivity, morale, and license to operate.

Conclusions:
The development and implementation of a dedicated OH programme based on OH best practice principles has not only benefited the Company in assuring the stakeholders that Botswana diamonds are mined in a safe and productive manner. These undertakings have also ensured that robust programmes are put in place to maintain employees’ health and wellbeing.

Sub-theme: Oral Presentation (Mining Forum Launch)
The Centre of Excellence (CoE) at the Mine Health and Safety Council (MHSC) was established with the aim of being a game changer and the first port of call in determining, delivering and disseminating occupational health and safety (OHS) research output that will strategically impact and provide value proposition to the South African Mining Industry (SAMI). The CoE is mandated to transform how research opportunities are identified, managed and disseminated for implementation in the SAMI. The core function of the CoE is to actively drive the journey to ‘Zero Harm’ and ensure that it assists the MHSC to be the knowledge leader and trusted advisor to the Minister of Mineral Resources and stakeholders on OHS challenges in the SAMI, and to promote a culture of OHS in the SAMI.

The CoE comprises three different units:
- Research Determination
- Research Delivery
- Research Dissemination

The Research Delivery unit’s role is to oversee research programme delivery that was identified through the Determination unit and which needs to be communicated to the mining industry through the Dissemination unit. The main aim of the Research Delivery unit is to ensure continuous management and oversight of all research programmes, ensuring efficiency and development of quality research outcomes.

The aim of this presentation is to explain the research, funding and application processes, as well as provide an overview of research previously conducted in the fields of occupational health and occupational hygiene. A brief insight will also be given into the research being conducted currently.

Sub-theme: Oral Presentation (Mining Forum Launch)
Real-time monitoring and predictive analysis in mining

Prof Cas J Badenhorst\textsuperscript{1} and Johannes J van Staden\textsuperscript{2}

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Keywords:

Notes:

Sub-theme: Oral Presentation (Mining Forum Launch)
Dr Sally Spankie1, Karen Galea2, Anne Sleuwenhoek3, Andrew Apsley4 and Martie van Tongeren5

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Keywords: REACH, exposure assessment, exposure scenarios, risk characterisation ratio

Background:
The Regulation concerning Registration, Evaluation, Authorisation, and Restriction of Chemicals (REACH) was progressively rolled out between 2007 and 2018. It required a registration dossier to be prepared and submitted to European Chemicals Agency (ECHA) for all substances used, produced or imported into Europe. This is performed by the ‘registrant’ i.e. jointly by the companies who use or produce the substance. A Chemical Safety Report presenting the hazard classification, a chemical safety assessment (human health, safety and environmental risk assessment) and exposure scenarios for all identified uses is needed when substances are used in excess of ten tonnes annually. ECHA evaluates these registration dossiers. The dossiers are initially checked for compliance and animal testing proposals. If, on further evaluation, it is felt that more exposure information is necessary, then the substance will be listed on the Community Rolling Action Plan (CoRAP). The Member State Competent Authority (MSCA), on behalf of ECHA, then liaises with the ‘registrant’ to inform them of their obligations to update the dossier.

Methods:
The Institute of Occupational Medicine (IOM) has been involved in assisting companies with their human health exposure assessment for the registration dossier (a metal) and for dossier revisions (lubricant and monomer) as defined under CoRAP. Central to this work has been the development of exposure scenarios. This work has involved:

- Extracting and assigning data collected by company Questionnaires and from published literature and reports,
- Carrying out dermal and inhalation exposure measurement campaigns and gathering contextual data at company sites,
- Modelling dermal and inhalation exposure estimates using MEASE version1.02.01, RISKOFDERM and Advanced REACH Tool (ART) version 1.5
- Carrying out uncertainty analysis, and
- Developing and applying an approach to read-across exposure estimates.

Results / Presentation overview:
This presentation will discuss IOM’s contribution to three ‘companies’ exposure assessment and exposure scenario documentation for the registration dossier as outlined under the (4 editions of) REACH guidance, Chapter R.14: Occupational exposure assessment.
Applying the hierarchy of control to informal work environments

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Keywords: street vendors, waste reclaimers, information and training

Background:
The number of workers in the informal sector in South Africa continues to increase, and includes self-employed persons and casual workers. The scope of application of the Asbestos, Lead, Hazardous Chemical Substances, and Noise Regulations of the Occupational Health and Safety Act (85 of 1993) include self-employed persons, implicating a duty on them to control exposures that may be harmful to their health, but they often fail to do so, possibly due to lack of knowledge or funding.

Methods:
Health and safety risk assessments were conducted at informal work environments that included waste reclaimers. A risk assessment process based on the ‘Five steps to risk assessment’ developed by the UK Health and Safety Executive (HSE) was followed. This process included identification of any hazard associated with the work performed, determining who can be harmed and how, evaluating risk and current control measures, and identifying additional control measures required. Control measures which are suitable, cost-effective and realistic to the work environment need to be identified and implemented to mitigate the assessed risks.

Results:
Risks identified in the informal work areas included ergonomic risks, exposure to hazardous chemical substances, exposure to hazardous biological agents, thermal stress due to working outside, exposure to noise as well as various safety risks. Implemented control measures are lacking, and may include second-hand personal protective equipment (PPE) obtained from waste or other sources. Due to the informal nature of the work, there are no external stakeholders to implement or fund control measures. Therefore, self-employed persons are usually reluctant to spend money on control measures, including PPE.

Conclusions:
Information and training as primary control measures may be the most effective approach, because understanding the effects associated with exposure to health risks may motivate self-employed persons to further control their exposure to these risk factors.

Sub-theme: Using Data to Inform Control – Oral Presentation (SAIOH Conference)
Control of respirable crystalline silica and carbon dioxide gas in people carriers

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Keywords: people carriers, forestry, respirable crystalline silica, CO₂ gas, controls

Background:
Whilst performing yearly respirable crystalline silica (RCS) monitoring in a forestry depot, the company's occupational health nurse voiced concerns regarding the indoor air quality of the people carriers used to transport forestry industry employees to the plantation work areas. Rough terrain (dirt roads) often results in these trips being slow and rigorous. Each trip comprises of up to 60 employees in the people carrier, who are collected and dropped off at the various areas each morning and afternoon. It was evident that the biggest concern to employees was the potential exposure to RCS (through the air vents), as well as a build-up of carbon dioxide (CO₂) gas.

Methods:
The assessments spanned a period of 18 months, with modifications to the carriers occurring in between each visit. The sampling and measurements were as follows:

- Total inhalable dust, respirable dust and RCS static air samples positioned in the middle of the carrier (NIOSH Methods 0500, 0600 and 7602)
- Direct CO₂ gas measurements (Delta OHM)
- Air velocity measurements at the carrier vents (hot-wire anemometer)

Results:
- Initial CO₂ gas: > 3000 ppm when the carrier was stationary, and > 2300 ppm whilst in transit
- RCS levels: > 20% of the TWA OEL-CL
- Total inhalable dust samples: < 10% of the TWA OEL-RL

After corrective measures were implemented, including the enlarging of the inlet vents surface area as well as the fitting of a Bidum dust filtering material, CO₂ gas levels were reduced to below 1000 ppm when stationary, and RCS levels were reduced by 10% of the TWA OEL-CL.

Conclusions:
Simple, inexpensive but effective control measures can be implemented to reduce employee exposure to RCS and CO₂ gas in people carriers. Furthermore, the above assessment highlights the importance of identifying all workplace hazards, and not just those that are in plain sight.

Sub-theme: Using Data to Inform Control – Oral Presentation (SAIOH Conference)
Using 21st century exposure science to inform control of exposure

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Keywords: exposure science, exposure control, intervention, workplace, teaching and learning

Background:
Exposure science studies human contact with chemical, physical, or biological agents occurring in their environments, and advances knowledge of the mechanisms and dynamics of events causing or preventing adverse health outcomes. It is the domain of a multi-disciplinary approach focusing on the mitigation of human health risk, by control of exposure or reducing the vulnerability / enhancing resilience of the receptor. The developments of the ‘exposome’ and exposure science have shown that all exposures, e.g. consumer, residential, environmental and occupational, should be considered over the entire lifetime. While the current focus is on the assessment of occupational exposure, these new developments highlight the need for occupational hygiene to not only focus on exposure assessment but also consider the underlying processes and their control. The focus should be on the design and selection of effective (occupational) exposure prevention and control strategies, taking into account efficacy, efficiency (cost-benefits) and intervention implementation issues.

Methods:
The current occupational hygiene academic curriculum was evaluated following criteria adopted from global guidelines and input from external reviewers. The approach was to integrate exposure science, occupational hygiene and environmental health in the curriculum. This will provide a more holistic approach and understanding of the relationship between the stressor and exposure, and the resulting health outcome of the exposure, at group and individual level.

Results:
The revised curriculum includes (but is not limited to) the following courses: Fundamentals of workplace / environmental / residential / consumer exposure; Source strengths and apportionment; Probabilistic, aggregated and cumulative exposure and risk assessment; Exposure-induced health outcome; Computational exposure assessment; Advanced exposure controls; Fundamentals of intervention / implementation science; and Multi-criteria decision analysis.

Conclusions:
Exposure science is instrumental in identifying populations that have high exposures, mitigating these exposures and protecting vulnerable and susceptible populations. Occupational hygiene, therefore, can be considered a sub-specialised field of exposure science with the focus on controlling workplace exposures.

Sub-theme: Control of Chemical Stressors – Oral Presentation (SAIOH Conference)
Informed decision-making on administrative controls to reduce exposure to particles: Scientific basis of reduction of exposure duration

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Keywords: ‘safe’ dose, scenario-specific adjustments, occupational exposure limit (OEL), exposure duration

**Background:**
Reduction of duration of exposure may be a simple administrative control, however, in most cases the scientific validation deriving a ‘safe’ scenario-specific duration of exposure is lacking. A key factor to preventing the worker from developing occupational diseases should be the reduction of the (cumulative) lung-deposited dose. Especially for exposure to particles, this should be adjusted to the specific scenario conditions that determine the dose, i.e. the particle concentration, particle size distribution (PSD) and the level of exertion. If exposure to concentrations at occupational exposure limit (OEL) level is considered as ‘safe’, it is imperative to investigate whether the actual exposure conditions comply with, or deviate from, the conditions for which the OEL values have been derived.

**Methods:**
Computational simulations were conducted to derive a ‘safe’ lung-deposited dose under the OEL-conditions, i.e. PSD of MMAD 2.5 µm, GSD 1.5, for light exertion (20.8 L/min) using the MPPDv2 lung deposition model. Both the ‘total’ deposition and the regional deposition (nasal, tracheobronchial and alveolar areas) were considered. Next, simulations were performed with eight PSDs at OEL concentration in combination with six different breathing patterns. The results of the 48 scenarios were compared to the ‘safe cumulative dose’ to derive ‘scenario-specific’ adjustment factors with regard to the duration of exposure.

**Results:**
In general, lung particle mass deposition increases with lung ventilation rates up to 35 L/min, depending on the PSD with 16% compared to OEL-conditions. Ventilation rates above 35 L/min show dramatic decrease of total deposition because the shift from nasal to nasal-oral breathing. However, for the tracheobronchial fraction the opposite can be observed as deposition increases by approx. 400% for the larger particles.

**Conclusions:**
The results clearly demonstrate that a reduction of exposure duration would not necessarily result in a proportional reduction to a ‘safe’ dose, but the exposure scenario and disease-specific adjustments have to be considered.

Sub-theme: Control of Chemical Stressors – Oral Presentation (SAIOH Conference)
Anticipation of exposure control of emerging technologies through workplace material and process design

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Keywords: exposure control, carbon nanotubes (CNT), carbon nanofibres

Background:
Occupational hygiene practice has evolved significantly globally, however, exposure to hazardous chemicals remains a major occupational stressor. In South Africa, occupational hygiene practice is predominately focused or limited to exposure assessments. The anticipation principle of occupational hygiene shall be implemented during material / product and process design. This approach involves several disciplines including material science, process technology, toxicology, exposure science, procurement and allied safety. The application of the anticipation principle can be demonstrated for emerging technologies like nanotechnology.

Methods:
Literature on nanotechnology, hazard and exposure prevention, material and process design was reviewed through the use of multiple libraries (NIOSH bulleting 65, ScienceDirect, Scopus, PubMed and Google Scholar). The present work was limited to two types of carbon nanotubes (CNTs), i.e. single- (SWCNTs) and multi-walled carbon nanotubes (MWCNTs). A total of 122 reports/articles on exposure control and health risk prevention associated with CNTs were reviewed. Only 38 references were found relevant to the scope of this work.

Results:
A total of 25 (66%) and 13 (44%) studies pointed out that material safety and process design reduce exposure and hazards to CNTs, respectively. With regard to hazard, SWCNTs were found to be more toxic than MWCNTs. The synthesis processes of MWCNTs determined the concentration of metal catalyst residue, and thus the toxicity. Moreover, the type of synthesis determined the exposure index. Exposure reduction through process design, consistently advocated enclosure / isolation, and down-flow booth.

Conclusions:
The findings of the study emphasise the need for occupational hygienists / exposure scientists to be involved in the early stages of material / product and process innovations. However, information on material and process design remains important in the selection of proper controls during the anticipation stage. Therefore, the anticipation principle can effectively be utilised in the reduction of exposure and hazard, through material and process design stages. Unfortunately, no literature was found on the elimination of hazard or exposure through design.

Sub-theme: Control of Chemical Stressors – Oral Presentation (SAIOH Conference)
Testing of local exhaust ventilation (LEV) systems: Status and practice in the UK

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Keywords: local exhaust ventilation (LEV), design, testing, legislation

Background:
International and South African legislation for Hazardous Chemical Substances requires employers to ensure that chemical emissions are controlled. Where local exhaust ventilation (LEV) systems are used, these must be correctly designed and tested to ensure exposures are reduced.

Methods:
A few Health and Safety Executive (HSE, UK) statistics for you…

- ~ 60% of LEV systems are not thoroughly examined and tested
- ~ 60% of those that are tested are not tested competently
- > 60% LEV systems are not checked or maintained
- 8 000 cancer deaths and 13 000 new cases of cancer each year
- 13 000 deaths per year from respiratory disease (that's 36 people per day!)
- Currently an estimated 13 000 new cases of breathing or lung problems caused or made worse by work each year.

If your company carries out a process where a dust or fume is generated, YOU need to be sure your LEV system is up to the job of providing adequate protection to your biggest asset – your employees.

This presentation will explain how to carry out simple checks on both your system, contractors and what to look out for when purchasing new LEV plants.

Sub-theme: International Keynote Presentation 2 (SAIOH Conference)
Hearing loss prevention:  
What are the barriers and what does it take to succeed?

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Keywords: hearing loss prevention (HLP), barriers, solutions

**Background:**  
No one should ever be injured by occupation noise, as noise-induced hearing loss (NIHL) is 100 percent preventable. Procedures to prevent NIHL have evolved significantly since their early inception in the 1950s. This presentation will describe the essential components of an effective hearing loss prevention (HLP) programme, quantify the on-going costs, and describe barriers and solutions to implementation of effective HLP programmes.

**Methods:**  
Research was conducted at more than 100 industrial plant sites to quantify the cost for hearing loss prevention and noise control. Both barriers and solutions to success of an effective HLP programme were identified.

**Results:**  
A comprehensive programme costs on the order of R 5 825 ($400 US Dollars) per employee per year. The return on investment in noise control takes approximately 5-6 years. Mitigating excessive noise from compressed air, equipment setup and/or need for maintenance, and eliminating airgaps on enclosures are the most cost effective and significant treatments. Fit testing hearing protection is a programme game changer, and encoding prevention methods early in a person's education is vital.

**Conclusions:**  
Several programme game changers are presented that include hearing protection fit testing, determining the return on investment to eliminate the risk, and a handful of mitigation homeruns to help jump start a noise control programme. Finally, my experience with successful programmes will be described, including a few personal examples.

*Sub-theme: International Keynote Presentation 3 (SAIOH Conference)*
Thermal imaging: A visual identification method to aid noise control techniques

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Keywords: thermal imaging, noise control, preventative maintenance, ‘beneath-the-surface’, ‘as low as reasonably practicable’ (ALARP)

Background:
Defective mechanical components, parts and associated drivetrains are likely to produce excessive noise emissions over and above the noise emitted during normal operation. The likelihood of detecting the additional noise contribution is considered relatively low when only a sound level meter is used to measure noise within a specific area or for a specific source / machine, without any additional information and data (previous data / frequency analysis etc.).

Methods:
Thermography or thermal imaging can be utilised to visually identify any potential temperature anomalies for machine components, parts and /or associated elements, which may be caused through unwanted friction, misalignment or mechanical damage. Not only can the thermal imaging assist with preventative maintenance programmes to identify machines / components that require immediate or short-term attention to ensure noise levels are kept to ‘as low as reasonably practicable’ (ALARP), this technique will also assist with reducing costs associated with broken machines / components and possible down time.

A hand-held thermal imaging camera can be utilised in conjunction with a Type 1 sound level meter with a frequency filter to perform a machine / component-specific survey to detect, identify, measure and confirm noise sources which can be included in noise control programmes. Various thermal imaging cameras are readily available and can be used with minimal training and experience – adding to the hygienists’ arsenal of valuable equipment.

Results:
Thermal images of defective machines / components can assist to visually indicate the necessity to repair or replace worn or faulty elements. With instant access to the digital and the infrared images, the information and data can be presented and reported shortly after an assessment, thereby reducing the time to implement corrective actions.

Conclusions:
Early detection of defective machines / components with the use of thermography can be successfully utilised as a visual aid in the identification of unnecessary additional noise emissions and the prevention of mechanical failures.

Sub-theme: Control of Physical Stressors – Oral Presentation (SAIOH Conference)
Are industry implemented Hearing Conservation Programmes (HCPs) effective? 
An industry evaluation

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Keywords: hearing conservation programme (HCP), hearing protection devices (HPDs), attenuation, noise-induced hearing loss (NIHL), noise reduction rating

Background:
Hearing conservation programmes (HCPs), such as those described in SANS 10083, aim to prevent the onset of noise-induced hearing loss (NIHL), preserve current hearing thresholds and empower exposed employees with knowledge for protection against NIHL. Approximately 11 000 NIHL cases were compensated between 1997 and 2002 in South Africa despite the questioning of HCP effectiveness, as well as regulatory enforcement and inspection. This study investigated the possible contribution of hearing protection device (HPD) selection and employee knowledge levels to observed NIHL incidence.

Methods:
Area noise levels of Plant A at 85 dB(A), Plant B at 85–95 dB(A) and Plant C at >95 dB(A) were derived from sound level meters (SLMs) with frequency analysers along with dB(C) and dB(A) functions. Employee knowledge levels pooled as ‘Learners’, ‘Developers’ and ‘Proficient’ were measured through questionnaires completed by HCP enrolled employees.

Results:
A total of 19 HPDs were found to be used and had attenuation ratings derived according to ANSI S3.19-1974, EN352 and AS/NZS 1270 methodologies. The computation procedures for each rating method yielded variable attenuation outcomes when applied against noise levels at all three plants, resulting in residual exposure in cases where the adequacy rating was rated as insufficient, whilst HPDs rated as providing overprotection resulted in interference with everyday speech and radio communication efficiency. The questionnaire survey showed that the majority of exposed employees at 75% (n=98) were ‘with insufficient knowledge levels in training aspects such as noise assessment purpose and noise rating limit.

Conclusions:
The American and European HPD rating systems are incompatible for simultaneous use in a single noise environment due to differing computational outcomes during selection, which consequently introduces uncertainty on attenuation adequacy. Observed employee insufficient knowledge levels have implications on the employer, employees, health and safety representatives / committees, and the legislator / regulator. These results indicate that HPD selection and insufficient employee knowledge contribute to the noted NIHL incidence in industry; this requires general improvement.

Sub-theme: Control of Physical Stressors – Oral Presentation (SAIOH Conference)
People implement controls

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Keywords: behavioural safety, culture, controls, corrective

Background:
As hygienist we like to think of ourselves as logical people and we tend to view the implementation of controls as a mechanised process. Step 1 is that the hygienist recommends a control, followed by step 2 where the control must be taken by the employer and implemented. Yet, how often have you heard from a consultant ‘I come back every two years to repeat the survey and virtually copy and paste the same recommendations for controls’? It’s suggested that in an ideal world where implementation of controls was driven by robots, nice logical steps would work fine. This contrasts with reality, which is that we work with people and getting people to do anything is far from straightforward. A manager who doesn’t care about the health of employees will not approve that expensive ventilation system and an employee who does not care about his own health won’t wear that respirator – that is when you aren’t watching his every move!

Results:
The field of ‘safety’ recognised the human behaviour aspects years ago and this led to the birth of ‘behavioural safety’, which has matured into a significant standalone field, which is led largely by psychology professionals. Some introspection is needed from occupational hygienists here. Experience in the petrochemical industry informs that behavioural safety is as applicable to ‘health’ as it is to ‘safety’. If this is true, then why isn’t ‘behavioural safety’ called ‘behavioral health and safety’? Perhaps the omission of ‘health’ is largely due to the lack of understanding of behaviour based safety principles within the occupational hygiene field.

Conclusions:
If we are to achieve SAIOH’s vision, of preventing occupational illness and disease, it may be timeous to engage with the field of ‘behavioural safety’ in order to achieve a positive shift to ‘behavioural health and safety’.

Sub-theme: Control of Physical Stressors – Oral Presentation (SAIOH Conference)
Occupational Health Service Providers (OHSPs) shall, as required by the Occupational Health and Safety Act (85 of 1993) [OHSAct] and Regulations, where indicated by the risk assessment, risk work and/or the Regulations, do medical surveillance and fitness for work or employment examinations.

These examinations may be provided in-house in a company clinic, in an occupational medical or health practitioner’s premises, through an off-site clinic facility or in a mobile unit at the workplace. In addition, the services may be offered by an independent practitioner, or a practitioner employed by the company that makes such services available.

The OHSP shall either be an occupational medical practitioner or an occupational health nurse practitioner (as defined by the OHSAct). Currently there is no juristic control over the establishment of occupational health services.

Through a combined effort, peer review organisations such as the South African Society of Occupational Medicine (SASOM), assist government regulator organisations to ensure that these examinations and medical surveillance services are standardised and correctly applied and rendered by practitioners and organisations with the appropriate skills, resources and training.

For approval to practise, the OHSPs shall need to provide the required and relevant qualifications, documents and resources that enable them to render a professional service. This is an example of the implementation of effective control measures in line with legislative requirements, with the ultimate objective of ensuring the health and wellbeing of workforces.

Now more than ever before, the advent of ‘exposure science’ has mandated that OHSPs (e.g. occupational medical practitioners, occupational health nursing practitioners and occupational hygiene practitioners) work together and collaboratively in the workplaces, to continually ensure and promote good ‘occupational health’ practice.

Sub-theme: Challenges of implementing Health Surveillance as part of a company’s control and exposure reduction programme – Sister Organisation Oral Presentation (SAIOH Conference)
The decrease of biological blood lead levels at a lead nitrate plant in South Africa

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Keywords: biological monitoring, blood lead levels, controls / interventions

Note: This presentation was first delivered at the ICOH 2018 Congress, Dublin, Ireland, 1 May 2018

Background:
Following a significant increase in production at a lead nitrate plant in South Africa, the blood lead levels of its employees also increased. This was concerning as the average blood lead results in 2015 increased to 44 ug/dl, well above the legal South African limit of <20 ug/dl. This prompted the need to introduce more stringent controls / interventions in order to decrease the average blood lead levels and avoid adverse health effects to the workers.

Methods:
The controls / interventions used comprised the following:
- a retrospective analysis of all historical biological monitoring results with direct comparisons to the man-job specifications, as well as the occupational hygiene monitoring results of airborne pollutants;
- an intensive lead study, which included a visit to a nearby lead refining facility to obtain comparative data;
- the demarcation and separation of work zones including change house and dining facilities;
- conducting of medical examinations, to include lead effect monitoring;
- a review of personal protective equipment (PPE) and implementation of controls to ensure correct use thereof;
- introduction of a comprehensive lead-health training programme; and
- introduction of a three-monthly biological blood lead monitoring programme.

Results:
As a consequence of the above controls / interventions, the average blood lead level decreased from 44 ug/dl in 2015, to 23 ug/dl year average 2017, representing a 46% decrease over a period of two years. Some employees achieved significant decreases in lead levels, from well above 30 ug/dl to well below 20 ug/dl.

Conclusions:
An increased understanding and awareness of the hazards of lead, both by the employer and employees, resulted in a significant decrease in the average blood lead burden of the workforce. The continuous application of controls / interventions in the workplace should lead to further decreases in the average blood lead levels well below the South African legal limit.

Sub-theme: Challenges of implementing Health Surveillance as part of a company’s control and exposure reduction programme – Sister Organisation Oral Presentation (SAIOH Conference)
Learnings from the development, implementation and maintenance of a control strategy for diesel particulate matter (DPM)

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Keywords: diesel particulate matter (DPM), exhaust, filters, effectiveness

Background:
Disposable diesel exhaust filters (DDEFs) were pioneered in the USA in the early 1990s and are now a critical control for Diesel Particulate Matter (DPM) in the Australian underground coal mining industry.

This presentation details the development of DDEFs in Australia, their implementation and how the effectiveness of a control can be compromised without an ongoing management strategy.

Methods:
The discussion will follow the development of DDEFs in Australia during the 1990s and how rapid commercialisation of DDEFs and the search for cost savings during industry down turns has led to a range of DDEFs with varying effectiveness being used in the coal mining industry.

The discussion will also highlight the need for appropriate measurement strategies to be implemented to ensure DDEFs (or any control strategy) is working effectively in-situ. This includes measuring the DPM concentration of the raw exhaust pre- and post- the DDEF to ensure the complete filtration system is operational.

Results:
A range of results will be presented that highlight the effectiveness and problems of using DDEFs to control DPM in coal mines and stresses the requirement that the installation of any control strategy should be accompanied by an ongoing monitoring programme to ensure its effectiveness.

Conclusions:
DDEFs are an effective control strategy for DPM generated by mining vehicles in the coal industry. However, their effectiveness can decrease rapidly if inefficient filter media is used by suppliers, or their ongoing effectiveness is not measured directly at the tailpipe exit, to ensure the whole filtration system continues to be operational.

Sub-theme: International Keynote Presentation 4 (SAIOH Conference)
Exposure of workers to hazardous biological agents (HBAs) in the health care sector

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Keywords: health care sector, hazardous biological agents (HBAs)

Background:
The workplace provides an ideal place for the proliferation of microorganisms and the spread of diseases, as people spend approximately 90% of their time indoors. Many microbes reproduce rapidly, require minimal resources for survival and are also a potential danger in a wide variety of occupational settings. Most exposed occupations include: food production, agriculture, farming, hospitals and laboratories.

Methods:
Regular inspections are conducted at different private and public hospitals to determine compliance in relation to the systems put in place to control the exposure of health care workers to hazardous biological agents (HBAs). The process includes scrutinising the occupational hygiene programme in place through document perusal, physical inspection coupled with worker observation and interviews. Such physical inspections are conducted at targeted areas like reception, isolation wards, mortuaries, oncology wards and waste management.

Results:
Health care workers employed in public hospitals are at risk of being exposed to HBAs due to the lack of engineering controls and non-maintenance of those that are in place. In the private hospitals, conditions are better because engineering controls are maintained and proper personal protective equipment (PPE) and training on the correct use of the PPE is provided.

Conclusions:
Health care workers will always be at risk of being exposed to HBAs because of the working conditions in hospitals. The involvement of senior management in the implementation of occupational health and safety in the workplace is key to ensure the protection of the health of workers.

Sub-theme: Special Session – Stakeholders – Inspectorate and partner views on adequate control – Oral Presentation (SAIOH Conference)
Prohibited use of compressed air

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Keywords: compressed air (CA), hazardous chemical substance (HCS), prohibited, blow, air-borne

Background:
Section 8 of the Occupational Health and Safety Act, 85 of 1993 requires that every employer provide and maintain, as far as reasonably practicable, a working environment that is safe and without risk to the health of employees. Although the use of compressed air (CA) is prohibited to remove particles of a hazardous chemical substance (HCS) from any surface or person by regulation 13 (a) of the Regulations for HCSs, 1995, it is still a practice commonly used in industry.

Methods:
An analysis was conducted on the exemption applications for the use of CA to clean equipment, received by the Department of Labour (DoL) since 2016. The number of notices issued by the DoL in this regard was also investigated.

Results:
CA is a concentrated stream of air at high pressure and high speed. Several applications for exemption were made to the Chief Inspector after prohibition notices were issued to companies. There is an escalation in exemption applications relating to the use of CA. A lack of knowledge of the possible health and physical risks is prevalent amongst companies using CA. The use of CA may increase fluid mist, dust and/or particles of a HCS in the area.

Conclusions:
CA accidentally blown into the mouth can rupture the lungs or stomach. CA entering a worker’s bloodstream can result in death, if the air bubble reaches blood vessels in the brain. Use of CA causes HCS particles to become air-borne and be easily inhaled. Often, companies do not consider all risks associated with the use of CA to remove particles from surfaces and equipment; furthermore, alternatives are not fully investigated. Financial costs to alter procedures is given by industry as the reason for its continued use of CA to clean equipment. The use of CA by workers to clean their clothing is only controlled by administrative measures (e.g. written instruction from company management).

Sub-theme: Special Session – Stakeholders – Inspectorate and partner views on adequate control – Oral Presentation (SAIOH Conference)
The science fiction of Occupational Hygiene (OH) monitoring: Moderate predictability of welding fume quantification

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Keywords: welding fume (WF), ‘as low as reasonably practicable’ (ALARP), sampling, exposure correlation

Background:
Welding fume (WF) was reclassified by the International Agency for Research on Cancer (IARC) as a Group 1 carcinogen in 2017. Considering the limitation of occupational exposure limits (OELs) to serve as a distinction between benign or malignant concentrations, exposure to carcinogens should be controlled to be ‘as low as reasonably practicable’ (ALARP). Control implementation is reactive to data evaluation. This impedes protecting employees' health as there is lag time between sampling and data reporting. The purpose of this endeavour was to create a regression formula to predict WF breathing zone concentrations, using the length welded as the determinate factor.

Methods:
Twenty activity-based personal samples were collected using IOM samplers attached within the employees' breathing zone. WF was gravimetrically quantified in accordance with MDHS 14/4. Length welded was measured for rectangular fabrication, and calculated using diameter for circular ducts. A correlation and regression equation was calculated between the length welded and the quantified WF 8h TWA, using Microsoft Excel data analysis package.

Results:
The mean length welded was 1.55 ± 1.5 m, minimum and maximum lengths respectively 0.2 m and 5.6 m. Mean 8h TWA breathing zone concentration: 0.79 ± 0.18 mg.m⁻³, minimum and maximum values: 0.17 and 3.32 mg.m⁻³ The correlation between length welded and breathing zone WF concentration was: r = 0.48. The regression formula calculated:
y = 0.2581x + 0.385

Conclusions:
WF quantification is highly variable and plume dispersion is easily influenced by environmental factors. This burdens creating a regression formula to predict breathing zone concentrations, as well as halters monitoring repeatability. Considering WF has been reclassified as carcinogenic, and the myriad external / environmental factors that influence WF exposure quantification, the resource focus should not be on quantifying exposure and compliance evaluation, but rather on controlling the hazard to be ALARP.

Sub-theme: Special Session – Stakeholders – Inspectorate and partner views on adequate control – Oral Presentation (SAIOH Conference)
Human body exposure to electromagnetic fields (EMFs)

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Keywords: electromagnetic fields (EMFs), assessment, exposure, instrumentation, control

Background:
Introduction to non-ionising radiation and electromagnetic fields (EMFs) and their health effects on the human body and how to best control exposure to EMFs.

Methods:
Normative, standards and guidelines for EMFs including standards of the International Commission on Non-Ionising Radiation Protection (ICNIRP) and the European Union (EU) Directive 2013/35/EU on the minimum health and safety requirements regarding the exposure of workers to EMFs.

Application and Sectors – Where are EMF health risks most prevalent?

Instrumentation – How to quantify exposure to EMFs using international best practice and relate this to EU and ICNIRP exposure standards?

Results:
A better understanding of non-ionising radiation, its health effects, how to accurately quantify exposure and relate sampling results to exposure standards and control exposure to EMFs.

Conclusions:
Occupational hygiene professionals are better equipped to assess the health risks associated with EMF exposure and better understand control measures to reduce exposure risk scenarios.

Sub-theme: International Keynote Presentation 5 (SAIOH Conference)
Presentation Overview:
Emergency plans are required for all activities, processes and conditions. Occupational hygienists in South Africa tend to leave the design and operation to persons who often have little knowledge on hazards and the risks which can occur if an incident or accident happens. Most emergency plans have little information on the toxic effects of chemicals, especially acute effects, and are limited in value when an incident occurs. Worst case emergency releases present additional problems and input to enable accurate reaction by those exposed and the responders.

Emergency plans are required worldwide. These need to adequately address the potential risks which could arise from the site activities and processes should an incident occur. Currently more than 50% of emergency plans are not user friendly and have inappropriate information. This presentation will illustrate some of the shortfalls and also the method of evaluation of existing emergency plans. It also provides examples of incidents with poor or inadequate emergency responses. Occupational hygienists’ knowledge of toxicology, acute exposure, risks and potential controls can be used to improve emergency plans. This presentation will also provide the tools to improve emergency plans. It will enable the occupational hygienist to be a valuable member of the emergency team and a decision maker.

Results:
Having evaluated more than 100 emergency plans for major hazardous installations (MHI) as a MHI risk assessor, I will provide the results of these assessments and discuss common misconceptions and other errors. The presentation will also illustrate the potential role of the occupational hygienist in the planning, designing and auditing of emergency plans.

Conclusions:
Emergency plans are an important part of a control programme. Occupational hygienists, with their valuable and specific knowledge and training, should be involved in this process. The current status of many emergency plans requires occupational hygienist input for improvement.
The advantage of different methods of evaluating solar ultraviolet radiation (UVR) exposure in implementing control measures

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Keywords: ultraviolet radiation (UVR), outdoor workers, measurement methods

Background:
Exposure of outdoor workers to solar ultraviolet radiation (UVR) cannot be eliminated completely due to the nature of their work. In addition, exposure to solar UVR can be both beneficial and harmful and therefore needs to be carefully controlled. Various methods have been used to evaluate the exposure of workers to solar UVR. The five most commonly used methods are electronic dosimetry, polysulphone badges, bacteria spore badges, self-reported exposure using instruments (such as interviews), and modelling. Each one of these measurement methods is most suited to achieve a specific goal. If an inappropriate measurement method is chosen, it may result in biased or incorrect estimations of exposure leading to unsuitable control measures being implemented.

Methods:
A literature search was conducted on UVR measurement methods, using relevant search terms, and included articles from 2000 to 2018.

Results:
The most commonly used measurement method was electronic dosimetry followed by polysulphone badges. The benefit of electronic dosimetry is that it provides data over time which makes the implementation of control measures, such as rescheduling of work, more effective. However, both polysulphone and bacteria spore badges are lighter than electronic dosimeters, making them more practical to use when measuring solar UVR on anatomical sites such as the head. This type of data can be used to inform anatomical site specific control. Self-reported exposure measurements, such as questionnaires, may provide historic exposure but are plagued by recall errors. Modelling using satellite data can only provide approximated data for individual exposure and is most often used in evaluating population-level sun exposure.

Conclusions:
The choice of the most appropriate measurement method or combination of measurement methods is of vital importance in the evaluation of worker exposure to solar UVR and the consequent effective implementation of control measures.

Sub-theme: ‘5 Minutes, 5 Slides’ Mini Oral Presentation (SAIOH Conference)
Managing occupational exposures to hazardous chemical substances (HCSs) in a laboratory environment using occupational hygiene statistics

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**Keywords:** exposure, hazardous chemical substances (HCSs), Bayesian statistics, pathology laboratory

**Background:**
Diagnostic pathology laboratory work involves potential exposure to a wide range of hazardous chemical substances (HCSs), notably volatile organic compounds (VOCs), including xylene, which is mainly used for tissue staining processes, and formaldehyde, used for preservation and fixing of tissue. This study was conducted in 14 laboratories, including histopathology, cytology, clinical pathology and tuberculosis (TB), all forming part of approximately 300 laboratories operating under the largest diagnostic laboratory service provider in South Africa. The aim of the study was to ascertain the levels of workers’ exposure to HCSs and, using an occupational hygiene statistical package, recommend a suitable control strategy.

**Methods:**
Concentrations of VOCs and formaldehyde were measured in the 14 laboratories using standard air sampling pumps connected to a substance specific sampling media, following the NIOSH methods 1501 and 2541, respectively. Each laboratory was sampled for two separate shifts. A statistical package (*IH DataAnalyst*) was used to verify that the data sets conform to the lognormal distribution hypothesis and to calculate various statistical parameters related to the results. The software, which includes a Bayesian statistics component, was also used to calculate the probability of exceeding the occupational exposure limit (OEL) and to classify the data sets from each laboratory into one out of five management and exposure control categories.

**Results:**
The measurement data obtained from the 14 laboratories indicated that different laboratories fell under different exposure categories, corresponding to different control strategies, from ‘No action required’ (0, or green category) to ‘Implement hierarchy of controls and monitor to validate respirator protection factor selection’ (5, or red category).

**Conclusions:**
This study demonstrates that compliance or non-compliance with an OEL is insufficient to classify and manage exposure in an occupational hygiene setting. Further statistical interpretation of the sampling data is needed in order to make informed decisions about the level of control required for exposure to HCSs.
Sub-theme: ‘5 Minutes, 5 Slides’ Mini Oral Presentation (SAIOH Conference)
A systematic review on occupational exposure to chalk-dust particles and health effects: Knowledge gaps in South Africa

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**Keywords:** chalk dust, occupational exposure, calcium carbonate, health effects, public schools

**Background:**
Chalk and dry wipe board methods in schools are a major source of submicron particles. Exposure to submicron particles enriched with calcium carbonate (CaCO\(_3\)) has been linked to various adverse health effects such as respiratory and cardiovascular illnesses, and skin and eye irritation. Teachers and learners are the most exposed groups, however, children carry the highest burden as their immune systems are still developing. This review aims to determine practices in developing countries which assist in reducing exposure to CaCO\(_3\), with a view of importing some practices into South Africa.

**Methods:**
Online literature search was conducted, using sites such as PubMed, Science Direct, Google Scholar database and grey literature of all articles on CaCO\(_3\) exposure and health effects published in the English language between 2014 and 2018. A total of 100 articles were reviewed; 20 were rejected while 80 were found to be relevant.

**Results:**
Teachers who spend an average of seven hours in class are exposed daily to chalk dust. Smokers are more prone to developing lung disorders such as pneumonia, irritation of the respiratory system and multiple bullae. In Taiwan, chalk dust exposures in classrooms have been reduced by mechanical ventilation which slows down aerosol gravitational deposition and increases the particle retention time in the air because of turbulent airflow. Another recommendation is that schools should keep classroom doors open and ceiling fans on. There are relatively no studies conducted on such phenomena in South African schools.

**Conclusions:**
There is a significant need to investigate occupational exposure to chalk dust in South African schools (ventilated and non-ventilated classrooms) where traditional teaching methods (chalk and dry wipe board) are used. There are knowledge gaps in determining health effects associated with exposure to chalk dust and in developing public health interventions to manage these occupational hazards.
Skin and respiratory exposure to 11 metals in precious metals refineries

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Keywords: platinum group metals (PGMs), arsenic, nickel, lead, Ghostwipes™

Background:
Workers in precious metals refineries are potentially exposed to a wide spectrum of metals which include platinum group metals (PGMs - platinum, palladium, rhodium, iridium, ruthenium and osmium) as well as other metals (nickel, cobalt, lead, copper and arsenic). The aim of this study was to quantify the concentrations of metals to which precious metals refinery workers are exposed to via the skin and respiratory routes.

Methods:
The skin and respiratory exposure of 40 workers from two South African precious metals refineries were measured concurrently over two consecutive work shifts. Skin exposure to metals was measured using Ghostwipes™ on the palm, wrist, neck and forehead of workers; respiratory metal exposure was measured using IOM samplers. Surface wipes were also collected using Ghostwipes™. All samples were analysed using Inductively Coupled Plasma - Mass Spectrometry (ICP-MS).

Results:
Workers were exposed to quantifiable concentrations of platinum, palladium, rhodium, iridium, ruthenium, osmium, lead, cobalt, nickel, copper and arsenic on all four anatomical areas and through inhalation. For some occupations, the respiratory exposure to soluble platinum, palladium and rhodium exceeded the occupational exposure limits (OELs). Exposures to lead, cobalt, nickel, copper and arsenic compounds were found to be between 10 and 50% of the OELs for some occupations. Workers in the concentrate handling areas experienced the highest exposure to all metals via the skin and respiratory exposure routes.

Conclusions:
The precious metals refinery workers included in this study were exposed to soluble PGMs and other potentially harmful and carcinogenic metals via the skin and respiratory exposure routes. This may lead to possible inhalation, skin absorption and ingestion of these metals. The control of these workers’ exposure should, therefore, include inhalation, skin absorption and ingestion as potential exposure routes. Additionally, the concentrate handling areas should be prioritised, since exposure to all metals was the highest in these areas.

Sub-theme: Using Data to Inform Control – Poster Presentation (SAIOH Conference)
A systematic review on correlation between lead exposure, intelligence quotient (IQ) and academic performance in developing countries: A South African perspective

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Keywords: lead (Pb) exposure, developing countries, children, cognitive development, behavioural change

Background:
Lead (Pb) exposure is an environmental health dilemma in many developing countries, like South Africa. Literature shows that Pb exposure impairs school performance among children in rural communities. Studies in developed countries have indicated a correlation between Pb exposure and poor academic performance in scholars. Pb exposure causes neurologic damage and stunts normal brain growth; such exposure is linked to cognitive and behavioural impairment which influences learning disabilities. Exposure to even low Pb doses often causes loss of self-control and shortened attention span that lead to poor performance at school and ultimately to the drop out of scholars.

Methods:
Online literature search was conducted using sites such as PubMed, Science Direct, Google Scholar database and grey literature of all articles on Pb exposure and behavioural change published in the English language between 2010 and 2018. A total of 60 articles were reviewed; 10 were rejected while 50 were found to be relevant.

Results:
Developing countries have high Pb levels due to non-existence of public interventions to environmental Pb exposure. Most of the studies conducted on Pb exposure in South Africa have focused on determining risk factors associated with Pb exposure among children. The review also showed that epidemiological studies in South Africa determined the impact of short-term Pb exposure only.

Conclusions:
The review indicates that there is a dearth of scientific data on Pb levels and health outcomes (such as low IQ, poor academic performance and cognitive abilities). South Africa has implemented some environmental health interventions, the phase-out of leaded petrol and the enactment of legislation to control the use of Pb in paint. However, there is still a need for a more holistic approach to managing Pb exposure. The review indicates a need for research studies on Pb exposure and specific health outcomes, in order to direct policy and environmental health practices in the prevention of environmental Pb exposure.

Sub-theme: Control of Chemical Stressors – Student Poster Presentation (SAIOH Conference)
The design and management of risk control systems for health

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Keywords: risk, assessment, management, wellness, controls

Background:
Workplace health risks are a historical fact and a reality now. Organisations are required to manage health and safety in order to control risks effectively and prevent harm to people.

Methods:
Training materials and information on assessing risk and managing controls, obtained from the Occupational Hygiene Training Association’s (OHTA) module on the control of hazardous substances, the Centers for Disease Control (CDC, USA), the National Institute for Occupational Safety and Health (NIOSH, USA) and the Health and Safety Executive (HSE, UK) were accessed and collated into an integrated approach describing the basic steps of a control management system.

Conclusions: The proposed risk control system includes a wellness dimension to promote the health of employees, which act as a stimulus for the implementation of controls and feedback to help create a wellness culture that is employee-centered.

Sub-theme: Control of Chemical Stressors – Poster Presentation (SAIOH Conference)
Control of isocyanate exposure in the motor vehicle repair industry

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Keywords: isocyanates, motor vehicle repair industry, Health and Safety Executive (HSE), Safety Health Awareness Days (SHADs)

Background:
Exposure to isocyanates is the leading cause of occupational asthma in both developed and developing countries worldwide. Spray painters using isocyanate-based paints in the motor vehicle repair industry are proven to be at a greater risk. According to the Health and Safety Executive (HSE) these employees have an occupational asthma incidence 80 times the average UK industry.

Methods:
Safety Health Awareness Days (SHADs) were conducted where all motor vehicle repair shop owners were invited. SHADs included short presentations by HSE and industry speakers. Audio visual aid and working scale models of a spray booth and a spray room were used to show how exposure occurred, could be controlled, and ways of verifying that controls are effective and being used appropriately. Workplace inspections were also conducted.

Results:
After attending the SHAD event, the regional assessments proved that at least 50% of the body shops improved exposure control measures. Almost 25% of the biological monitoring results showed no detectable isocyanate exposure. The post-SHAD survey indicated that 91% of the body shops knew the clearance time of their spray booths and almost 85% of the owners installed pressure gauges to check for negative enclosure pressure.

Conclusions:
The end-result of this research was proven to be a success as a reduction of isocyanate exposure was indicated in the motor vehicle repair industry. The SHAD approach allowed for involvement and interaction with business owners, employees, and local authority as well as industry representatives. Therefore, this placed a liability on the aforementioned parties to engage and work together to protect worker health.

Sub-theme: Control of Chemical Stressors – Student Poster Presentation (SAIOH Conference)
**Blood parameter responses in mice (Mus musculus) exposed for one week to an electromagnetic field**

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Keywords: extremely low frequency electromagnetic field (ELF-EMF), biological effect, blood parameters

**Background:**
Extremely low frequency electromagnetic field (ELF-EMF) radiation is omnipresent where humans reside and the biological effects of ELF-EMFs are unclear. A mouse model is used. The aim of this study thus was to measure the effects of ELF-EMFs on 15 blood parameters in four-week old healthy male mice.

**Methods:**
A short-term ELF-EMF exposure of one week was applied. Besides the control treatment group, one-hour, four-hour and 24-hour exposure treatments were applied daily to 25 randomly selected mice in each treatment group, at a magnetic flux density of 5 µT.

The mice were housed in specially designed polypropylene mouse cages. At the end of the two trials, blood was collected from the orbital cavities of the mice for analyses.

**Results:**
ELF-EMF did not have a significant ($p > 0.05$) effect on the red blood cell population and the related parameters, haemoglobin concentration and haematocrit; as well as on the number of thrombocytes and total leucocytes. The different leucocyte cell types did, however, show significant changes ($p < 0.0001$). The number of granulocytes, eosinophils and basophils, was elevated, but the number of neutrophils was suppressed. The T-lymphocyte CD3, CD4 and CD8 populations demonstrated significant increases in number, particularly in the one-hour ELF-EMF exposure group ($p < 0.001$). The B-lymphocyte CD19 populations did not show any differences when compared to the control treatment group ($p = 0.57$).

**Conclusions:**
The results of this study support the notion that ELF-EMF exposure, in the short-term, could cause haematological and immunological modifications.

*Sub-theme: Control of Physical Stressors – Poster Presentation (SAIOH Conference)*
Assessment of noise levels in the thermodynamic laboratory at the University of Johannesburg

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Keywords: thermodynamic, noise exposure, noise sources, students, laboratory

Background:
Prolonged exposure to noise exceeding 85 dB(A) induces the probability of development of noise-induced hearing loss (NIHL). Studies in the United States regard NIHL as one of the most common learning hindrances among youths, particularly students, and NIHL has been termed the ‘silent epidemic’—often unrecognised. Recently, students at the thermodynamic laboratory of the University of Johannesburg raised several complaints about high noise exposure. Therefore, this study evaluated the noise levels in the thermodynamic laboratory based on recent complaints.

Methods:
A calibrated Type 1 sound level meter was used to measure ambient noise levels near students’ work stations during practical sessions. Five measurement points were selected. Measurements were taken in line with SANS 10083 requirements. Measurements were taken for eight hours and the calibration status of the instrument was checked before the survey was undertaken, using an oscillator. Data was then analysed using the sound pressure level log formula to calculate the average noise exposure.

Results:
The noise level at work station A was found to be 73 dB(A), while at work station B, it was 80 dB(A). The levels at both work stations were significantly increased by a two stage compressor air tank which releases pressure every 20 minutes, and the F300A nozzle performance test. This implies that noise at both work stations was at minimum dB(A) levels as per requirements in the NIHL regulations. However, exposures to high noise levels for short intervals of around 20 minutes do exist, which suggests potential hearing threshold shift.

Conclusions:
It is noted that machines used over a short period of time emit noise levels above 85 dB(A). Despite the results indicating levels below 85 dB(A), students need to wear earplugs during practical sessions. Furthermore, the equipment used, viz. F300A nozzle performance test, two stage compressor, petrol combustion engine and TD200 small engine test set, shall be demarcated with noise risk signage.

Sub-theme: Control of Physical Stressors – Poster Presentation (SAIOH Conference)
Evaluation of noise levels forklift operators are exposed to at a fresh produce market in South Africa

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Keywords: fresh produce market, noise-induced hearing loss (NIHL), standards, noise dosimetry

Background:
The fresh produce market is a retail organisation where farmers sell fresh food directly to consumers. It is one of the largest markets in the country and has clients from all walks of life, from South Africa as well as neighbouring countries. Activities that take place at the market involve delivering and loading of goods, usually in pallets using forklifts, which emit a tremendous noise that puts the operators at risk of noise-induced hearing loss (NIHL). The purpose of this study was to determine the noise levels that forklift operators are exposed to, and to ascertain if the noise levels comply with the applicable standards.

Method:
Personal dosimetry measurements were taken from forklift operators according to the SANS Code of Practice 10083:2013 method, using noise dosimeters. These were calibrated prior to and after taking measurements. Short interviews were conducted with forklift operators to ascertain their awareness regarding noise in the workplace and also to document their years of experience in operating forklifts.

Results:
53% of the noise dosimetry measurements taken exceeded the noise rating limit of 85 dB(A), with the maximum being 90.9 dB(A). Hence, forklift operators are at risk of developing NIHL. In addition, 47% of the noise dosimetry measurements exceeded the action limit of 82 dB(A). The maximum and minimum peak values recorded were 143.5 dB(A) and 125.4 dB(A), respectively.

Conclusion:
Forklift operators at the fresh produce market are exposed to noise levels exceeding the accepted 8-hour rating level of 85 dB(A), and are thus at risk of developing NIHL.

Sub-theme: Control of Physical Stressors – Poster Presentation (SAIOH Conference)
Control of heat stress in underground mines

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Keywords: ventilation, acclimatisation, heat stress risk, hydration / dehydration, job rotation

Background: Heat stress is one of the recognised physical stressors in mines. In extremely hot environments there is a high rate of accidents, and risks of workers suffering from heat disorders. The consequences can be expressed by the occurrence of heat rash, increased sweating and fatigue. However, heat stress can be managed to protect the health of employees. The current literature illustrates how ventilation, acclimatisation, fluid intake and personal protective equipment (PPE) can all be implemented to ensure that the risk of heat stress is properly controlled.

Methods: Miners were allocated to work in relatively mild heat stress conditions (29.5 to 30.5°C wet bulb temperature) for six days, and then to severe conditions (31.7 to 33.9°C wet bulb temperature) for another six days, under supervision. Ventilation systems (local exhaust and dilution) introduced cold air from the outside into the mine, and diluted the warm air inside the mine. Miners were given water, sports drinks and other fluids at the start of their shift, to consume during work breaks to avoid dehydration. They were also provided with cooling vests or clothing which impedes air flow and limits sweat evaporation.

Results: The acclimatised personnel adapted to the thermal environment and the employees’ work rate increased to that of more experienced miners; cases of heat strain were identified and treated. Ventilation installation resulted in improvements in the underground environment conditions, increasing airflow and oxygen availability. Constant hydration reduced levels of dehydration in the workers, and in combination with the specialised PPE and job rotation, led to less incidents of heat stress in the mining environment.

Conclusions: The mining industry is an important economic sector in many parts of the world. Although there has been progress in the control of heat exposure and stress, there is much room for improvement in terms of decreasing accidents which are caused by heat stress.

Sub-theme: Mining – Student Poster Presentation (SAIOH Conference)