

SOUTHERN AFRICAN PYROMETALLURGY 2024

INTERNATIONAL CONFERENCE
Sustainable Pyrometallurgy - Surviving
Today and Thriving Tomorrow

11-14 MARCH 2024

MISTY HILLS CONFERENCE CENTRE
JOHANNESBURG, SOUTH AFRICA



Preliminary Programme

Workshop – Monday, 11 March 2024

08:00-12:00 **Data analysis and machine learning in metals processing 2024**
P.C. Pistorius

Book and pay separately for this workshop

Conference Day 1 – Tuesday, 12 March 2024

08:00-08:30 **Registration**

08:30-08:35 **Welcome and Opening Address**

B.S. Xakalashé, *Conference Chairperson, Mintek, South Africa*

08:35-08:40 **Safety Briefing**

Venue Official

08:40-08:55 **SAIMM Presidential Address**

W.C. Joughin, *SAIMM President*

Session 1: Education

Session Chair: M.W. Erwee, *Samancor Chrome, South Africa*

08:55-09:30 **Keynote Address: Metallurgical engineering education – how do we sustain and grow our talent pool?**
P.C. Hayes, *University of Queensland, Australia*

09:30-10:05 **Keynote Address: Teaching and research activities in pyrometallurgy and refractory materials at Wuhan University of Science and Technology (WUST)**
S. Song, *WUST, China*

10:05-10:15 **Sponsor Presentation, Exmente, South Africa**

10:15-10:35 **Mid-Morning Refreshments**

Session 2: Education

Session Chair: M.W. Erwee, *Samancor Chrome, South Africa*

10:35-10:55 **Communication skills development through plain language principles and strategies**
A. van Staden, *EF Group, South Africa*

10:55-11:15 **Empowering teams for sustainable high-performance operations: A human-centered approach**
B. van Vuuren and J.H. Zietsman, *Ex Mente, South Africa*

11:15-11:35 **Today's graduates, tomorrow's leaders**
G. Mulder, *Hatch, South Africa*

Session 3: New Technology and Design

Session Chair: P.C. Pistorius, *Carnegie Mellon University, USA*

11:35-12:10 **Keynote Address: Navigating uncertainty: Advancing pyrometallurgy through reliable new technology development**

J.H. Zietsman, *Ex Mente, South Africa*

12:10-13:10 **Lunch**

Session 3: New Technology and Design (Continued)

13:10-13:30 **Novel copper slag cleaning furnace design and supply**
F. Marx¹, H. Joubert¹, J. Jonker¹, T. Peng², and B. Matsetela³
¹Tenova, South Africa, ²China Nerin Engineering Co, China
³Kamoa Copper, South Africa,

13:30-13:50 **Fundamental design decisions for a DRI melter**
A. Esterhuizen and P. Jonker, *Tenova, South Africa*

13:50-14:10 **Short Open Arc Controlled (SOAC) DC open bath furnace for green iron production**
S.C. Louw¹, I.J. Geldenhuys², W.D. Moolman¹, G. Lötter¹, G.S. Terblanche¹, G. Farmer¹, E.J.L. Kleynhans¹, T. Ndwandwe¹, R. Webb¹, and P. Steyn¹, ¹Metix Pty Ltd (SMS Group) and ²I Geldenhuys Consulting, South Africa

14:10-14:45 **Keynote Address: A review of new technology developments in the metals industry in a low-carbon world**
P. Mackey, *PJ Mackey Technology Inc, Canada*

14:45-15:10 **Afternoon Refreshments**

Session 4: Circularity in Pyrometallurgy

Session Chair: B.S. Xakalashé, *Conference Chairperson, Mintek, South Africa*

15:10-15:30 **Keynote Address: Pyrometallurgical concepts for recovery of lithium, cobalt and nickel from spent batteries**
B. Friedrich, *RWTH-AACHEN University, Germany*

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- 15:30-15:50 **Improved design methods of slag cleaning furnaces and matte settling furnaces in the copper and PGM industries**
P. Conradie and S.C. Louw, *Metix Pty Ltd (SMS Group), South Africa*
- 15:50-16:10 **Tenova's dry slag granulation process: The experience on EAF and LF slag in steel industry**
M. Guzzon, M. Messuti, M. Bissoli, E.J. Chiarullo, and E. Malfa, *Tenova S.p.A., Italy*
- 16:10-16:15 **Day 1 Conference Close**
- 16:30-18:30 **Network Cocktail Function**
Misty Hill, Conference Exhibition Hall

Conference Day 2 - Wednesday, 13 March 2024

- 08:00-08:30 **Registration**
- 08:30-08:35 **Welcome and Opening Address**
B.S. Xakalashe, *Conference Chairperson, Mintek, South Africa*
- 08:35-08:40 **Safety Briefing**
Venue Official

Session 5: Digital Transformation

Session Chair: R.D. Cromarty, *University of Pretoria, South Africa*

- 08:40-09:15 **Keynote Address: Digital twin for KGHM-Legnica: Simulation-based footprinting and exergy allocation of impacts**
M.A. Reuter, *SMS-Group GmbH, Germany*
- 09:15-09:35 **Tenova's digital information systems for submerged arc furnaces**
R. Hansraj, P. Jonker, and M. Singh, *Tenova, South Africa*
- 09:35-09:55 **Digital transformation of smelters- exploring the benefits of optimized operational schedules**
Y. Valdez-Navarro¹, Y. Zhang¹, J. Louw², and T. Moodley², ¹Hatch, Canada and ²Hatch, South Africa
- 09:55-10:05 **Sponsor Presentation, Hatch, South Africa**
- 10:05-10:25 **Mid-Morning Refreshments**
- 10:25-10:45 **The implementation of automated power BI reporting in power BI at the Anglo American Platinum smelting operations**
R.L. Sakaran, A. Cizek, D. Coetzee, W. Mbiza, T. Ndlovu, and N. Wanblad, *Anglo American, South Africa*

- 10:45-11:05 **Digitalization of a barrier monitoring system to manage the risk of rapid phase change explosions due to mixing of molten material and water in pyrometallurgical furnaces**
M. Pong¹, T. Koehler¹, B. Ferrer¹, A. Sadri¹, and M. Sitefane², ¹Hatch, Canada and ²Hatch, South Africa

Session 6: Modelling

Session Chair: Q.G. Reynolds, *Mintek, South Africa*

- 11:05-11:25 **Integrated variational quantum algorithms and response surface designs optimization for chromite roasting to produce sodium chromate**
M.J. Mvita, N.G. Zulu, B. Thethwayo, and S. Makhamis, *University of Johannesburg, South Africa*
- 11:25-11:45 **Slag physical property determination: A review of experimental and computational methods to determine structure, μ , σ , and κ**
S. Zaaïman, H. Muire, and J.H. Zietsman, *Ex Mente, South Africa*
- 11:45-12:05 **Nanoparticle formation in the exhaust fumes of a metallurgical furnace**
J. Conradie, *Resonant, South Africa*
- 12:05-12:25 **Slag physical property data and models: A review of structure, μ , σ , and κ**
H. Muire, S. Zaaïman, and J.H. Zietsman, *Ex Mente, South Africa*
- 12:25-13:25 **Lunch**

Session 7: Operational Update

Session Chair: M.A. Reuter, *SMS-Group GmbH, Germany*

- 13:25-14:00 **Keynote Address: Advanced ferroalloys production technology for energy effective future plant operations**
N.A. Barcza, *South Africa*
- 14:00-14:20 **Recent developments at Anglo American Platinum's smelting operations**
R. Snodgrass¹, G. Marsden¹, K. van der Merwe¹, and S. Shoko², ¹Anglo American Platinum Limited, South Africa, ²Anglo American Platinum PLC, Zimbabwe
- 14:20-14:40 **PGM furnace crucible upgrade and performance**
H. Joubert¹, G. de Villiers¹, J. Nel¹, D. Senekal¹, P. Mbedzi² and J. Davis², ¹Tenova, ²Sibanye-Stillwater, South Africa
- 14:40-15:00 **Alternative cooling medium for safe furnace operation**
K. Maluleke, P. Jonker, B. Bouwer, and H. Joubert, *Tenova, South Africa*

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15:00-15:20 **An updated overview of the history and current operational facilities of Samancor Chrome**
S. Swanepoel and M.W. Erwee, *Samancor, South Africa*

15:20-15:40 **Converter aisle scheduling using dynamic simulation**
T. Isaacs¹, J. Bezuidenhout¹, B. Gerrits², and S. Matutu³,
¹Hatch, South Africa, ²Hatch, Canada and ³Zimplats, Zimbabwe

15:40-16:00 **Afternoon Refreshments**

Session 8: Refractories

Session Chair: B.S. Xakalashé, *Mintek, South Africa*

16:00-16:35 **Keynote Address:**
J. Terblanche, *Arcelor Mittal, South Africa*

16:35-16:55 **V-shape repair methodology for ferrochrome furnaces**
C. Coetzee¹, M.W. Erwee², S. Brisley¹, and C. Patru³, ¹Intocast,
²Samancor Chrome, South Africa and ³TYK Europe GmbH, Germany

16:55-17:15 **The use of micro-X-ray fluorescence imaging for furnace refractory quality and wear characterization**
D. Chetty, N. Fotoyi, Y. Thakurdin, and C. Carelse, *Mintek, South Africa*

17:15-17:20 **Day 2 Conference Close**

17:20-17:45 **Time at leisure**

17:45-18:30 **Buses depart to Lesedi Cultural Village from Misty Hills Main Reception**

18:30-20:00 **Conference Dinner and Entertainment**
Lesedi Cultural Village

20:00 **Buses return to Misty Hills Main Reception**

Conference Day 3 - Thursday, 14 March 2024

08:00-08:30 **Registration**

08:30-08:35 **Welcome and Opening Address**
B.S. Xakalashé, *Conference Chairperson, Mintek, South Africa*

08:35-08:40 **Safety Briefing**
Venue Official

Session 9: Sustainability

Session Chair: N.A. Barcza, *South Africa*

08:40-09:15 **Keynote Address: Energy requirements for electrification of ironmaking and steelmaking**
P.C. Pistorius, *Carnegie University, USA*

09:15-09:50 **Keynote Address: Decarbonization of primary steelmaking**
E. Lourens, *Arcelor Mittal, South Africa*

09:50-10:10 **The use of Zimbabwean limonite-coal composite pellets as a sustainable alternative feed for cast iron production**
S.M. Masuka¹, T. Chisahwira¹, S. Maritsa^{1,2}, D. Simbie², and E.K. Chiwandika^{1,2}, ¹University of Zimbabwe, ²Harare Institute of Technology, Zimbabwe

10:10-10:20 **Sponsor Presentation, Tenova, South Africa**

10:20-10:40 **Mid-morning refreshments**

10:40-11:00 **Seizing opportunities today: Enhancing profitability and environmental sustainability in pyrometallurgical plants**
H. Weitz¹, T. Makgoale², and J.H. Zietsman², ¹Ex Mente, Europe and ²Ex Mente, South Africa

11:00-11:20 **Dry furnace off-gas cleaning system improvements at the Polokwane metallurgical complex**
M. Ndlovu¹, J. Bezuidenhout², G. Erasmus², R. Hundermark¹, and Q. Van Rooyen¹, ¹Anglo American Platinum, ²Hatch, South Africa

Session 10: Process Modelling

Session Chair: J.H. Zietsman, *Ex Mente, South Africa*

11:20-11:40 **The impact of feed composition on the recovery of base metals in an electric furnace**
R.L. Sakaran^{1,2}, J.D. le Roux², and A.M. Garbers-Craig², ¹Anglo American and ²University of Pretoria, South Africa

11:40-12:00 **SO₂ abatement of unstable and lean off-gas from pyrometallurgy processes with WSA and dynamic simulations**
C. Frandsen, *Topsoe A/S, Haldor Topsøes Allé, Denmark*

12:00-12:20 **Single particles entering a slag bath: How do they influence process dynamics and furnace capacity?**
A. Bogaers, J. Swanepoel, W. Roos, and J.H. Zietsman, *Ex Mente, South Africa*

12:20-13:20 **Lunch**

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Session 10: Process Modelling (Continued)

- 13:20-13:40 **Optimizing the tapping process based on a predictive model accounting for human factors**
J.E. Olsen¹ and Q.G. Reynolds^{2,3}, ¹SINTEF, Norway, ²Mintek and ³Stellenbosch University South Africa
- 13:40-14:00 **An exploration of ferroalloy furnace tapping dynamics using reduced-order models**
Q.G. Reynolds^{1,2}, J.E. Olsen³, M.W. Erwee⁴, J.D. Steenkamp⁵, and J. Sutherland⁶, ¹Mintek, ²Stellenbosch University, South Africa, ³SINTEF, Norway, ⁴Samancor Chrome, South Africa ⁵Glencore, Canada and ⁶Transalloys Ltd, South Africa
- 14:00-14:20 **Computational reacting flow models for the pre-reduction of manganese lumpy ore with hydrogen**
M. Khama¹, Q.G. Reynolds^{1,2}, A. Sarkar³, J. Safarian³, and B.S. Xakalashé¹, ¹Mintek, ²Stellenbosch University, South Africa, ³Norwegian University of Science and Technology, Norway

Session 11: Experimental

Session Chair: X.C. Goso, Mintek, South Africa

- 14:20-14:40 **One step forward and two steps back: An industrial perspective of chromite pre-oxidation**
S. Swanepoel, Samancor, South Africa
- 14:40-15:00 **Analysis of a sustainable route for chemical beneficiation and production of ferrochrome, combining oxidative pre-treatment, hydrogen pre-reduction and leaching processes**
E.L.J. Kleynhans¹, S.P. du Preez², and J. Davies², ¹Metix Pty Ltd (SMS Group) and ²North-West University, South Africa

15:00-15:20

Afternoon Refreshments

15:20-15:40

Assessment of slag compositions with elements of variable valence states through direct oxygen measurement by EPMA

R. Starykh, S. Sineva, D Shishin, and E. Jak, *The University of Queensland, Australia*

15:40-16:00

The reduction and recovery of cast iron from limonite-coal composite pellets

S. Maritsa¹, S.M. Masuka², and E.K. Chiwandik^{1,2}, ¹Harare Institute of Technology and ²University of Zimbabwe Zimbabwe

16:00-16:20

Experimental and thermodynamic study of Cu-Ni mattes solidification upon cooling

S. Sineva¹, D. Shishin¹, R. Hundermark², and E. Jak¹, ¹The University of Queensland, Australia and ²Anglo American Pt, South Africa

16:20-16:40

Pre-reduction of ilmenite in CO-H₂ system using a fluidized bed furnace

X.C. Goso¹, K. Bisaka², N.Z. Fotoyi¹, T.G. Ntloko¹, and G.Tawane¹, ¹Mintek ²Zawadi Business Solutions Pty Ltd, South Africa

16:40-17:00

Conference Close