Presentation to REPS_STERG Symposium

Solar Thermal Treatment of Manganese Ores

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Mineral Economics and Strategy

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Manganese ore processing – current landscape

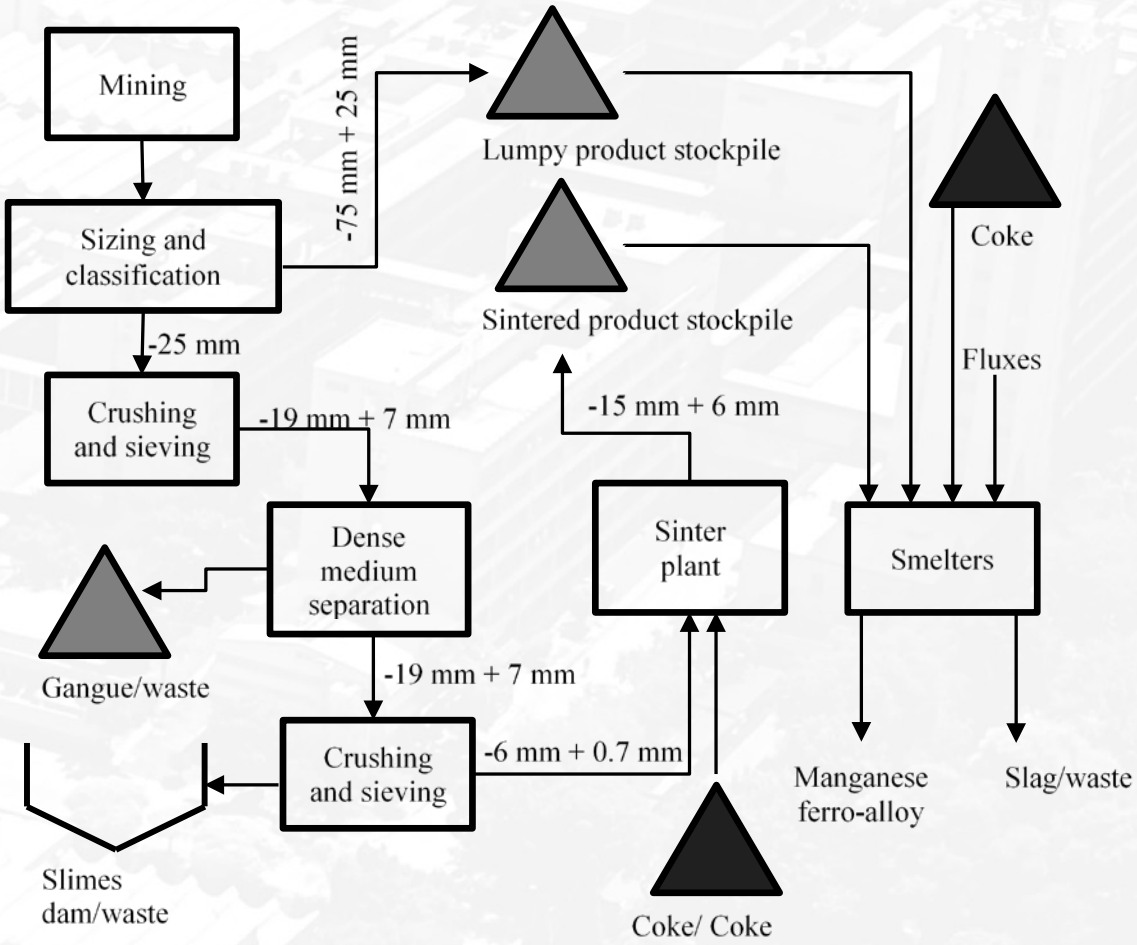


Figure 1. Manganese ore processing

Experiments

Figure 2. STERG solar concentrator

Figure 3. Untreated ore , -6 mm

Figure 4. Pellets, -13 mm + 6 mm

Results - Thermal

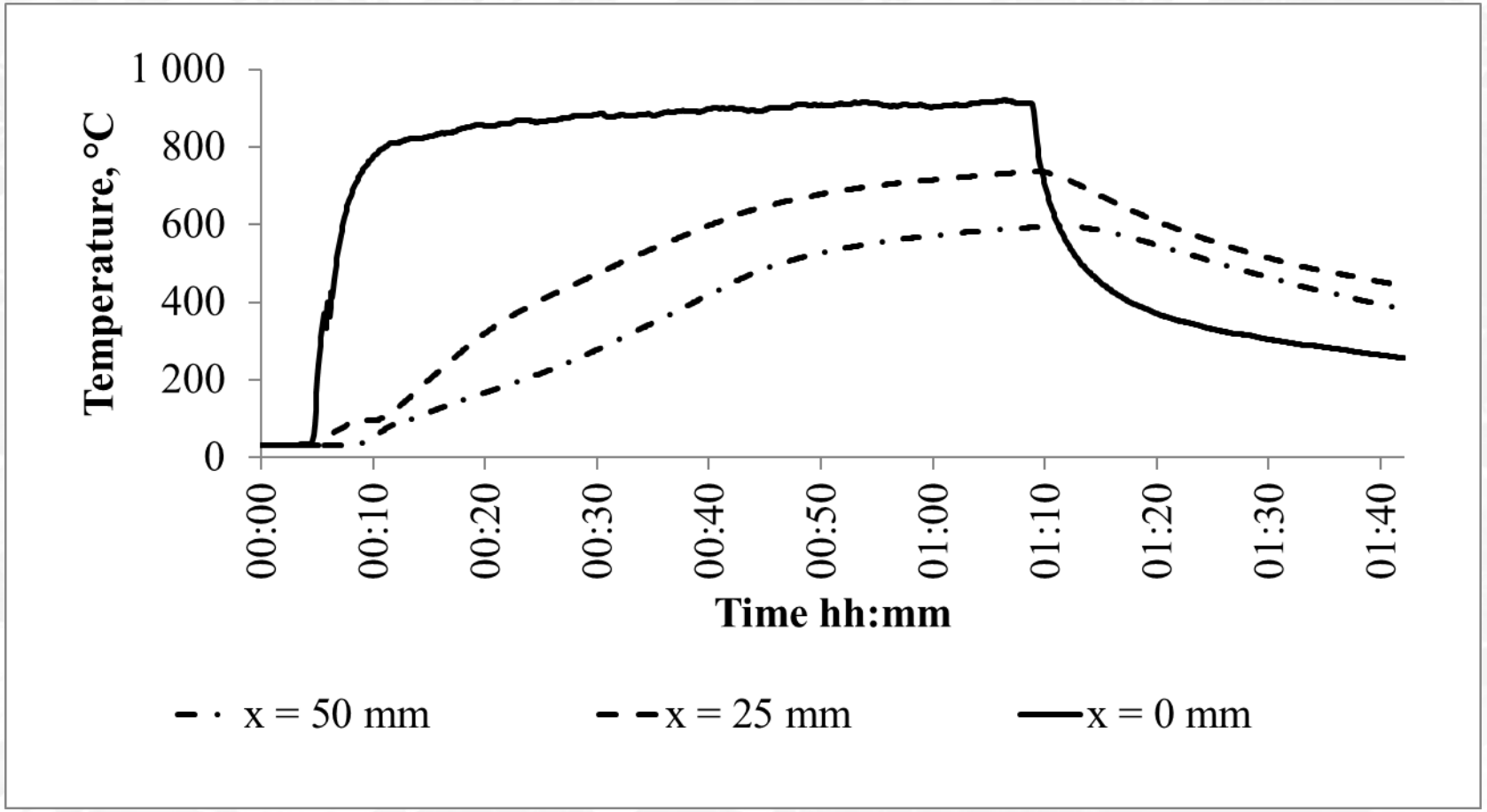


Figure 5. Temperatures recorded, Pellets B +

Results – Modelling

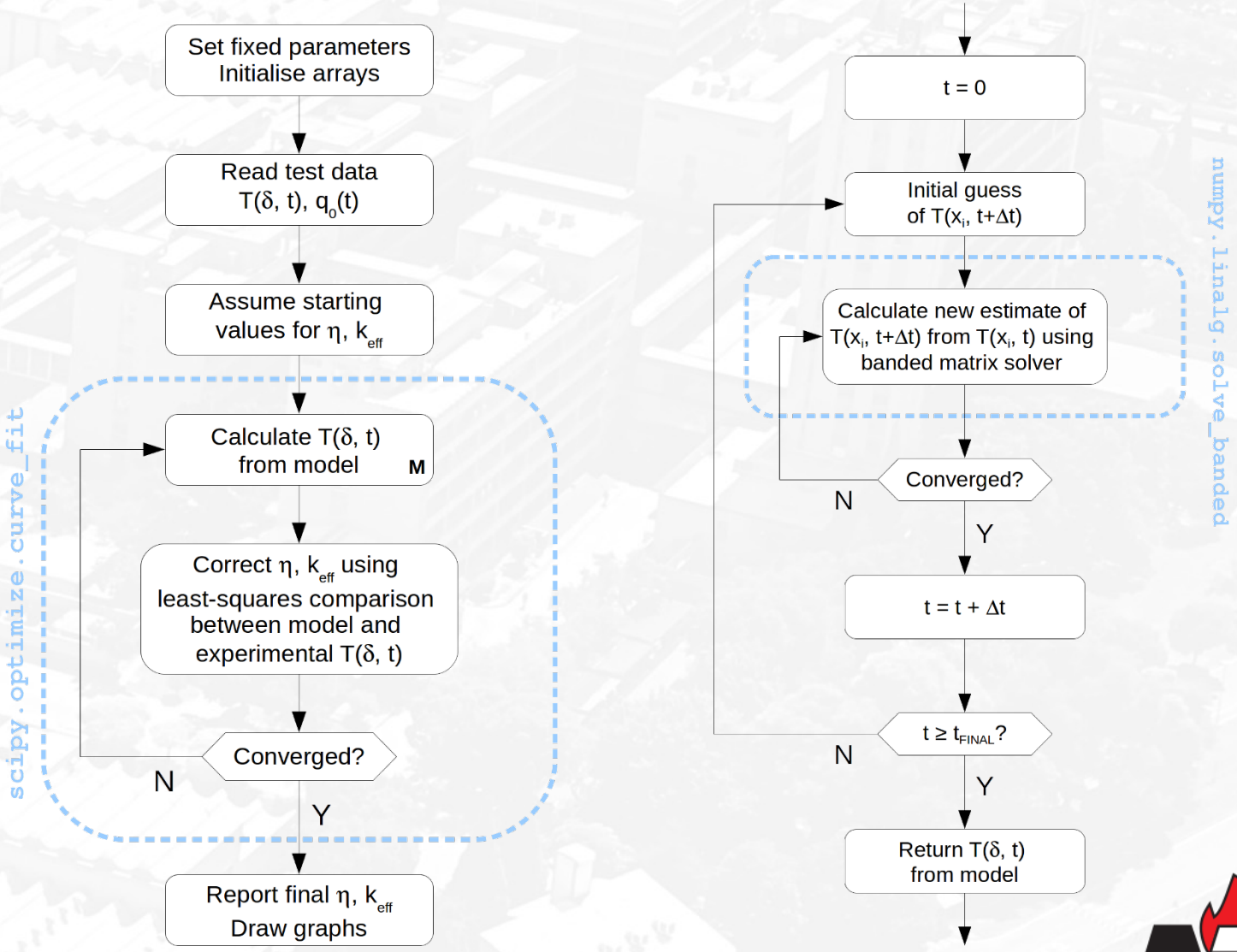


Figure 6. Algorithms for heat transfer modelling

Results of heat transfer model

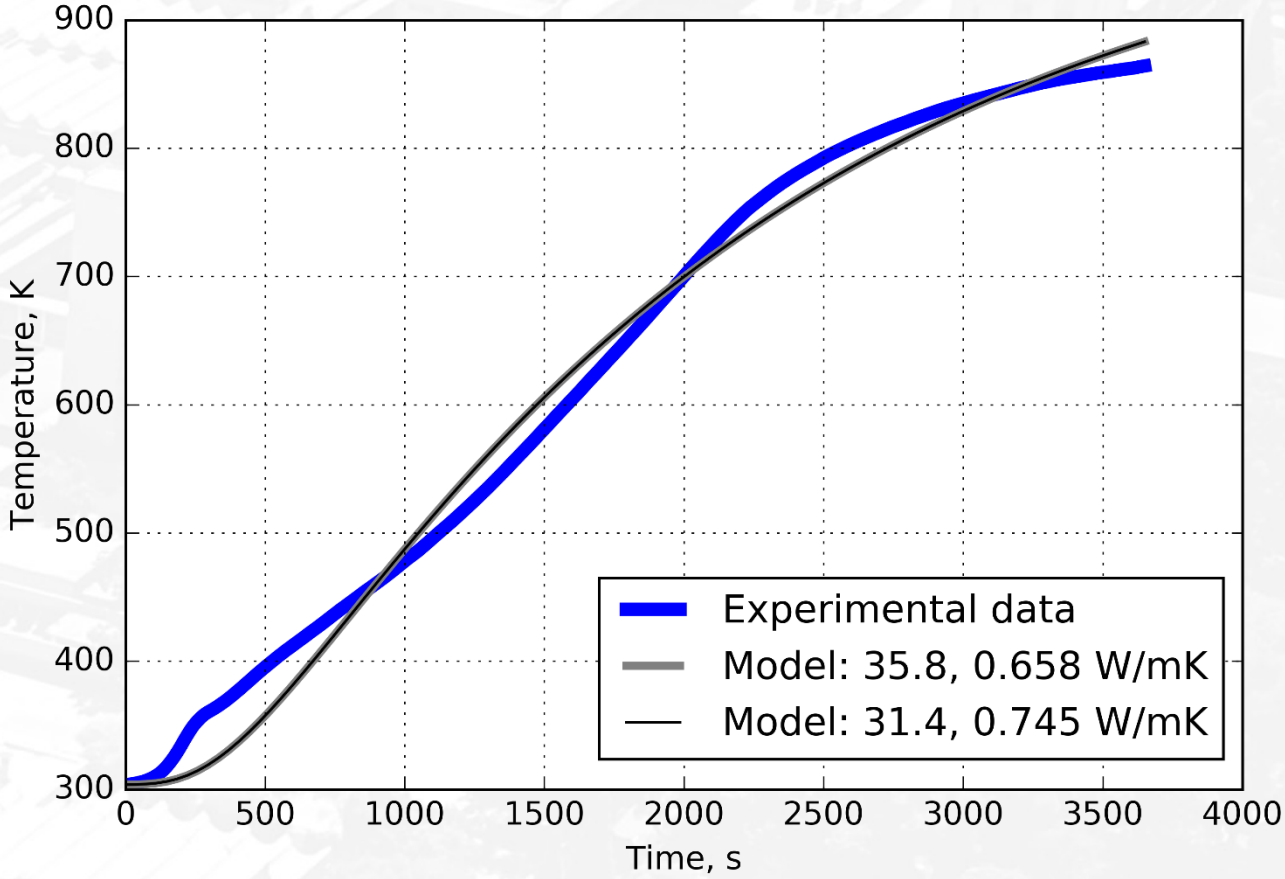


Figure 7. Experimental temperatures and model predicted temperatures

Effective thermal conductivity/ Concentration factor

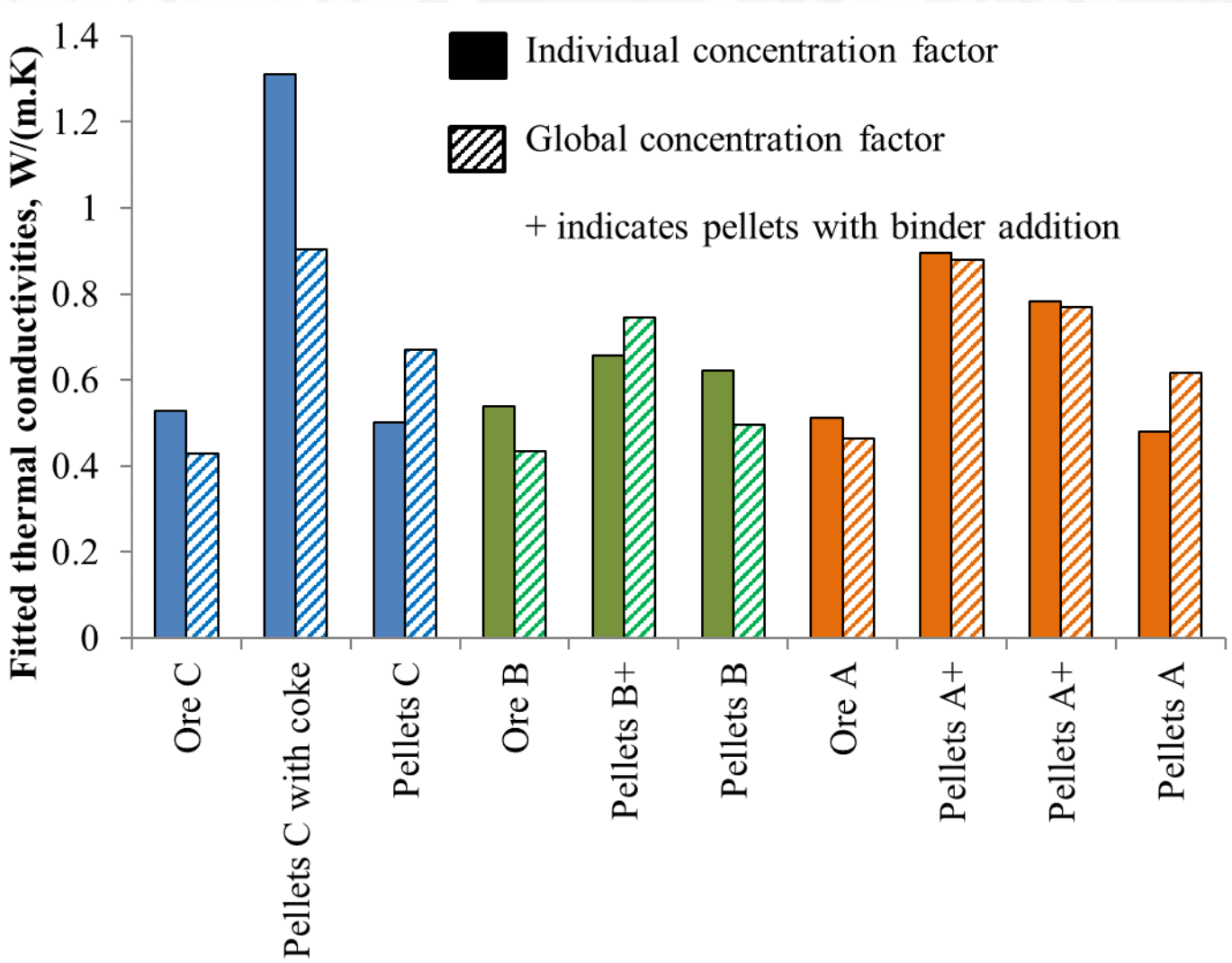
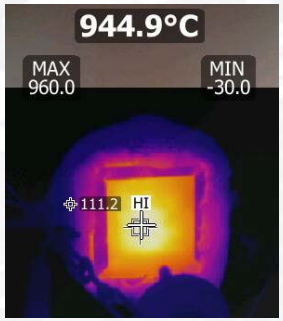
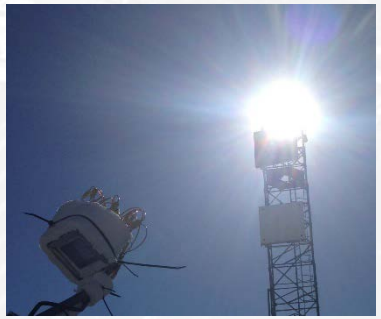


Figure 8. Effective thermal conductivities

Effective concentration ratio





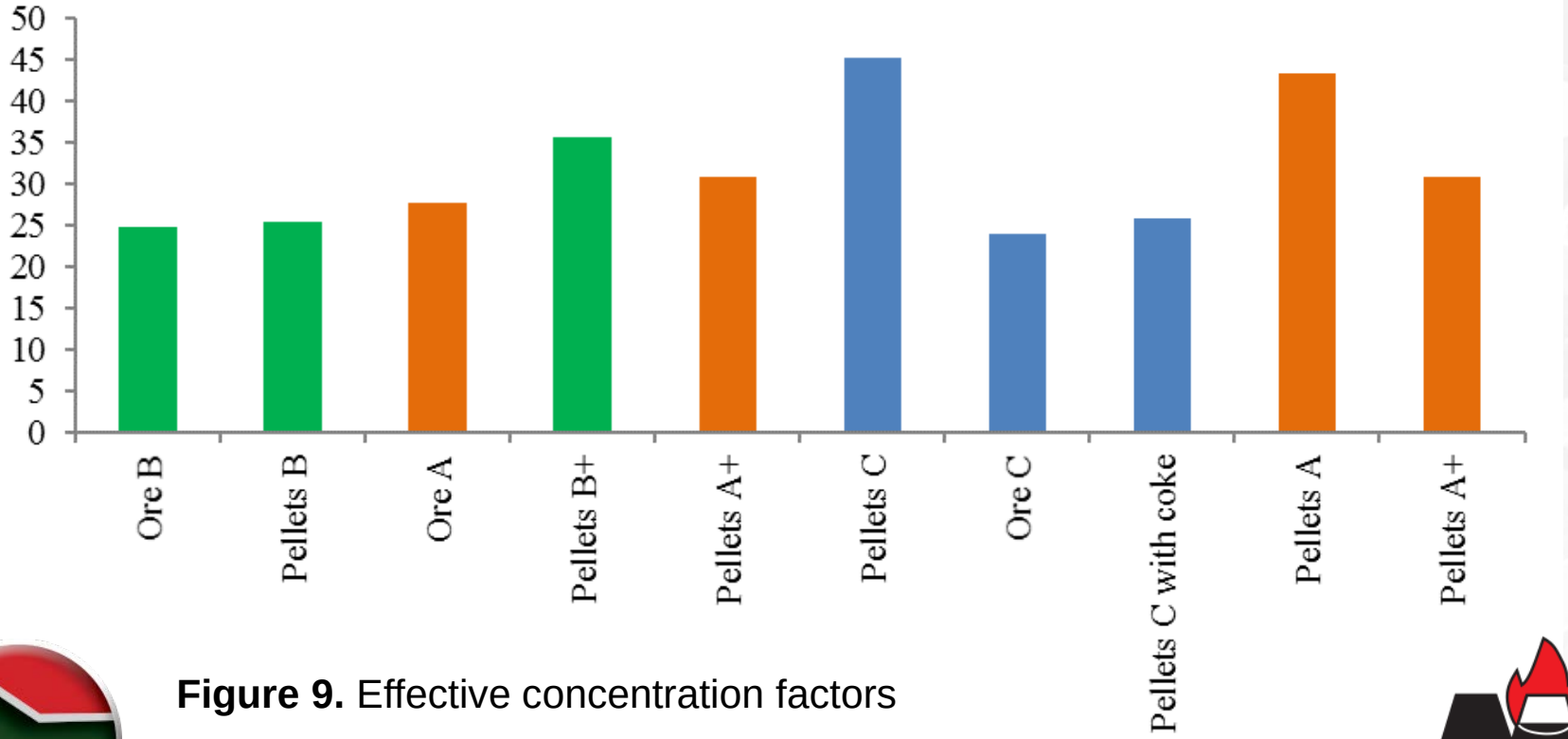


Figure 9. Effective concentration factors

Thermodynamic modelling

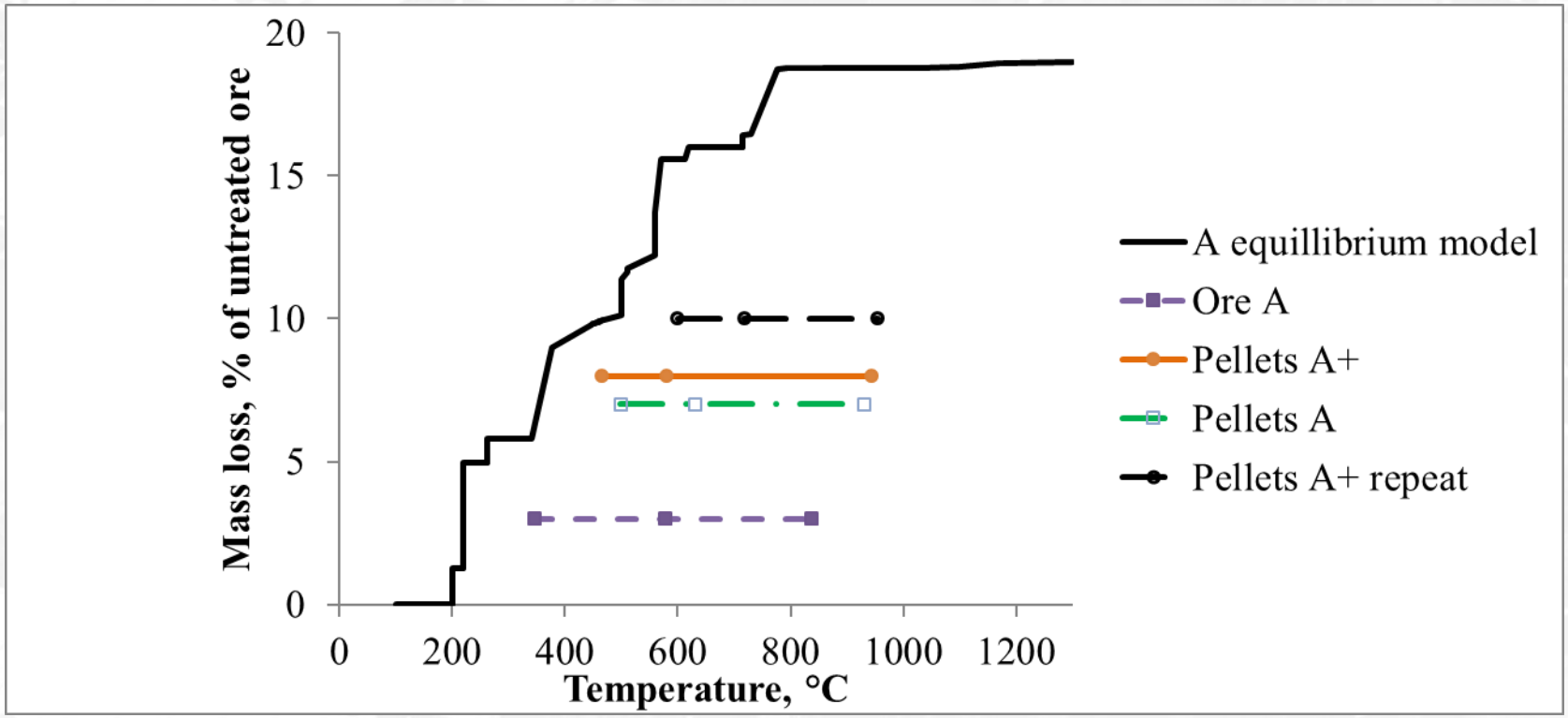


Figure 11. Thermodynamic equilibrium model - A

Thermodynamic modelling

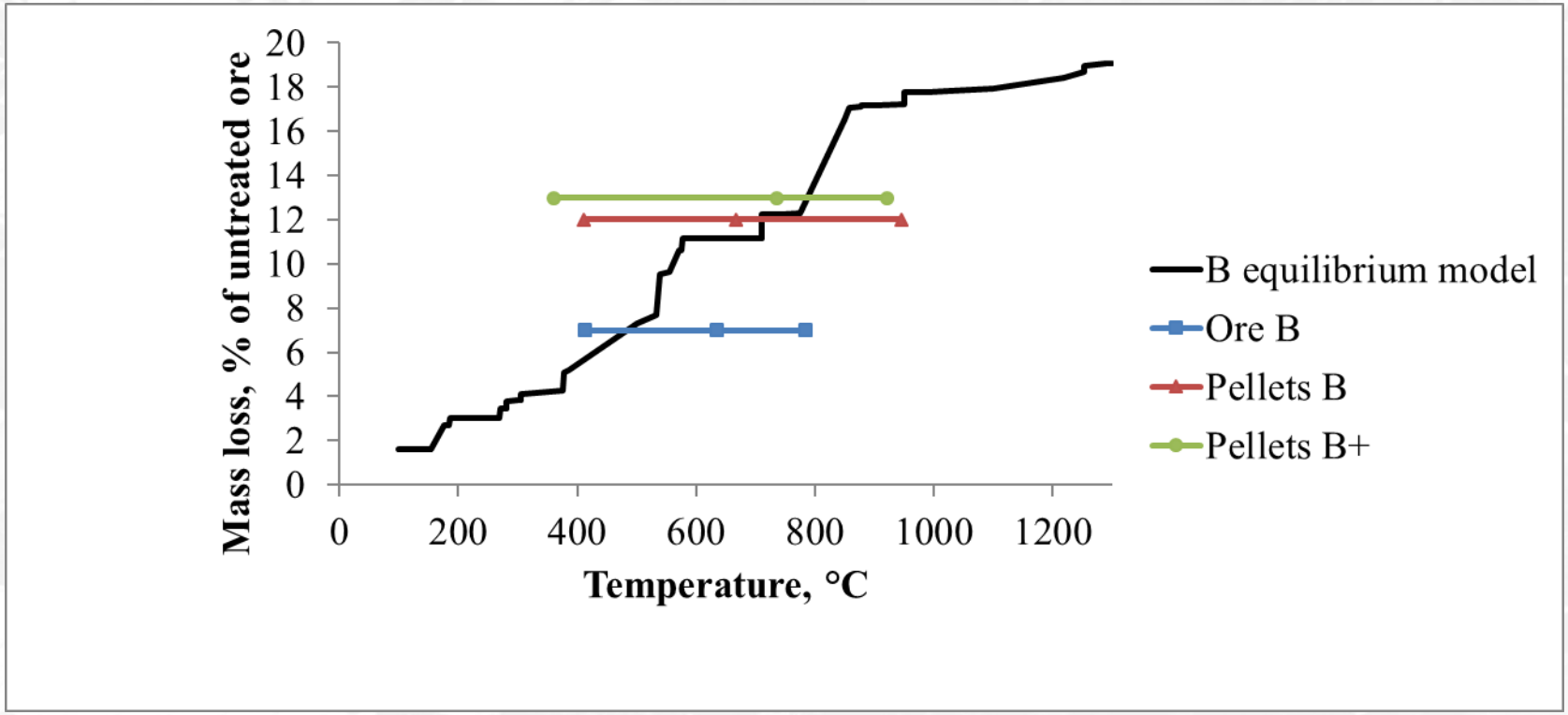


Figure 12. Thermodynamic equilibrium model - B

Thermodynamic modelling

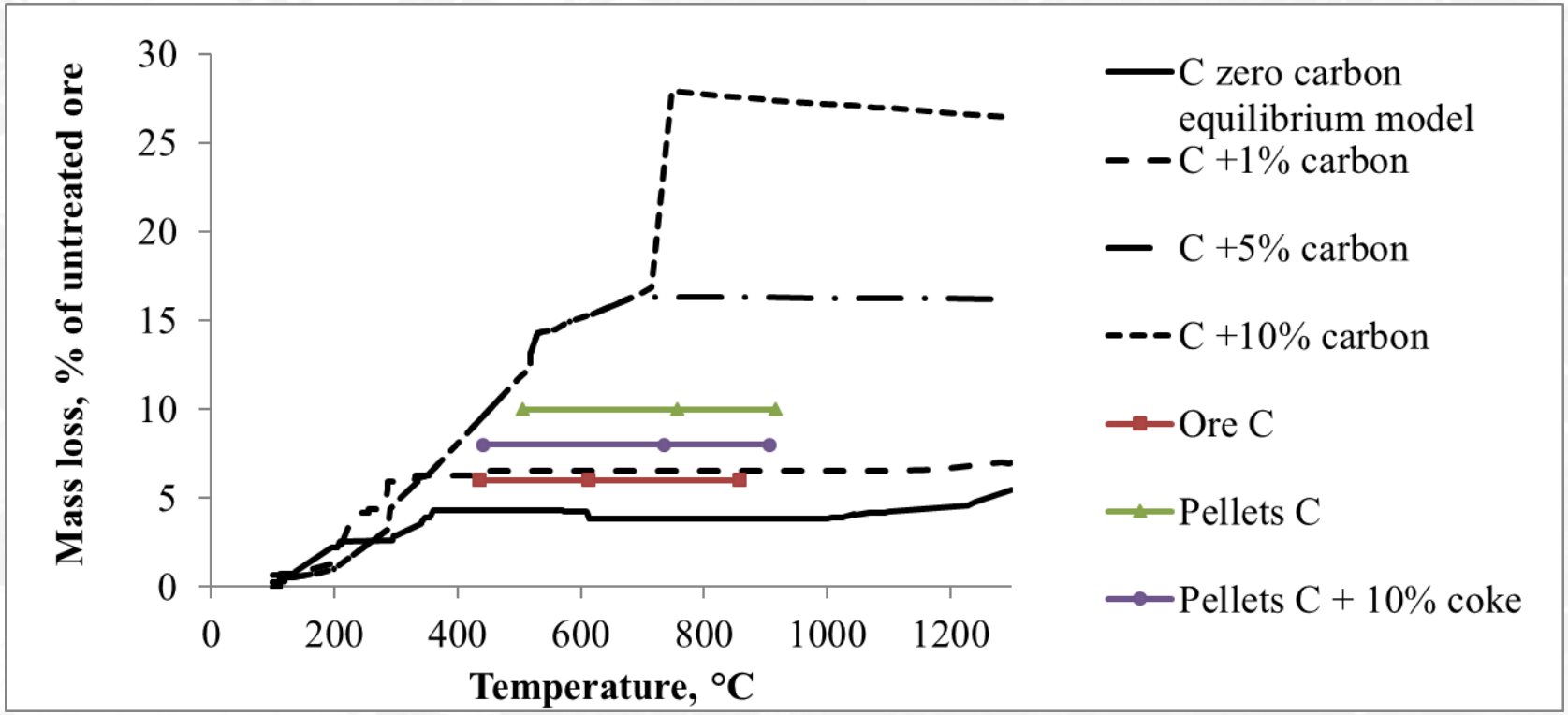


Figure 13. Thermodynamic equilibrium model - C

Future studies

- Modify set-up to investigate forced convection
- Take measures to improve concentrator efficiency
- Expand heat transfer model to include chemical reactions and variable convection
- Review implications of results on economic model

Figure 14. How to avoid sunburn

Conclusions

- Heating and thermal decomposition of manganese ores has been demonstrated
- Effective thermal conductivities has been determined for test materials in air
- The effective concentration ratio has been determined for the concentrator
- Empirical results when compared to thermodynamic equilibrium models indicate that kinetics factors are limiting decomposition
- Organic content in ore C facilitated higher mass loss by acting as a reductant

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Acknowledgements

- MINTEK
- STERG
- Southern African Universities Radiometric Network, SAURAN
- Transalloys

Figure 15. SAURAN station on adjacent rooftop

M.J. Brooks, S. du Clou, J.L. van Niekerk, P. Gauche, C. Leonard, M.J. Mouzouris, A.J. Meyer, N. van der Westhuizen, E.E. van Dyk, and F. Vorster. Sauran: A new resource for solar radiometric data in southern africa. *Journal of Energy in Southern Africa*, 26:2–10, 2015.

Thank You

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