Proof of Concept of a Solar Sinter

Lina Hockaday
Senior Engineer
Mintek
Pyrometallurgy Division
18 July 2019

6th Annual STERG Symposium
STELLENBOSCH, SOUTH AFRICA
18 - 19 JULY 2019

STERG
SOLAR THERMAL ENERGY RESEARCH GROUP

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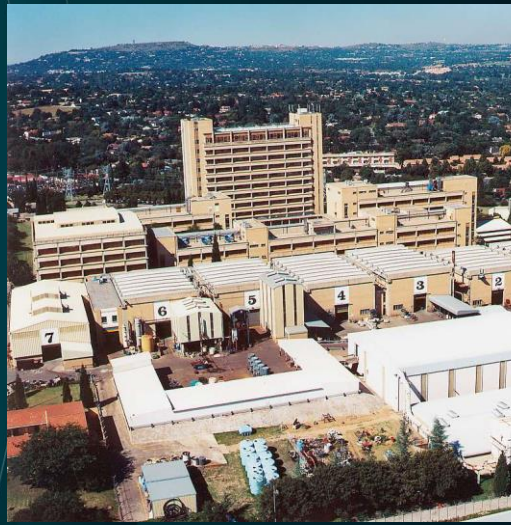
Mintek (Established 1934)

- Government-owned minerals research organization
- Employs ~700 people (250 professionals)
- Annual budget of ~R500m (US $35m)
- State & corporate funding (50:50)



Core expertise

- Electric smelting – especially DC arc furnaces
- Large-scale piloting and process demonstration
- Development of new processes

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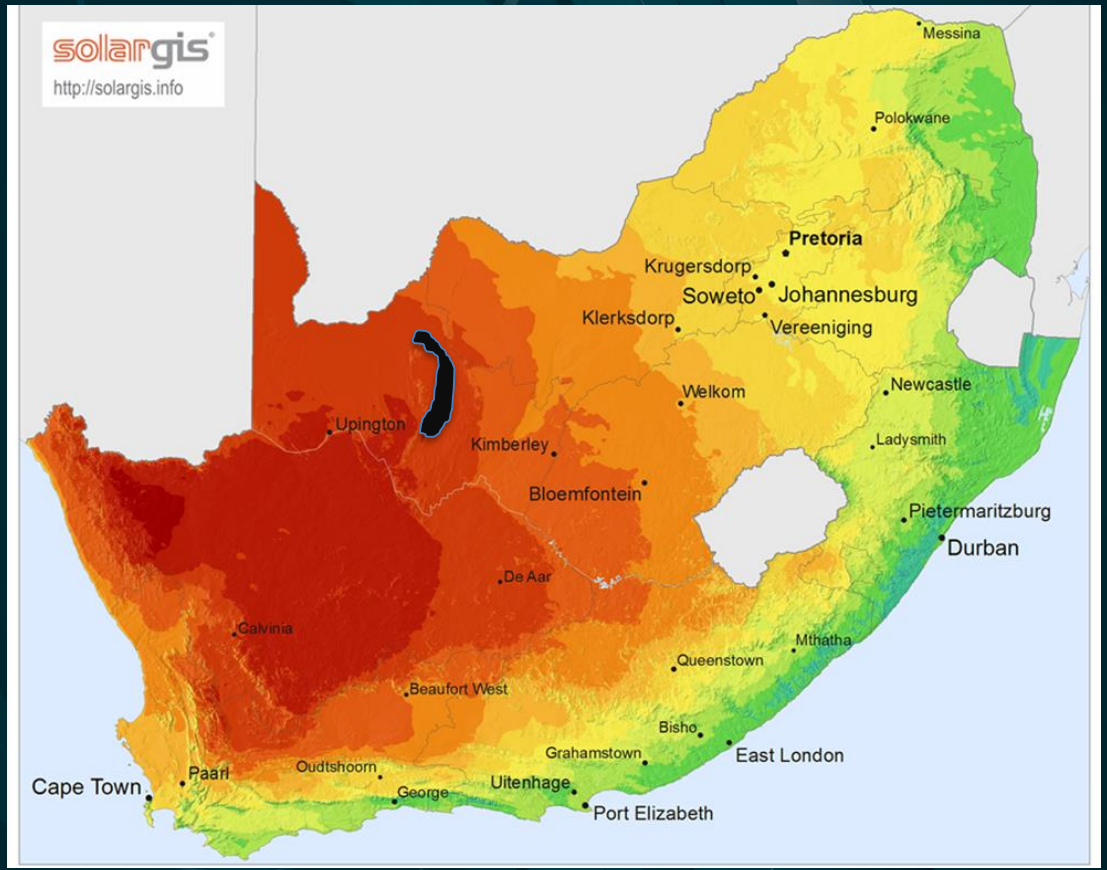
Kalahari Manganese Fields



Manganese exports are 94.7% of total sales

Transnet tests world's longest manganese production train

11TH OCTOBER 2018

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BY: MARLENY ARNOLDI
CREAMER MEDIA ONLINE WRITER

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Transnet Freight Rail (TFR) has successfully run a 375-wagon manganese train over a distance of 861 km from Sishen to Saldanha Bay.

https://www.engineeringnews.co.za/article/transnet-tests-worlds-longest-manganese-production-train-soon-to-operationalise-2018-10-11/

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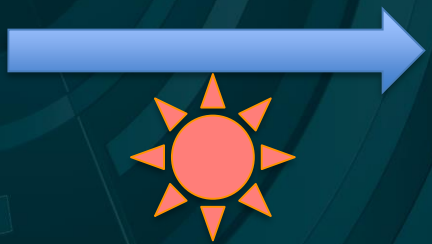
How do you proof a concept?

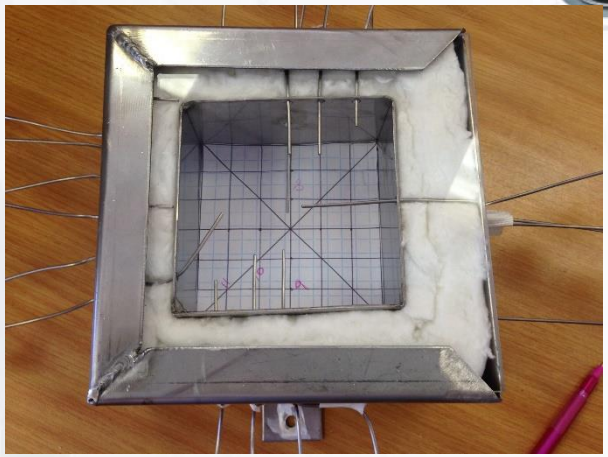
- Demonstration of technical feasibility
- Understanding of the fundamental physics involved
- Relating the value of the concept to its practical application



< 6 mm ore fines

manganese ore sinter

Experiments – Round 1



STERG solar concentrator

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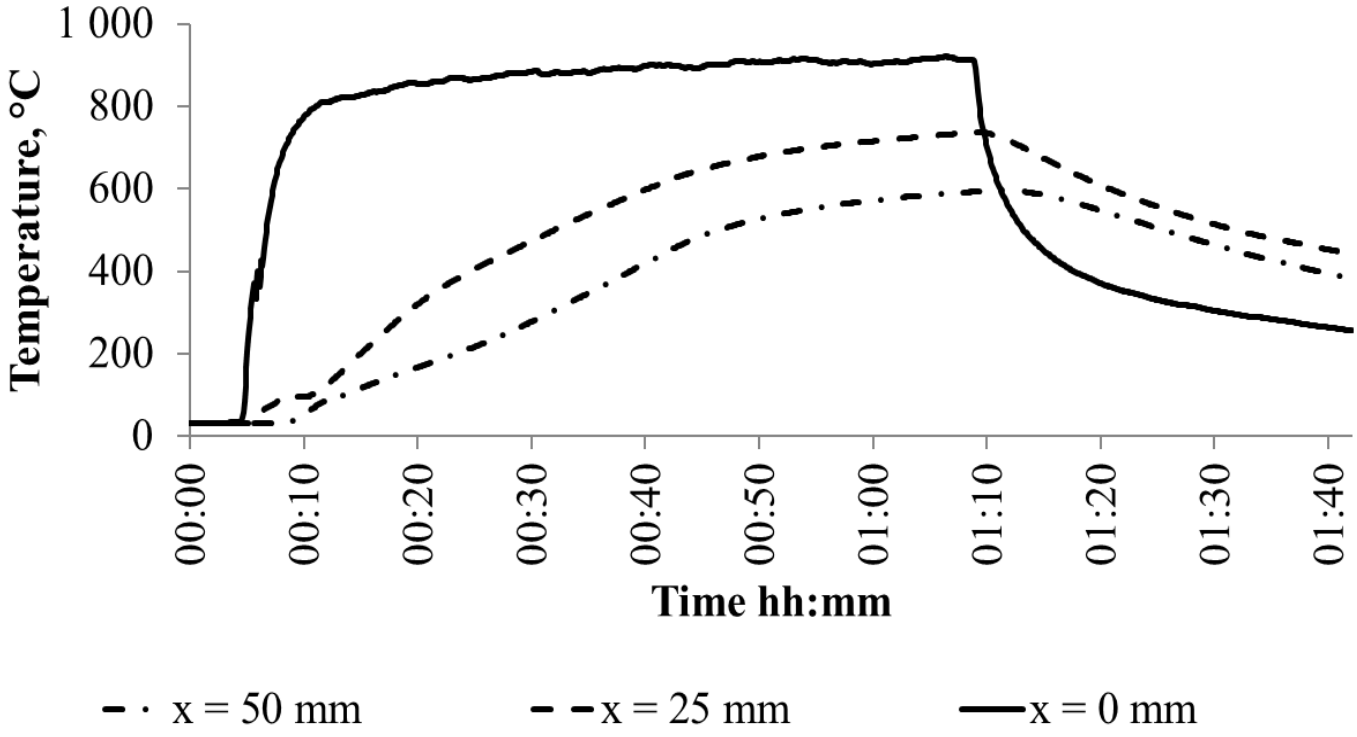
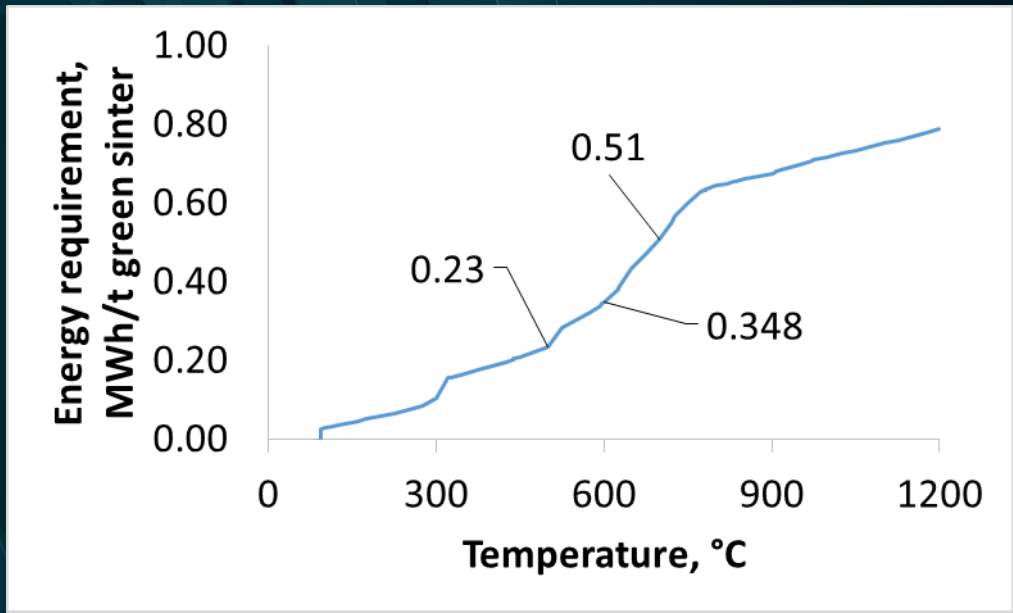
Results – Round 1

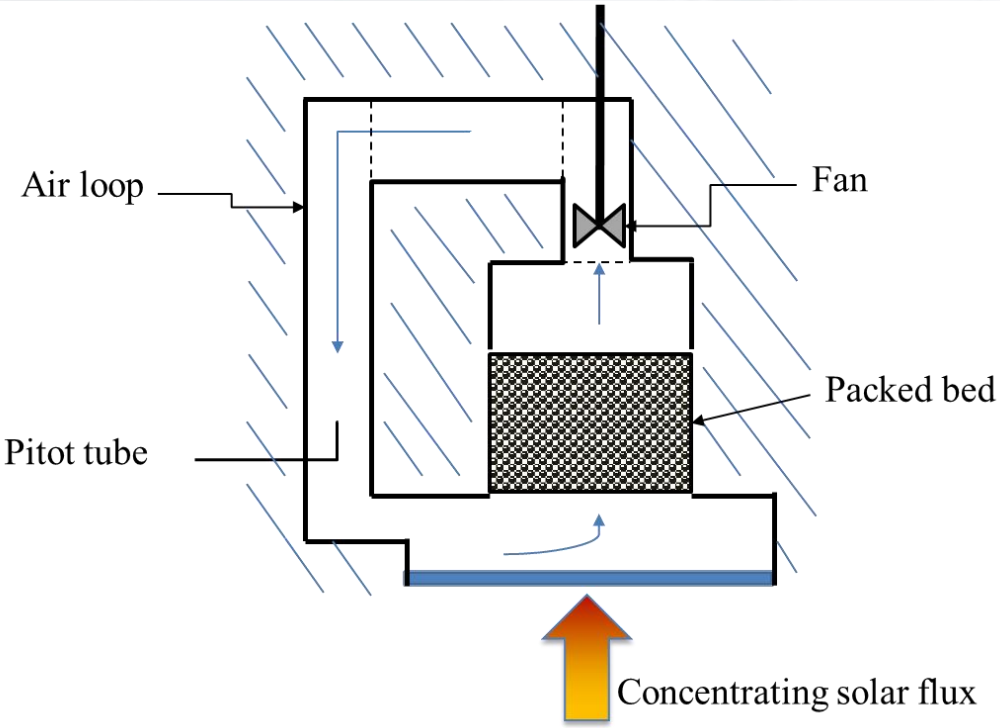


Results – Round 1

- Heating and thermal decomposition of manganese ores has been demonstrated
- Empirical results when compared to thermodynamic equilibrium models indicate that kinetics factors are limiting decomposition

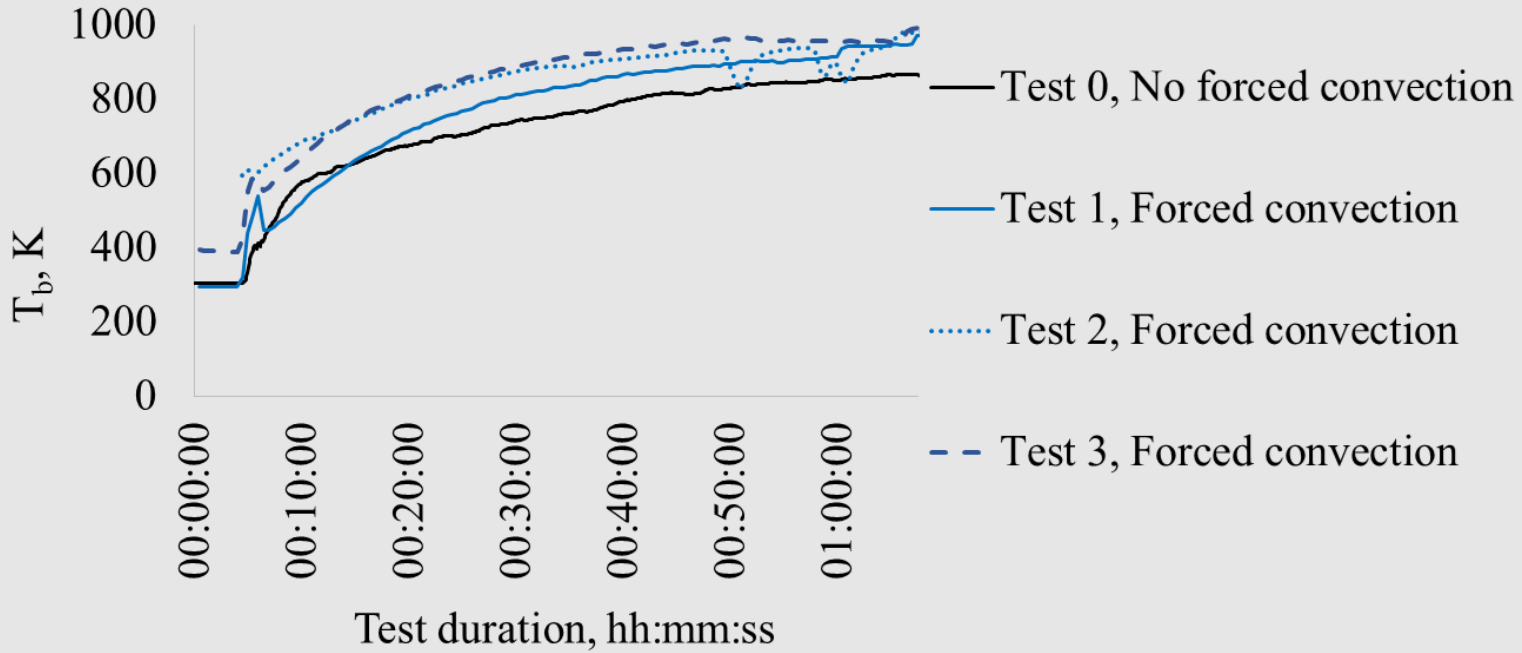


Experiments – Round 2



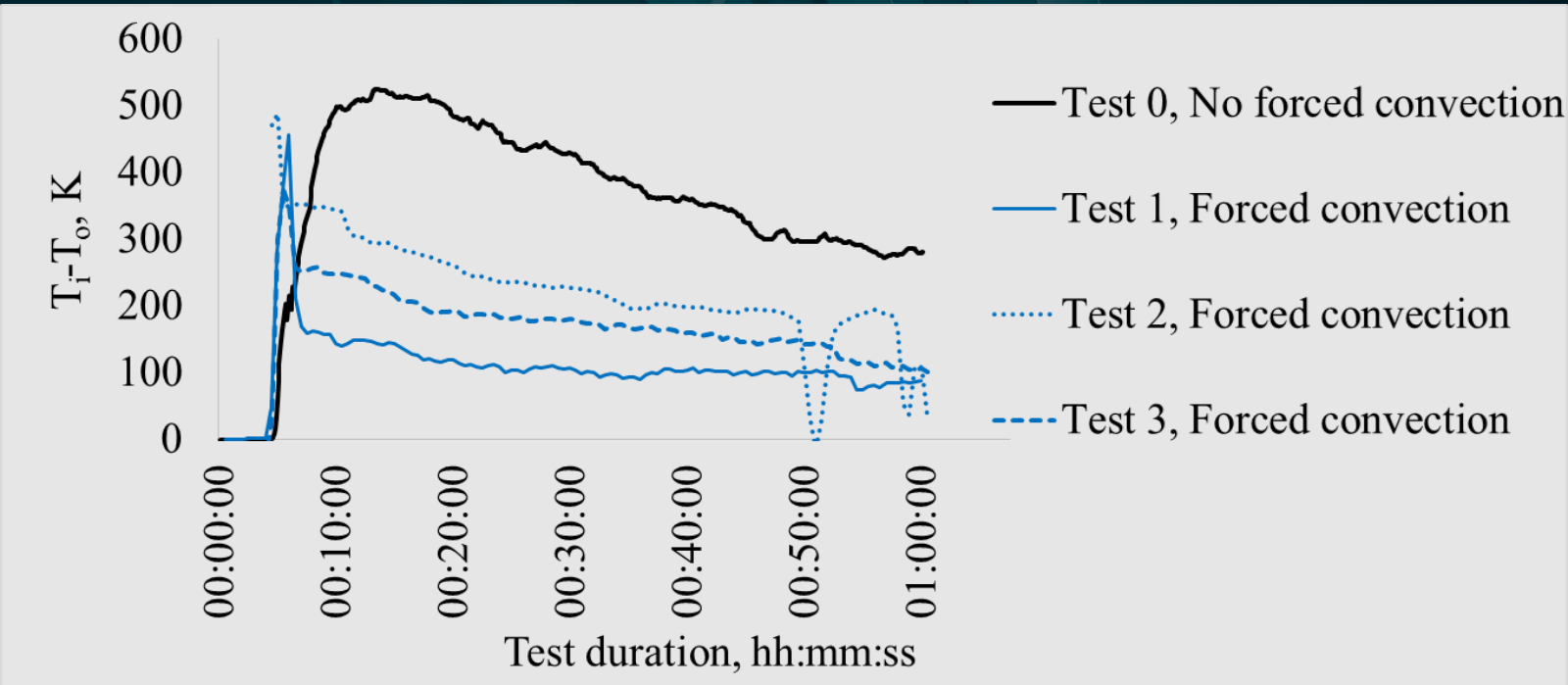
STERG Solar Roof, Stellenbosch, South Africa

Results – Round 2

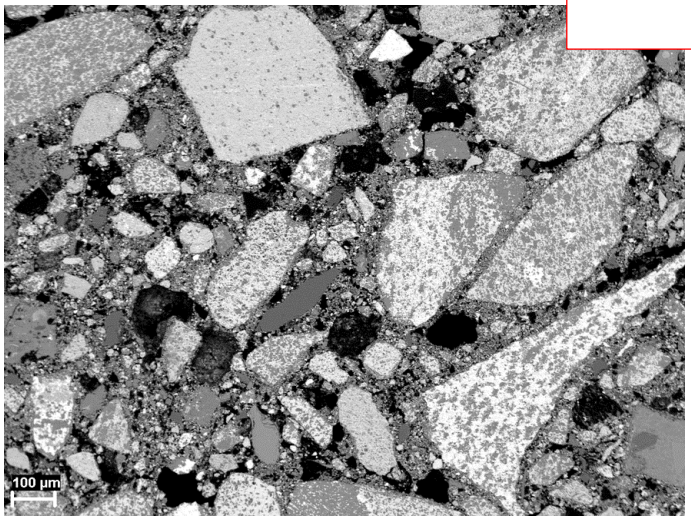


Average packed bed temperature

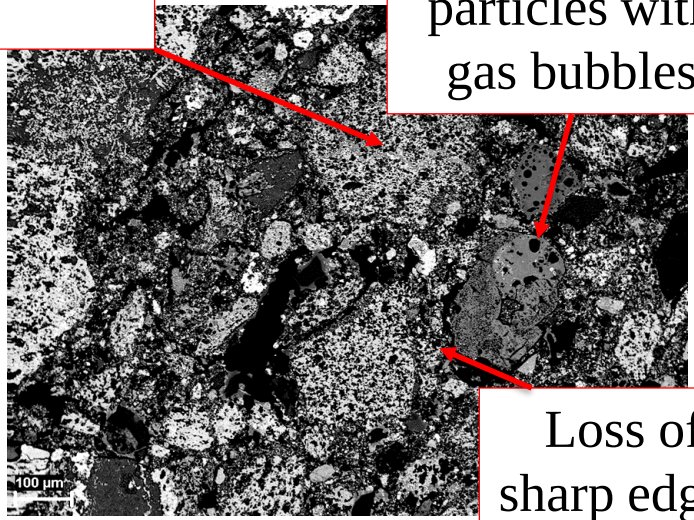
Results – Round 2



Scanning Electron Microscopy (SEM) images

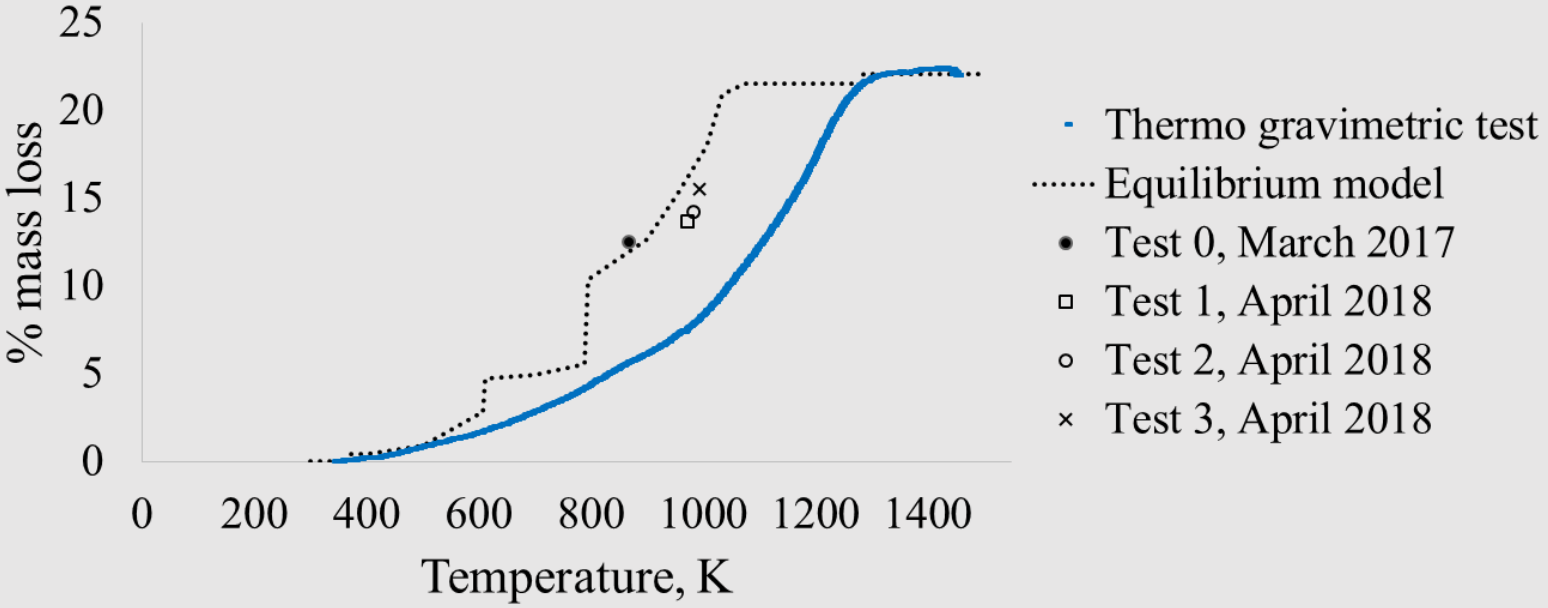


Before solar thermal treatment



After solar thermal treatment

Thermodynamic model



Thermo gravimetric experiments mass loss as compared to FACTSage model. Mass loss for experiments are plotted against the maximum bed temperature, T_b, calculated for each experiment.

Towards a Solar Sinter – Outside help

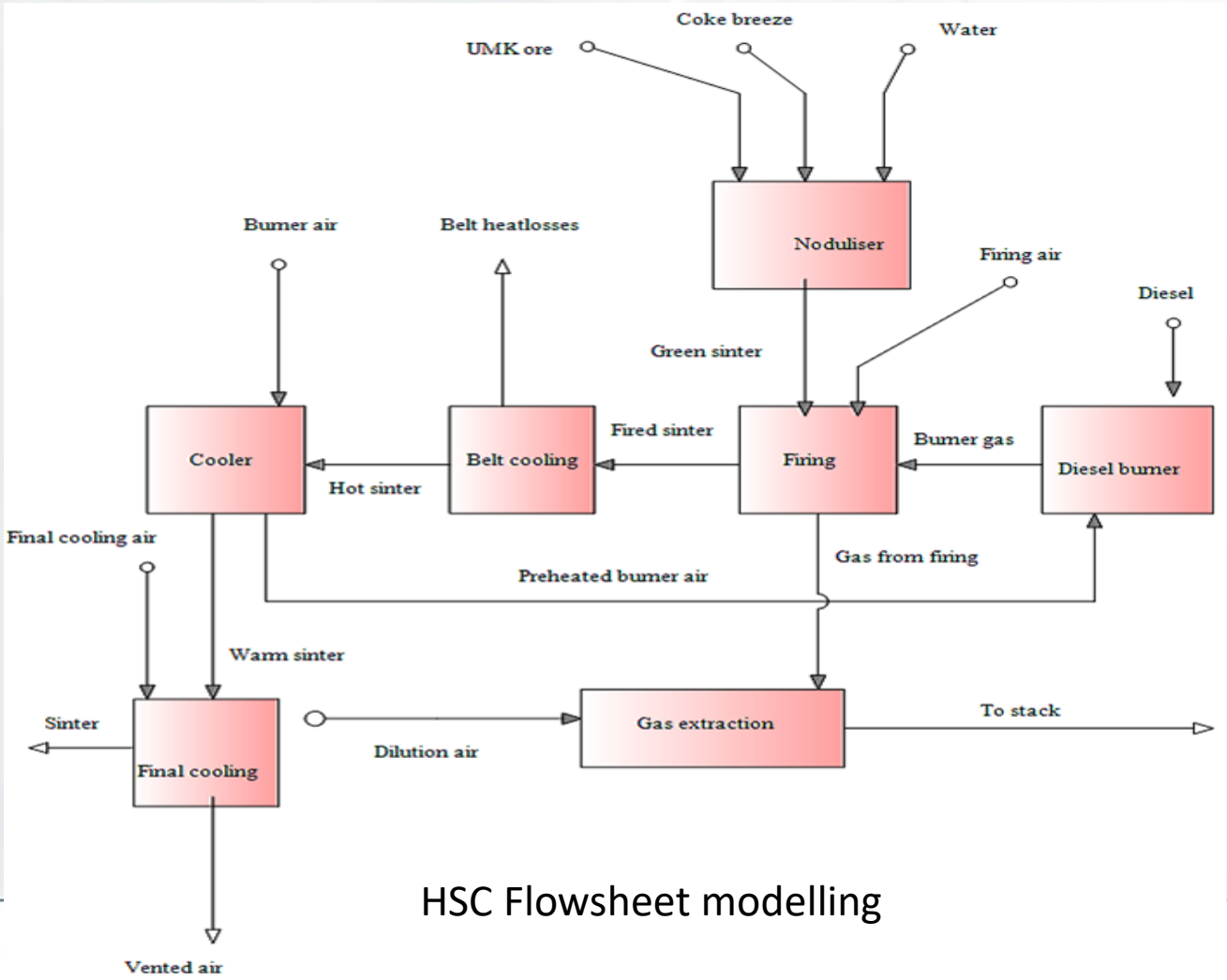
Sintered by concentrating solar flux

Not sintered by concentrating solar flux

10 mm

Thank you to Prof. Flamant from CNRS-PROMES, France

Towards a Solar Sinter – Value of concept



HSC Flowsheet modelling

2 Routes for fossil fuel reduction

Drying and preheating of green sinter, °C*	Coke breeze consumption, % of ore
None (current practice)	9.4
110	9.0
200	8.7

*Drying by air at 300 °C produced by concentrating solar thermal plant assumed

Burner air temperature, °C#	Diesel consumption, kg/t ore
350 (current practice)	1.65
600	1.22
800	0.85

#Heating by air at 900 °C produced by concentrating solar thermal plant assumed

Sintering at 1200 °C with solar energy only would also eliminate the need for diesel as no coke ignition would be required…

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Conclusions

- Currently data processing is still underway
- Flowsheet evaluation and techno-economics is under consideration for the SolarPACES 2019 paper
- Modelling is in progress with the aim to include mass transfer as well as heat transfer into the model

By the way….

- **PREMA** Project

- **SolarPACES** 2019, 1 to 4 October 2019, Daegu, South Korea
- **SASEC** 2019, 25th to the 27th November 2019
- **HiTEMP2**, 6-18 March 2020, Adelaide, Australia
- **Colloquium** on Renewable Energy for Energy Intensive Industry (SAIMM) 21 June 2019, Kathu
- **Mn School** (SAIMM) 23-24 June 2019, Kathu

Thank You

Lina Hockaday
linah@mintek.co.za

Twitter: @Mintek_RSA
LinkedIn:
https://za/linkedin.com/company/mintek

www.mintek.co.za

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