INDUSTRIE & ENERGIE 2017

VERSNELLEN
Energy storage of high temperature heat

Industrie&Energie 2017
Gerard Jägers
2017-12-12
### Agenda

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Agenda

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2. Application of waste heat is a challenge
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4. Heat storage is studied
Over the last 25 years, the energy efficiency at Tata Steel in IJmuiden has improved over 30%.

- In 2014 an energy saving of 2.2% was obtained.

The annual energy savings are equivalent to the energy consumption of 65,000 households (i.e. the cities of Velsen and Beverwijk together).
The Trias Energetica shows the way towards energy efficiency improvement

1. Reduce unnecessary energy consumption, by good heat insulation, innovative design, hot connect, start-stop management;

2. For the remaining energy requirement use sustainable energy, such as wind, solar, biomass or geothermal energy;

3. When renewable energy is not sufficient, make use of efficient fossil sources, for example, low-CO₂ power of an incinerator.
Energie transitie in alle facetten en fasen met trias energetica als uitgangspunt

- Energie efficiency
  - Convenanten inclusief addendum
- Duurzame energie
  - Zon
  - Wind
- Restwarmte benutting in regio IJmond
- CO$_2$ reductie
  - HIsarna
  - CO$_2$ smart grid
  - CCS, CCU
  - Duurzame elektriciteit en/of waterstof?
1. Steel industry generates heat
2. Application of waste heat is a challenge
3. Thermo Electric Generation is under development
4. Heat storage is studied
Over one third of the residual heat is used within our own processes

Source: Restwarmte projecten CORUS (Kiesewetter & Hoeben)

1 Huidige stand der techniek nog onvoldoende gevorderd om economisch terug te winnen
Waste heat properties varies

Energy storage of high temperature heat

Waste heat quantity
Tata Steel IJmuiden participates in the development of a heat distribution network in the “Noordzeekanaal gebied”

Supply is fairly continuous where as demand varies over day and season: storage required?
Industrial waste heat is appreciated

De $\text{CO}_2$-ladder

- Biomassa uit de regio
- Diepe geothermiebron
- Warmte uit afvalcentrale
- Restwarmte Tata Steel
- Warmte uit gascentrale
- Warmte uit kolencentrale
- CV-ketel op aardgas

Alles doorgerekend met elektriciteitsmix van 2020.
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Thermo Electric Generation (TEG) combined with a heat transformer is in design phase

1. What is TEG and what’s its value to Tata Steel?
   - Thermoelectric power generator, 2 kW/m²
   - Compact, modular design; low CapEx
   - 70-150 GWh/y heat recovery potential by TEG at Tata Steel MLE

2. Scope of the project
   - To investigate the efficiency and stability of a TEG-system in combination with a heat transformer in Tata Steel’s production environment

3. Status of the project
   - Basic engineering started
   - Plant trial scheduled for end of 2018
Heat balance WRAP system has a steam loop

- Total
- Back up application
- 11 Cold gas / air flow in
- Tundish Gas heating
- Hot gas / air flow out
- Steam loop
- Q pinch steam converter
- 10
- RGS Thermagy
- Hot water loop
- Inverter
- Electrical power out
- Hot slabs in
- 1
- Cooled slabs out
- 2
- Other slab cooling
- 3
- Radiation to Thermagy
- 4
- Energy storage of high temperature heat
- 5
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- 7
- 8
- To heaters tundish pre-heat
- 9
- 11
- 12
Test of Thermo Electric Generation (TEG) is ongoing
Q pinch technology transforms waste heat into useful process heat

IN

75-150°C

Waste heat 100%

Electricity < 2%

OUT

100-200°C

Process heat 50%

30°C

Ambient heat 50%

Caloritum Black Box
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Flow diagram and thermal energy storage visualisation

- Heat recovery
- Thermal energy storage
- Heat exchanger
- Expansion vessel
- Intermittent waste gas stream of DSP process from stacks

process heat to DSP and BOS tundish drying processes
Thermal Energy storage (TES) is studied to use heat from flue gas in a discontinuous way

What is TES and what's its value to Tata Steel?
- Thermal Heat Storage from flue gas (700°C), 16 MWh capacity;
- Compact, modular design;
- 2.3 PJ/y heat recovery potential by TES at Tata Steel MLE.

Scope of the project
- To demonstrate the efficiency and flexibility of a TES-system in Tata Steel's production environment to replace Natural Gas.

Status of the project
- Basic engineering done;
- Seeking Financial opportunities for the demonstration project;
- Plant trial scheduled for end of 2018.
The pilot would have a significant size