**1st International Seminar**

**Hydrogen-based Reduction of Iron Ores**

4 - 5 May 2020

Cologne, Germany

**TARGET GROUP**

- Supervisors responsible for decisions on metallurgy, energy, strategy, environmental protection
- Analysts, stake holders and decision makers in energy transition, low carbon economy and decarbonization
- Blast Furnace staff
- R&D staff
- Raw material staff

The seminar places the emphasis on a wide overview on the subject: the first day covers the fundamentals and conditions for hydrogen-based iron ore reduction. The lectures of the second day round off the programme with practical approaches on different industrial plant concepts. **Note: Both, during lectures and discussions as well as in the breaks of the seminar, our guidelines on adherence to cartel-law regulations must be followed.**

**DIRECTED BY**

Dr.-Ing. Hans Bodo Lüngen / Prof. Dr.-Ing. Johannes Schenk

**REGISTRATION FEE**

EUR 910,00* registration fee VAT-free plus EUR 140,00 conference package (total EUR 1050,00*)

EUR 1.110,00 registration fee VAT-free plus EUR 140,00 conference package (total EUR 1250,00)

* for employees of member companies and individual members of the Steel Institute VDEh and for scientific staff of universities.

The conference package includes food and beverages during the seminar (incl. 19 % VAT).

A free withdrawal from the seminar is possible until two weeks prior to the start. Then, 25% of the seminar fee must be paid. The total registration amount will be charged for no show or cancellation from the first day of the seminar.

**CONTENT**

- CO₂-emissions and their mitigation in the steel industry
- Hydrogen – production and importance for the economic sector
- Thermodynamics and kinetics of hydrogen-based reduction
- Injection of carbon-hydrogen carriers into the blast furnace
- History, developments and processes of direct reduction
- Iron ores for hydrogen-based direct reduction
- Hydrogen-based direct reduction with Midrex
- Hydrogen-based direct reduction with HyL/Energiron
- Hydrogen-based direct reduction with Circored
- Hydrogen-based direct reduction for iron ore fines

**ORGANISATION**

Steel Academy
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**VENUE / SEMINAR HOTEL**

art'otel Cologne
Holzmarkt 4
50676 Cologne, Germany
Tel +49 221 80103-0 // www.artotel.com

The Steel Academy will automatically make a room booking for the participants at the art’otel Cologne from May, 3rd to 5th, 2020 for a special rate of EUR 110,00 per night incl. breakfast. The hotel room bill will be settled by you upon departure. Please advise at registration, if you do not need a room or whether you would like to stay longer in the hotel.
Monday, 4th of May 2020

Chapter “Fundamentals and Conditions”

09:00 Introduction to the seminar
P. Schmieding, H.B. Lüngen, J. Schenk

09:30 CO₂-emissions and their mitigation in the steel industry
Hans Bodo Lünngen
Requirements of the EC / CO₂-emissions of steelmaking routes in use / CO₂-mitigation of the European steel industry 1990-2015 / Current projects in Europe to reduce CO₂ in steelmaking

10:30 coffee break

11:00 Hydrogen – its production and importance for the economic sector
Ilona Dickschas
Principles of hydrogen electrolysis / P2X and sector coupling / Overview of references and projects

12:00 lunch

13:15 History, developments, processes of direct reduction
Hans Bodo Lünngen
Development and plants of Midrex, HYL and Circored / Other developments without importance or realization

14:00 Thermodynamics and kinetic fundamentals of hydrogen-based reduction
Karl-Hermann Tacke
Phases, reactions, equilibria / Kinetic effects: temperature, ore, particle size, porosity, gas properties and other parameters / Morphology / Modelling approaches

15:30 coffee break

16:00 Injection of carbon-hydrogen carriers into the blast furnace
Peter Schmöle
Use of different auxiliary reducing agents / Effects on blast furnace operations (Raceway adiabatic flame temperature, oxygen addition, reduction rates by C and H₂, top gas composition)

17:00 Iron ores for direct reduction
Rénard Chaigneau
Pellets are the natural choice for conventional DR. Also for efficient hydrogen-based reduction?

18:00 end of 1st day

18:30 common dinner

Tuesday, 5th of May 2020

Chapter “Shaft Furnace”

09:00 Hydrogen-based direct reduction with Midrex
Johannes Schenk
Process Diagram / Core Equipment / Options for hydrogen enrichment / Process limitations

10:30 coffee break

11:00 Hydrogen-based direct reduction with HYL/Energiron
Markus Dorndorf, Tenova
ENERGIRON-ZR process / Principles of design / Process schemes / CO₂ removal unit / High-C DRI – link to EAF process / Final products (DRI, HBI, Hot Metal) / Hydrogen utilization in ENERGIRON process

12:15 lunch

Chapter “Fluidized Bed Process”

13:30 Hydrogen-based direct reduction with Circored
Tobias Stefan, Outotec
Basic principles of fluidized beds / Sticking in fluidized bed based direct reduction / Process Principles Circored / History Circored plant Trinidad / Process options for ultrafines

14:45 Hydrogen-based direct reduction for iron ore fines
Christian Böhm
FINORED and "Breakthrough Technology" / Status of technologies / Flowsheets / Principles of the design / Raw materials / Products / Further use of products / Reductants / Limits of the process

15:45 end of seminar

SPEAKERS
Dr. ir. Rénard Chaigneau, Baffinland Iron Mines Europe B.V., Amsterdam
Ilona Dickschas, Siemens AG, Gas and Power, Hydrogen Solutions, Erlangen
Dr.-Ing. Markus Dorndorf, Tenova Metals Deutschland GmbH, Essen
Dr.-Ing. Hans Bodo Lüngen, Steel Institute VDEh, Düsseldorf
Prof. Dr.-Ing. Peter Schmöle, Dortmund
Prof. Dr.-Ing. Karl-Hermann Tacke, Technical University of Berlin
Prof. Dr.-Ing. Johannes Schenk, Montanuniversität Leoben
Dipl.-Ing. Tobias Stefan, Outotec GmbH & Co KG, Köln
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