

BR Valorisation Symposium, 5-7 October 2015

**RWTH**AACHEN  
UNIVERSITY



AACHEN  
KNOW-HOW CENTRE  
RESOURCE TECHNOLOGY

## Carbothermic Reduction of Red Mud in an EAF and subsequent Recovery of Aluminum from slag by Pressure Leaching in Caustic Solution

Frank Kaußen, Bernd Friedrich



IME Process Metallurgy and  
Metal Recycling, RWTH Aachen University  
Prof. Dr.-Ing. Dr. h.c. Bernd Friedrich

# Motivation and Overview

Red mud composition

Main components in wt.-%	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	SiO <sub>2</sub>	CaO	TiO <sub>2</sub>	Na <sub>2</sub> O	Cr <sub>2</sub> O <sub>3</sub>
Red Mud	27	28.5	13.1	3.8	8	7	0.35

- **Carbothermic Reduction in EAF**

- Addition of lignite coke as reductant
- Addition of lime as flux

→ **Aim: Preconcentration of alumina and maximum recovery of iron**



- **Pressure leaching of ground slag**

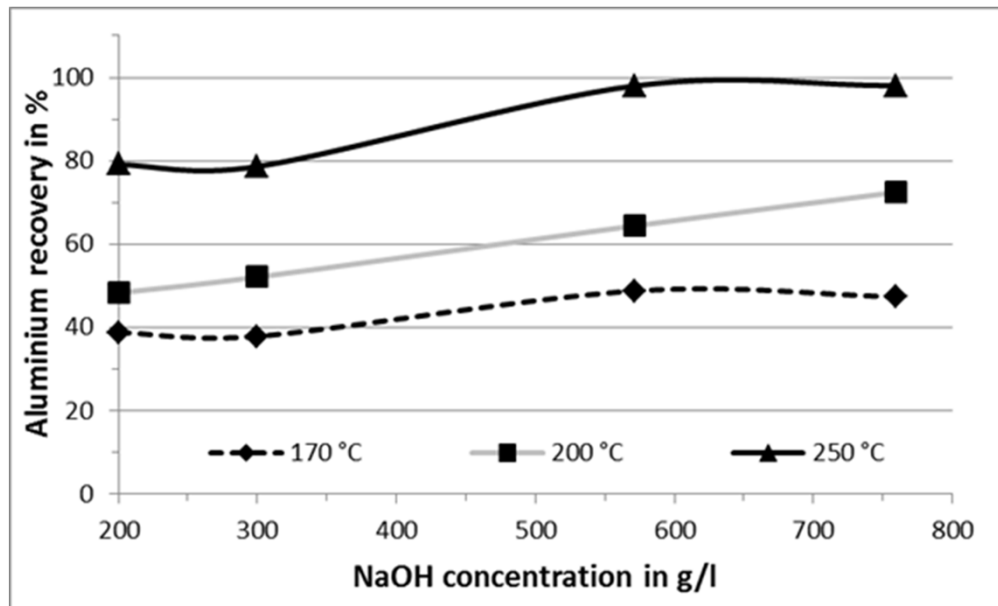
- Various caustic soda concentrations (200-760 g/l)
- NaF<sub>2</sub> (50 g/l) and Na<sub>2</sub>CO<sub>3</sub> (10 wt.-%) Addition

→ **Aim: Maximum recovery of alumina**



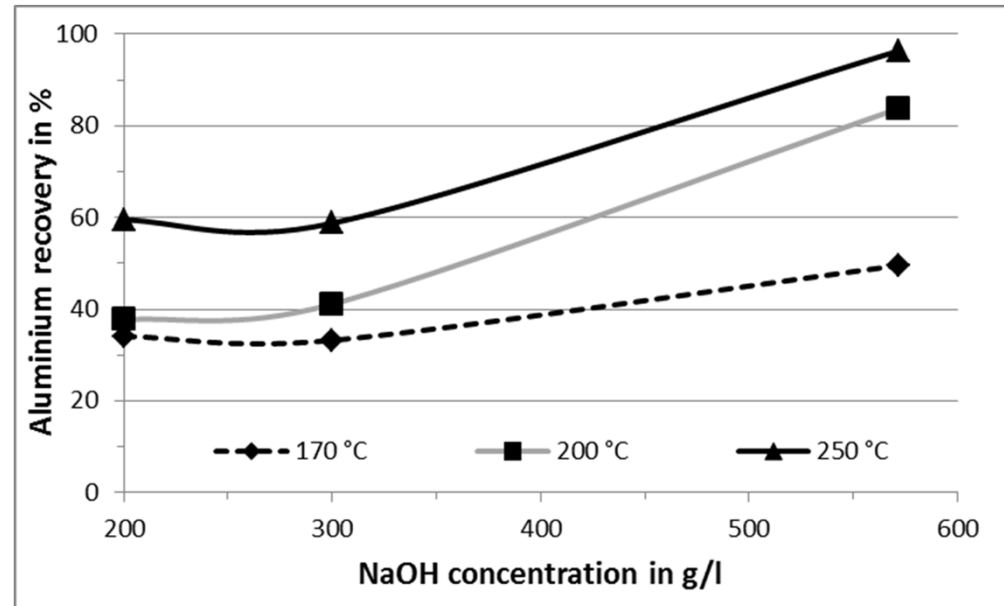
## Results carbothermic reduction and leaching

Main components in wt.-%	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	SiO <sub>2</sub>	CaO	TiO <sub>2</sub>	Na <sub>2</sub> O	Cr <sub>2</sub> O <sub>3</sub>
Red Mud	27	28.5	13.1	3.8	8	7	0.35
Slag with lime addition	40	1.1	18	29.1	11	2.8	0.07
Slag without lime addition	50	2.3	20.7	7.7	13.8	7.7	0.14
Leached Residue	2.2	0.5	20.7	38.7	18.2	11.9	0.09



- Maximum preconcentration up to 50 wt.-% without lime addition, but higher iron losses due to high slag viscosity
- 95 % aluminum recovery at NaOH > 550 g/l @ 250°C
- Leached residue contains only ~2 wt.-% Al<sub>2</sub>O<sub>3</sub> and ~0.5 wt.-% Fe<sub>2</sub>O<sub>3</sub>

## Results Fluoride addition



- Fluoride addition does not hinder the alumina recovery
  - Silica dissolution is fastend
  - Intensified silica precipitaion during the leaching at lower NaOH concentrations (< 300 g/l)
- At the end lower silicon contents in leach liquor

# BR Valorisation Symposium, 5-7 October 2015

**RWTH**AACHEN  
UNIVERSITY



AACHEN  
KNOW-HOW CENTRE  
RESOURCE TECHNOLOGY



**Thank you for your attention!**

Metallurgie  
**IME**  
Prozesstechnik  
Recycling  
DIE METALLURGEN

IME Process Metallurgy and  
Metal Recycling, RWTH Aachen University  
Prof. Dr.-Ing. Dr. h.c. Bernd Friedrich