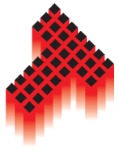


Innovative pyrometallurgical processing technology for red mud from alumina industry and melting unit for the technology implementation

ICSOBA 2011

**Technologiya metallovo LLC, Russia**

Speaker Nikita Golubev



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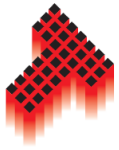


# Introduction

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## Main characteristics of red mud:

- Environmentally harmful product with high content of NaOH and moisture content up to 50%
- High content of iron oxides (up to 55%), comparable with medium-grade ore
- High content of  $\text{Al}_2\text{O}_3$  and other useful elements
- Low processing level in spite of high economic potential
- High storage expenses of accrued red mud reserves
- Demand for effective large-scale red mud processing technology



# Review of existing technologies

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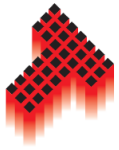
## Hydrometallurgical technologies

### Advantages:

- No need of preliminary drying

### Disadvantages:

- Complicated
- Inefficient and low scale
- Lead to appearance of waste products
- Reduction of iron is achieved by secondary pyrometallurgical technologies



# Review of existing technologies

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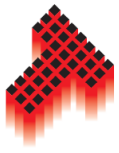
## Pyrometallurgical technologies

### Advantages:

- Large scale
- Practically wasteless processing
- Recovery of marketable goods

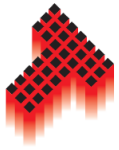
### Disadvantages:

- Necessity of preliminary drying of red mud
- High consumption of heat carriers for heating and melting of charge material



# Review of existing pyrometallurgical technologies

Process	Characteristic
Addition of red mud into charge in blast-furnace process	Small quantities of red mud processed, need of red mud transportation
Two-stage process (solid phase iron recovery unit and melting unit for separation of metal and slag)	Complicated technological scheme (2 units), low production, low firmness of lining
Multistage process of solid phase and liquid phase iron recovery directly in melting unit	Complicated technological scheme, low production and efficiency, low firmness of lining
Single-stage process – liquid phase iron recovery in melting unit with kish lining and separate tapping of metal and slag	Simple technological scheme, high efficiency



# Technology justification

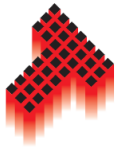
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## Main requirements:

- Single stage, continuous pyrometallurgical process
- Effective iron recovery
- Deriving of other marketable goods
- Non-use of coking coal

## Result:

- Large scale production
- Economic efficiency
- Absence of harmful secondary wastes

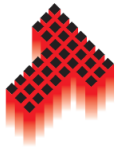


# MAGMA unit

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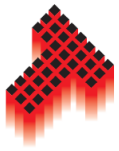
- Continuous-running melting unit
- Innovative method of unit chamber cooling
- Use of kish as a lining in slag-line area and in free space of unit
- High temperature process: slag – up to 1650°C, metal – up to 1500°C
- Drying and heating of charge material with waste-gas heat
- Separate tapping of metal and slag
- Possibility of use of various heat carriers



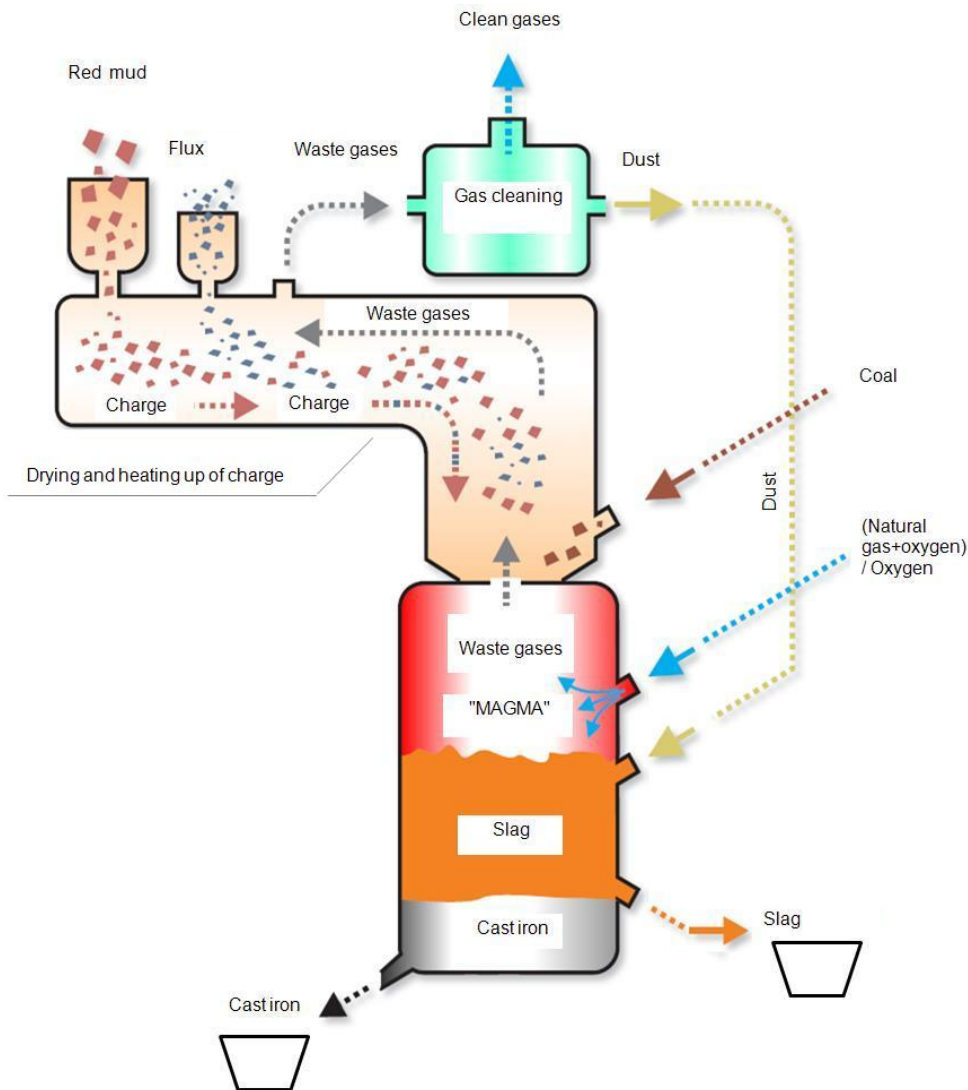


# Unit key features

Attribute	Value
Fuel type	Natural gas, coal, fuel oil
Oxidizing agent	Bulk oxygen
Gaseous phase temperature in free space of melting unit	1800-1850 °C
Melted slug temperature	1550-1650 °C
Metal temperature in metal bath	1350-1500 °C
Melting chamber housing material	Stainless steel
Melting chamber housing cooling	Primary cooling – liquid-metal coolant. Secondary cooling – gaseous nitrogen and air
Refractory of metal bath housing	High-alumina firebricks
Annual capacity of red mud (moisture content of 25%) processing	up to 350 000 t



# Unit workflow



- Charge of red mud and flux
- Drying and heating of mud with waste-gas heat
- Charge melting and liquid phase iron recovery
- Separate of metal and slag
- Tapping of pig iron and slag
- Injection of dust captured by gas cleaning system back into the unit

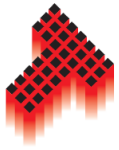
*Slag with various characteristics can be received, depending on contents of red mud and economic needs*



# Process performance ratios

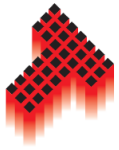
Fuel type	Charge			Product	
	Fuel	Oxygen, nm <sup>3</sup>	Coal for iron recovery, kg	Pig iron, kg	Slag, kg
Natural gas	105-120 nm <sup>3</sup>	200-220	350	260-275	600-650
Brown coal (ash - 45%)	250-255 kg	250-280	375-380	270-280	650-720

- Performance ratios per one ton of red mud processed with iron oxides content 45-50% and initial moisture 25%
- Ratios depend on analysis of red mud and carbon reducing agent



# Elements of used technologies

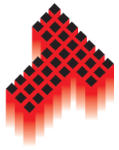
Technology	Scope of use
Liquid phase iron reduction	Arc-furnace, Romelt technology
Kish lining	Arc-furnace with water-cooling, Vanukov furnace, ferroalloy furnace
Fuel-oxygen burners	Modern iron-melting arc furnace
Liquid-metal coolant	Nuclear-power industry (fast neutron power reactor, submarine power reactor)
Preheating of charge with waste-gas	Arc furnace with pit preheater, Consteel furnace, pit melting unit



# Current status of project

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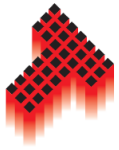
- Patents for technology, process and unit
- Material and energy balances
- Pilot tests for verification of process feasibility
- Engineering design of unit



# Main parties

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- Technologiya metallov LLC – owner and leader of project
- A.I. Leipunsky Institute of Physics and Power Engineering – justification of innovative cooling method
- South Ural State University – theoretical and practical justification of technology
- Hidropress R&D company – unit engineering
- CKBA research and production company – engineering of cooling system
- Akont R&D company – engineering of other equipment



# Conclusion

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- MAGMA technology provides economic efficient single-stage, high capacity, continuous process of red mud utilization
- Elements of technology are widely used in commercial use
- The technology provides wasteless processing of red mud
- The technology is developed for large scale utilization of red mud

# Thank you for your attention

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