Development of an approximation model for the evaluation of slag treatment strategies

Monika Häuselmann K1-MET GmbH
H. Schmid voestalpine Stahl GmbH | S. Wölfelschneider, R. Pietruck, D. Adolphy VDEh-Betriebsforschungsinstitut | L. Gronen, A. Morillon FEhS – Institut für Baustoff-Forschung e.V. | M. Omran Oulun Yliopisto

Coordinated by

Financially supported by

Recy & DepoTech
Leoben, 10.11.2022

INTRODUCTION

SLAG WITHIN THE IRON AND STEEL INDUSTRY

Motivation and background

Utilization of slag

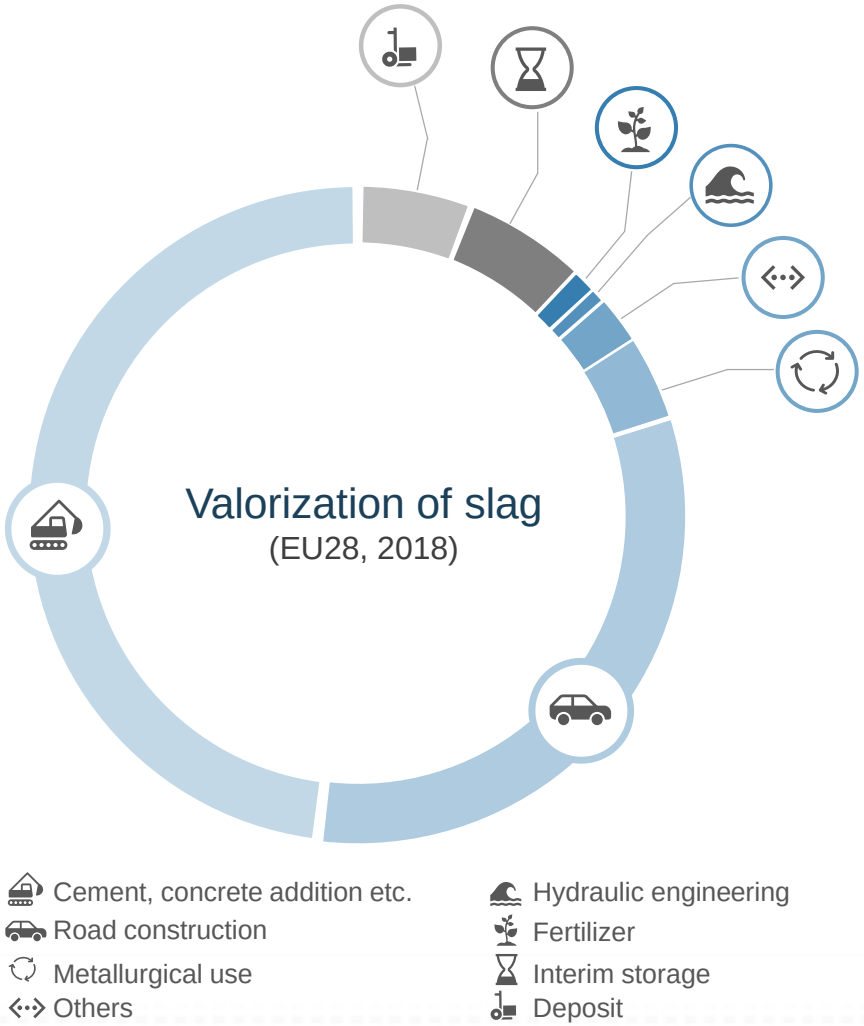
European iron and steel industry

Production of slag: approximately 36 mio tons in 2018 (EU28)

Valorization and fields of application

- Road construction
- Cement, concrete addition
- Fertilizer
- Metallurgical use

Technical, environmental and legal prerequisites regarding valorization of slag



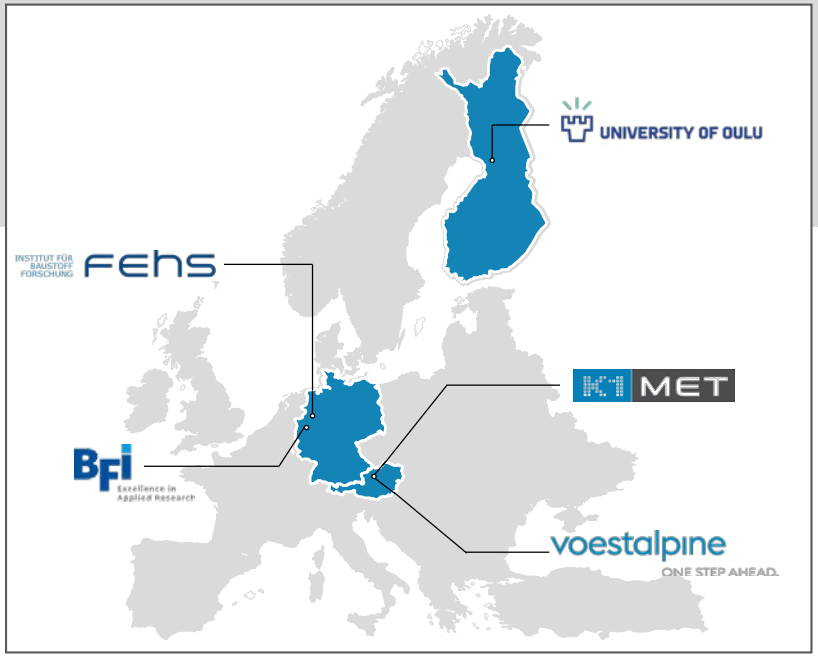
Reference: Data based on euroslag.com

Project overview

SLAGREUS

SLAGREUS - Reuse of slags from integrated steelmaking

Development of a concept for slag processing to increase internal and external recycling



Partner

VDEh - Betriebsforschungsinstitut GmbH (coordinator)
FEhS - Institut für Baustoff-Forschung e.V.
Oulun Yliopisto
voestalpine Stahl GmbH
K1-MET GmbH

Duration

06.2019 – 02.2023

Funding

The project receives a 60% funding by the European Commission from the Research Fund for Coal and Steel (RFCS)

SLAGREUS

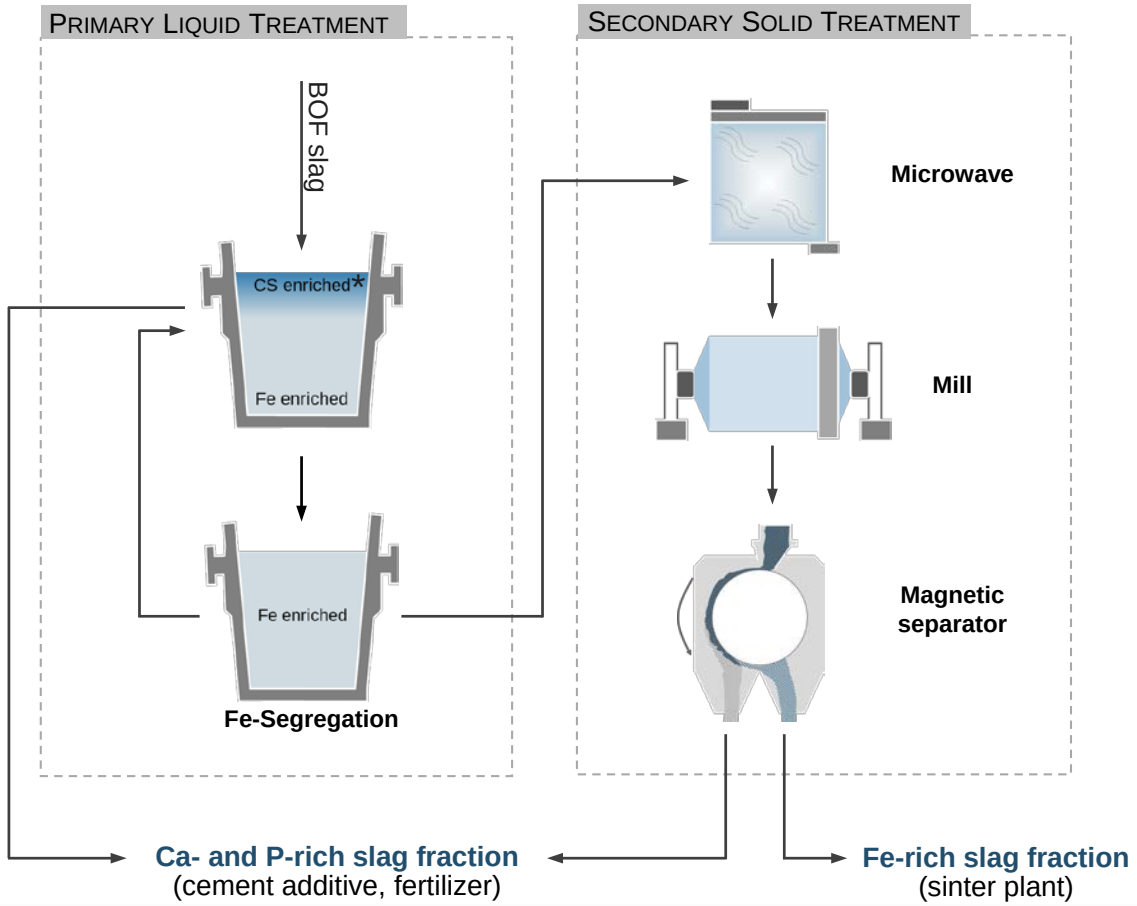
Process concept

Primary (liquid) iron enrichment

- Slag recirculation and slow cooling

Secondary (solid) iron enrichment

- Microwave treatment
- Grinding
- Dry magnetic separation



Prediction Tool

Functionality and Application

Prediction Tool

Objectives and requirements

Agile design

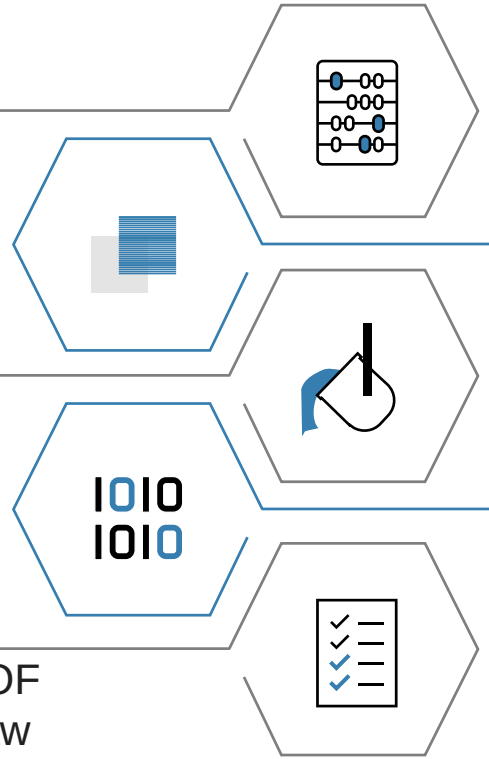
The setup and programming environment of the tool should easily enable adaptions, modifications, and enhancements

Outcome

Information on the expected quality and quantity of slag fractions from the pre-treatment processes, as well as the overall yield of the pre-treatment processes

Suitability

Assisting tool in evaluating the suitability of BOF slag as a possible Fe-containing secondary raw material



User interface and setup

Modular program design based on MS Excel (incl. interfaces for data exchange)

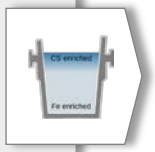
Calculation and data

Heuristic approach based on mass and energy balances (incl. thermodynamic calculations)

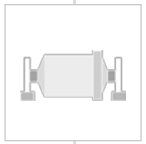
Prediction Tool

Calculation modules

PRIMARY IRON ENRICHMENT



SECONDARY IRON ENRICHMENT



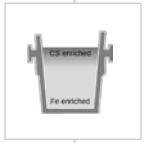
IRON SEGREGATION (SLOW COOLING)

- Mathematical conversion of chemical composition into mineral phases
- Composition of phases is calculated based on the chemical analysis of the main components
- Heat balance analysis and equation of STOKES
- Floating of C2S crystals

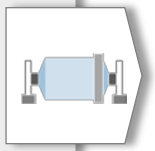
Prediction Tool

Calculation modules

PRIMARY IRON ENRICHMENT



SECONDARY IRON ENRICHMENT



MICROWAVE TREATMENT – GRINDING – MAGNETIC SEPARATION

- Definition of eight grain size classes comprising three phases with varying intergrowth
- Certain magnetic properties are assigned to the phases, from which the magnetic separation is derived
- Distribution numbers with process-technical background
- Individual phases of all final products are mathematically converted back into the corresponding chemical compositions

Prediction Tool

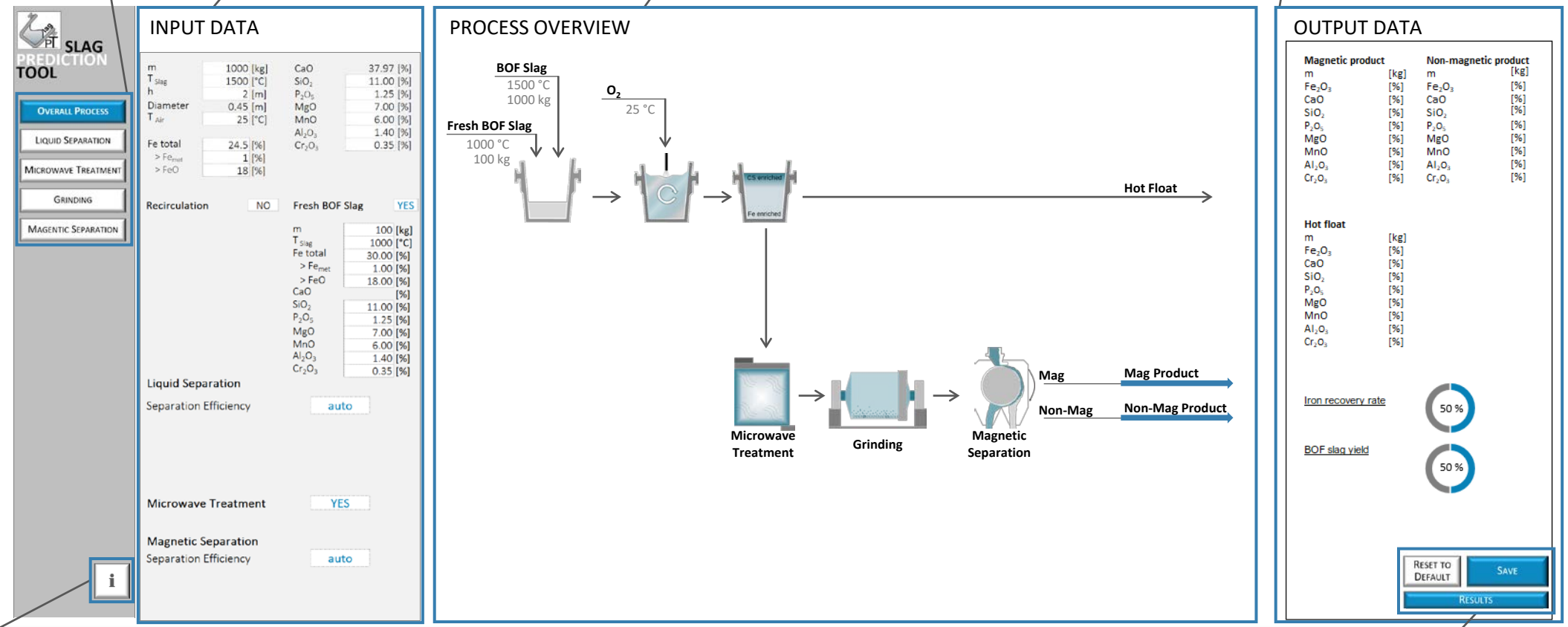
User interface

ADMINISTRATION
Buttons to switch between different modules

DATA (INPUT)
- Slag composition
- Process chain

FIGURE
Schematic process overview

DATA (OUTPUT)
Information regarding final or intermediate products



INFORMATION
- General information
- Data and underlying assumptions

ADMINISTRATION (RESULTS)
Management of results

Prediction Tool

Summary and conclusion

- Slags are a highly valuable by-product in the iron and steel industry offering considerable potential to contribute to circular economy by its recycling
- A properly functioning model can be used to "monitor" the process during operation and can provide indications for economic process-based calculations and investment decisions for different scenarios
- The tool is intended to be used for parameter studies and impact of the described treatment strategy on the available slag can be estimated
- Outlook: Verification and documentation of the tool

Development of an approximation model for the evaluation of slag treatment strategies

Monika Häuselmann K1-MET GmbH
H. Schmid voestalpine Stahl GmbH | S. Wölfelschneider, R. Pietruck, D. Adolphy VDEh-Betriebsforschungsinstitut | L. Gronen, A. Morillon FEhS – Institut für Baustoff-Forschung e.V. | M. Omran Oulun Yliopisto

Coordinated by

Financially supported by

Recy & DepoTech
Leoben, 10.11.2022