Success Story
COMET

FFG

metallurgical competence center

K1-MET
Competence Center for Excellent Technologies in Advanced Metallurgical and Environmental Process Development
Programme: COMET - Competence Centers for Excellent Technologies
Programme line: K1-Centers
COMET subproject, duration and type of project:
P 1.1 - Sinter optimisation, 07/2015 - 06/2019, multi-firm

VisuMet - Analysis of iron carriers with image processing

The image processing software VisuMet has been developed in the last 10 years for the estimation of iron ores and pellets in cooperation between Montanuniversität and industrial partners. The development will be continued for the blast furnace feed material sinter. VisuMet improves the knowledge of the raw material and will be used for better process management.

Introduction and development

VisuMet processes micro-images of iron carriers like iron ores, pellets and sinter. The samples are embedded in resin and polished sections are made. The image acquisition takes place automatically at pre-defined positions with an optical microscope. The magnification is 250x. The number of images depends on the kind of sample and the grain size. The iron carriers consist of different crystalline and amorphous phases, and pores of variable sizes which are influencing the reduction behavior.

VisuMet was developed in the course of the KnetMet project (2005-2008) and the K1-MET projects (2008-2015) by the Chair of Geology and Economic geology of the Montanuniversität and the project partners. The software has been improved until know based on microscopical investigations of more than 3000 different polished sections. The collection comprises more than 80 iron ores and 50 pellet brands, which had been produced worldwide.

The evaluation of the iron ores is based on the heterogeneous reduction speed of the main minerals limonite, hematite and magnetite. The reduction takes place from the rim to the core, why a concentric phase front movement model was integrated in the simulation of the reduction front. A discrete amount of shells, depending on the kind of mineral, will be removed by every step of the calculation (Fig. 1). As a result VisuMet displays the removed area as degradation curve (amount of steps/ cum. removed area), which can be assigned with quality fields (very well to badly reducible).

The quality assessment of the pellets is premised on the pore size. The pores are assumed to be circularly and the diameter is calculated from the pore area. The greater the amount of “big” pores the faster the pellet brand can be reduced.

Normally, for geoscientific purposes the phase portions are determined by point counting on sections of rock pieces. The phases are identified at the grid points. As a general rule 500-1000 points are being counted per section. For the comparison of the point counting method

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with VisuMet, two sections of each sample were enumerated and images were acquired at the same positions. Overall 144.000 points were evaluated. The results were compared to the data of 720 images analyzed by VisuMet. The correlation coefficient is 99,67 %. VisuMet has the advantages of distinction between hematite and magnetite which is not possible with electro-optical methods (SEM or QEM-SCAN). In addition VisuMet is cheaper than other systems.

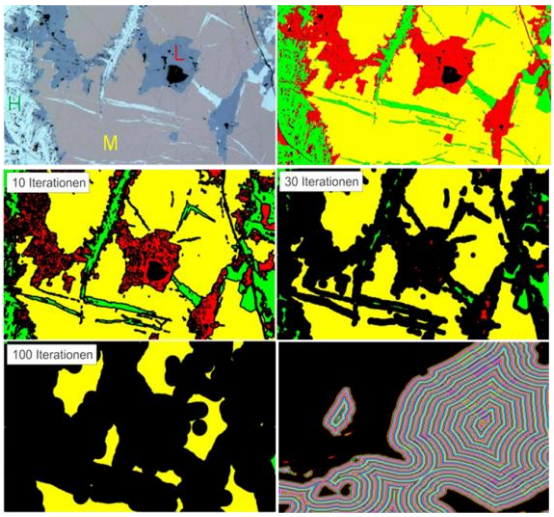

Fig. 1: Concentric phase front movement model for the simulation of the reduction of limonite, hematite and magnetite. During one iteration step a certain amount of shells depend on the mineral are excluded.

Status of the project and aim

The focus is on iron ore sinter at the current stage of the project. VisuMet will be further developed for the evaluation of the sinter quality. The aim is the determination of the important phases, structures and distribution which influences the technical parameters like RDI, strength, reducibility and others. A preliminary procedure for the determination of the sinter phases´ contents had been developed already. Now the results will be statistically evaluated for validation of the method. In the next project phase the results will be correlated with the technical quality parameters.

Impact and effects

The evaluation of iron carriers (iron ores, pellets and sinter) with VisuMet can improve the energy and cost-intensive processes of sinter and raw iron production in blast furnaces.

Contact and information
K1-Project 1.1 - Sinter optimisation

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