



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:

Validation of Non-metallic Inclusions by ESR, 07/2015 – 06/2019, multi-firm

From a new lab-scale mould towards industrial production

Within the frame of this project a new optimized mould was built during the first project year for the Experimental-ESR-Plant at the Univ. of Applied Sciences Upper Austria in Wels. The mold was successful put into operation for open and protective gas remelting. In parallel and based on prior experiments as well as thermodynamic calculations, optimized slag compositions were developed for specific steel grades and tested in the new plat configurations. Based on this, first trials on an industrial production plant were conducted, using the same slag composition, which proved the transferability of the laboratory results into industrial praxis.



Top quality steels production based on the ESR-process

Since the 1960ies, the ESR (electro-slag-remelting) process has increasingly established itself worldwide for the production of top quality steels. The typical areas of application range from high performance tools steels, aeronautical and space applications to power engineering and medical products. Characteristic features of ESR-steels are a very homogeneous distribution of the alloying elements (lowest segregations), also at largest dimensions, as well as lowest contents of non-metallic impurities (inclusions). Subsequently best mechanical properties especially regarding impact toughness and fatigue resistance, independent from the testing direction (isotropy), as well as highest corrosion resistance and polishability can be achieved.

The project deals with the further development of this process, especially regarding the optimization of the slag composition. Thereby also new areas of application in the field of cyclic loaded engineering steels for use in light weight constructions should be opened.



Reconstruction of the test facility, slag development and industrial trials

With the onset of this project a new mould for the existing laboratory ESR-plant at the Univ. of Appl. Sciences Upper Austria in Wels was designed and constructed together with voestalpine Stahl Donawitz. The new mould has a smaller diameter and opens the possibility to directly roll the produced ESR-ingots in a special industrial rolling mill. The new mould was designed to permit remelting experiments in contact with air as well as under protective atmosphere (Fig. 1).

During the start-up of the new plant configuration remelting experiments with different process parameters (electric current, amount of slag, slag composition) both with and without protective atmosphere were conducted successfully. Thereby the capacity of the new mould was well established.

In parallel to these tests and based on earlier experiments as well as supported by thermodynamic calculations, new concepts for the slag

composition were established. These new slag compositions are designed and adapted to fit the specific requirements of selected steel grades. Thereby particular attention was paid to the separation and formation of non-metallic inclusions. These slags were already tested in the new mould.



Fig. 1: Laboratory-ESR-plant with the new mould in operation under protective atmosphere (Source: Univ. of Appl. Sciences Upper Austria)

Based on the experiments performed at the laboratory-ESR-plant first industrial trials with the optimized slags were performed at the production plants of Böhler Edelstahl. These trials confirmed quite well the transferability of laboratory results to industrial production (Fig. 2).

Impact and effects

With the implementation of the new mould at the laboratory-ESR-plant, a lab-scale production route was established which permits the remelting of industrially produced electrode material

under various remelting conditions and its further plastic deformation and testing, again under industrial production conditions.

Thereby the best prerequisites for the development of optimized steel grades, which can meet the rising demands and requirements was established. First shipments to selected customers confirm also the high interest of potential users on these developments.



Fig. 2: Production plant at Böhler (Source: Böhler Edelstahl GmbH & Co KG)

By means of the so far achieved results, there exists a wide scope to extend the segment of ESR-produced steels and thereby to strengthen the industrial production as well as the associated jobs effectively. Additionally, the project improves the research infrastructure and provides a fundamental base to conduct excellent research work in the field of the production of top quality steels and alloys.

Kontakt und Informationen

K1-Projekt 2.3 – Validation of Non-metallic inclusions by ESR

University of Applied Sciences Upper Austria - Wels
 Stelzhamerstraße 23
 4600 Wels, AUSTRIA
 Tel: ++43-(0)50804-43910
 E.: reinhold.schneider@fh-wels.at, www.k1-met.com

Projektkoordination

FH-Prof. Dr. Reinhold Schneider

Projektpartner

Organisation	Land
FH-OÖ F&E GmbH (FH-Wels)	Oberösterreich
Böhler Edelstahl GmbH & Co KG	Steiermark
voestalpine Stahl Donawitz GmbH	Steiermark

Further information on COMET – Competence Centers for Excellent Technologies: www.ffg.at/comet

This success story was provided by the consortium leader/centre management for the purpose of being published on the FFG website. FFG does not take responsibility for the accuracy, completeness and the currentness of the information stated.