Recycling of zinc- and lead-containing dusts from the electric arc furnace

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Abstract

About 1/3 of the total steel production in Europe is performed by electric arc furnace steel making. Besides steel products different by-products as slag and dust are created. In electric arc furnace steel making about 15 to 20 kg dust per tonne of steel are produced. This dust consists of valuable metal oxides of iron, zinc and lead. The concentration of zinc and lead is depending on the scrap quality used as raw material for steel making. Dusts with higher zinc and lead concentrations are a suitable raw material for the recovery of these elements by non-ferrous smelters.

The aim of this project is to improve the economy and ecology of electric arc furnace steelmaking by increasing the zinc and lead concentration in these dusts.

From thermodynamic data it is known that zinc, lead and their compounds are more volatile compared to other elements like for example iron or iron oxide. Thus the recycling of electric arc furnace dust into the electric arc furnace shall increase the concentration of zinc and lead in the newly formed dust. Some preliminary work has been done by FEhS to recycle EAF-dust into the furnace. These tests have shown that it might be possible to increase the zinc and lead content in the dusts by recycling.

Owing to these results the companies of Krupp Edelstahlprofile GmbH and Det Danske Stålvalseværk A/S as well as Forschungsgemeinschaft Eisenhüttenschlacken FEhS decided to carry out further "in plant" investigations to check the results of the former tests aiming at the development of an injection unit for dust recycling at service stage with a capacity of several 1000 t/a.

According to differences in the production programme of steel quality of the two steel shops and the different dedusting systems it has been necessary to test the dust injection in both shops. Analytical work on chemical and mineral composition of samples and special investigations on the pneumatic transportation of dust have been carried out by FEhS.

In a first step the actual situation in both steel shops, i.e. amount of dust and composition of dust, slag, steel, logistical problems and other parameters, have been investigated. Thus it has been possible to get a survey over the dust production as a function of scrap quality, melting programme, operational conditions and steel quality produced.

In a second step injection trials using test injection equipment have been carried out. A main target of this step has been to show that the dust can be injected pneumatically without troubling the normal steelmaking routine, especially that there are no negative effects on the foaming behaviour of the slag. On the other hand valuable information about injection practice and dust handling has been achieved. The development of zinc and lead concentrations as well as the amount of dust during dust injection into single melts has been controlled and monitored.

Using all relevant results from these first steps the projection and construction of experimental injection plants in both steel shops started. Special attempts were necessary to integrate the experimental injection plants within the existing facilities. Having finished the constructions,

operational tests followed to find out problems during continual handling of bigger amounts of dust with the more complex equipment (trouble shooting) and for the training of the operational staff.

Due to changes in productivity, scrap quality and demanded steel quality operational conditions like gas flow, dust load of gas and dust composition are varying in a wide range. Thus long term runs have been made during the last period of the project. In this period up to 50% of all the dust created during steel making has been recycled. The amount of dust and the dust composition have been controlled on a monthly scale. Other parameters like consumption of electric energy, coal and man power for maintenance have been recorded. In this way the feasibility and the success of dust injection is controlled more effectively.

The most important results of the project are as follows:

– electric arc furnace dust can be recycled into the electric arc furnace without affecting the normal steel making routine,

– zinc and lead concentrations of electric arc furnace dusts are increased by recycling,

– the amount of dust that has to be processed externally by non ferrous smelters is reduced.