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CONDITIONING OF LEAD AND ZINC SLAGS IN PILOT SCALE EAF FOR FURTHER UTILIZATION *[Extended Abstract]*

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Extended Abstract

Slags are by-products of the pyrometallurgical production of lead which contain lead and zinc in a considerable amount. Due to legislative, economical, ecological and political reasons it will become more important to retrieve these valuables in the future and create thereby a cleaner slag with wider applications (e. g. alternative construction material) than the current status of deposition as landfills. The classic slag fuming process leads to high quantities of off gas which has to be treated in large exhausts systems. Same disadvantages and a worse settling behaviour due to increased turbulence in the reactor are valid for the AUSMELT or ISASMELT technology. Therefore the use of an electric arc furnace can be an alternative method for the treatment of lead and zinc bearing slags. An electric arc furnace (EAF) provides multiple advantages for this goal, especially regarding the implementation in an existing process route. The lead industry uses slags of the SiO_2-CaO-Fe_xO_y system with an average lead- and zinc oxide content of about 5-15 wt.-%. In this investigation six different slags have been exemplary treated covering a wide range of composition of the constituents (in wt.-%) Pb 1-55 %, Zn 5-12 %, Fe 9-28 %, SiO_2 7-25 %, CaO 3-16 %, Al_2O_3 1-8 %, MgO < 5 % and S 0,1-2,6 %. The slags with high lead contents originate from pyrometallurgical refining steps and do not represent the final slag composition for disposal but are chosen as well to determine the refining capacity of the EAF. Due to the prior process of water quenched granulation all slags contain a high percentage of amorphous phases. Lead is predominantly metallic and to some extent in oxidic compounds. Almost all of the zinc content is ZnO and occurs in dependence on the sulphur content also as sulphide. Iron appears in all oxide states as FeO, Fe_2O_3 and Fe_3O_4.

On the basis of theoretical considerations and preceding investigations tests have been conducted in a pilot plant scale DC electric arc furnace with the main focus on feeding coke through a hollow electrode. Additionally the pneumatic injection of coke through a lance system has been tested.

In all experiments lignite coke (grain size 1-5 mm) was used with 20 % excess due to the stoichiometric amount, necessary for the complete reduction of the lead and zinc assumed in oxidic form. All experiments were conducted in submerged operation mode and conductive heating of the slag in order to reach temperatures of 1400-1500°C to enhance the kinetics and reduce the slag viscosity. The experiments can be divided into three major series using:

1. a hollow electrode (250 kg of slag are molten and then coke was fed through the nitrogen purged hollow electrode).
2. a solid electrode (coke and slag are continuously fed into the furnace).
3. a solid electrode (250 kg of slag are molten an then coke was injected by pneumatic lance).

The desired final slag composition containing < 0,1 wt.-% Pb and < 1 wt.-% Zn was achieved in many trials in series a) which verifies the results of prior lab scale tests in a small EAF. The series b) and c) never reached the wanted limits of Pb and Zn, in case of series c) due to technical problems.

Nevertheless all experiments showed an exponential decrease in lead concentration during the trial regardless to the time of reductant addition. This behaviour implies that existing lead oxide can also be reduced to metallic lead by iron suboxides like FeO and therefore in absence of coke. Metallic lead is then either collected in the metal phase containing > 90 wt.-% lead or volatized and collected in the flue dust. Zinc as ignoble element cannot be reduced by FeO and can only be removed from the slag after the addition of the reducing agent. Zinc will be volatilised subsequently and is concentrated in the flue dust. The investigations prove that the electric arc furnace achieves good results for the treatment of lead and zinc bearing slags and has a great advantage on minimizing loss of valuable metals. Additionally it could be shown that the process can be expected to obtain positive economical results. In order to lay out an industrial slag treatment process the next step can be the upscaling of the process.

The full paper will be submitted to the "Journal of Sustainable Metallurgy".