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Researches Regarding of Recovering Potential of Slag Components From Electric Steel Mills

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Abstract. The steelmaking process in the electric arc furnace causes environmental pollution in all its components: water, air and soil. The electric arc furnace steelmaking is considered to be an industrial process with high degree of pollution because solid wastes (slag, dust) and gaseous pollutants (carbon oxide, sulfur oxide, nitrogen oxide, volatile organic compounds, dioxins and furans) are generated. The paper presents an assessment of the recovering potential of slag components from electric steel mills. It presents the results obtained by chemical analysis of slag from steelmaking in the electric arc furnace. For this purpose, four slag samples were taken from an electric arc furnace having a capacity of 75 tones. The type of steel that has been made is carbon steel. In the analyzed slag samples there were identified the following compounds: silicon oxide (SiO_2), lime (CaO), iron oxide (FeO), manganese oxide (MnO), magnesia oxide (MgO), chromium trioxide (Cr_2O_3), alumina (Al_2O_3), titanium dioxide (TiO_2), vanadium oxide (V_2O_5) and phosphorus pentoxide (P_2O_5). From the analysis of solid waste one can conclude that by recovering the ferrous and mineral components of these waste, followed by their capitalization, it is possible to reduce the negative impact due to storage of these wastes in the environment.

Keywords: slag, electric arc furnace, electric steel mills, pollution, recovering, steelmaking.

INTRODUCTION

Steelmaking process in the electric arc furnace is a very significant source of solid wastes. The specific slag quantity resulting from steelmaking varies depending on the charge quality and the type of steel produced (Iluțiu – Varvara, 2007).

The amount of slag generated during steelmaking in electric arc furnace is between 100-150 kg/t of liquid steel. For low alloy and carbon steelmaking the resulting amount of slag is between 100-150 kg/t of liquid steel, and for high-alloy steelmaking the slag quantity varies between 100 - 135 kg/t of liquid steel (Alanyali *et al*., 2006 and Erdem *et al*., 2005).

In the Tab.1 is presented the annual quantity of slag generated during steelmaking in electric arc furnaces, according to (Shen and Forsberg, 2003). According to this data, China is the largest generator of steel mill slag, followed by Japan, Europe and USA.

Tab. 1

Annual production of steelwork slags

Location	Annual production (million tons/year)
China	14.07
Japan	12.60
Europe	12
USA	8

The investigations regarding the compositions of the slags originated from the steelmaking in the electric arc furnace, showed that in the composition of these are always present: iron oxide (FeO), manganese oxide (MnO), magnesia oxide (MgO), lime (CaO) and phosphorus pentoxide (P_2O_5) (Nagy, 2000).

MATERIALS AND METHODS

For assessment of the recovering potential of slag components from electric steel mills there were taken four samples. The slag samples were taken from an electric arc furnace, having a capacity of 75 tones. The type of steel that has been made is carbon steel.

The slag samples were broken down to grains having up to 40 μm and then chemically characterized. The chemical composition determination of the slag samples was achieved using an X-ray fluorescence spectrometry apparatus used was X-ray spectrometer of type NITON.

RESULTS AND DISCUSSION

In (Fig.1) are presented the results of slag chemical analysis from steelmaking in electric arc furnace, for sample 1.

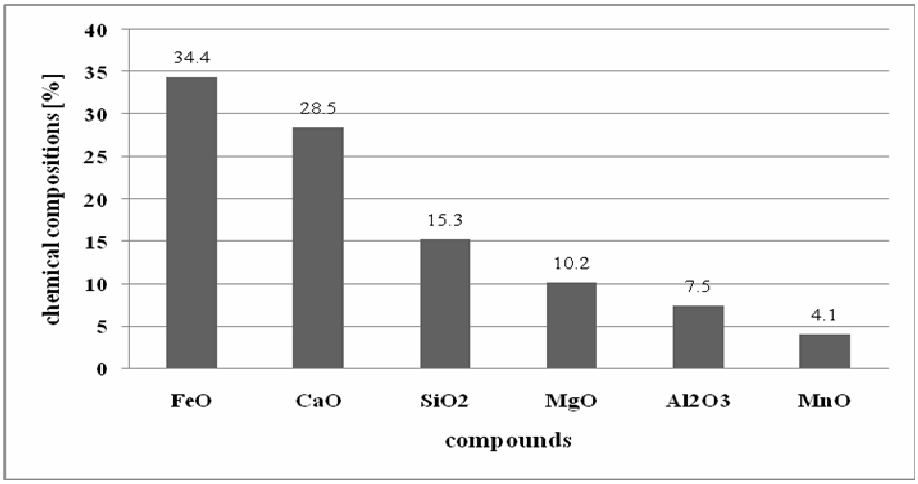

Fig.1. Chemical composition of electric steel plant slag for sample 1

In figures 2, 3 and 4 there are presented the results of slag chemical analysis from steelmaking in electric arc furnace, for samples of slag 2, 3 and 4.

From the analysis of chemical composition of slag samples from electric arc furnace it is clear that there are both ferrous components and mineral components.

Analyzing the chemical composition of the four slag samples studied show that:

- ✓ In the composition of the first sample of slag dominates the ferrous component, which is 34.4 [%];
- ✓ In all the slag samples, the ferrous component is significant, reprezenting a minimom of 13.5 [%] in third sample and a maximum of 34.4 [%] in the first sample;
- ✓ In the slag samples 2, 3 si 4 there are toxic oxides (Cr_2O_3 and V_2O_5).

Through the recovery of ferrous components of the slags one can obtain raw materials for processing ferrous alloys and the mineral component may be used in civil engineering.

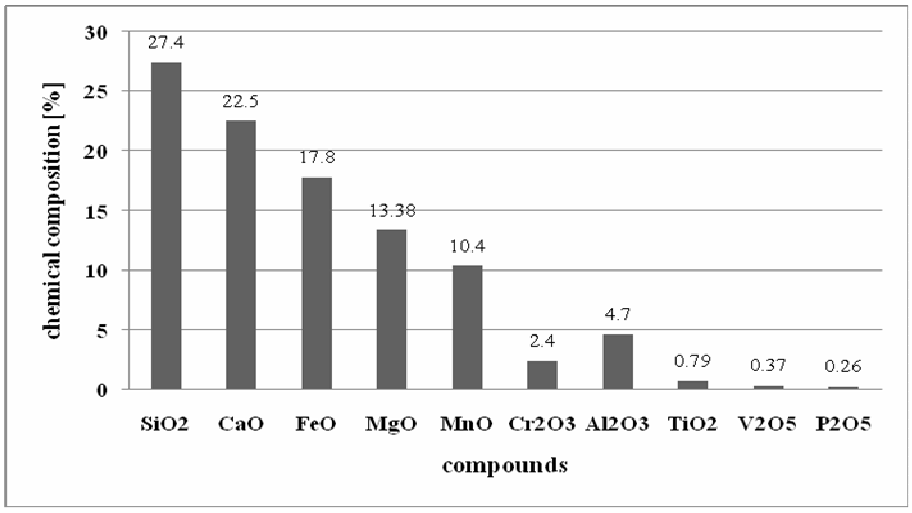

Fig.2. Chemical composition of electric steel plant slag for sample 2

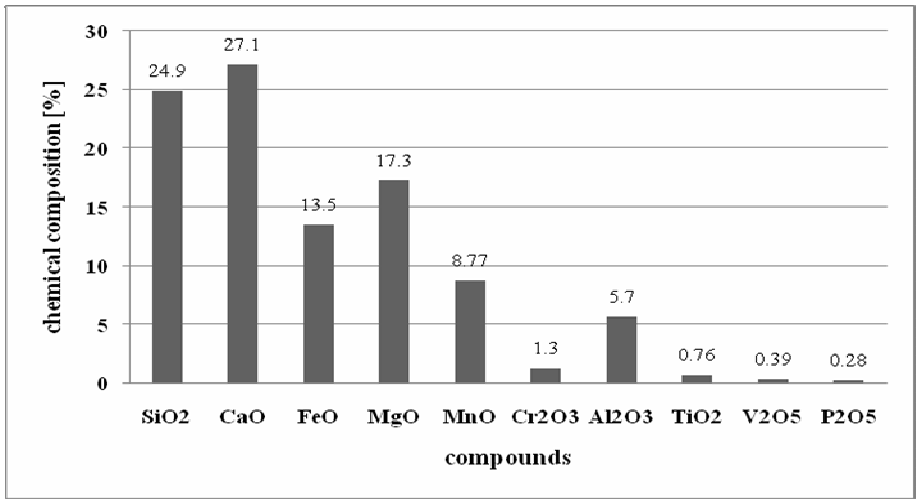

Fig.3. Chemical composition of electric steel plant slag for sample 3

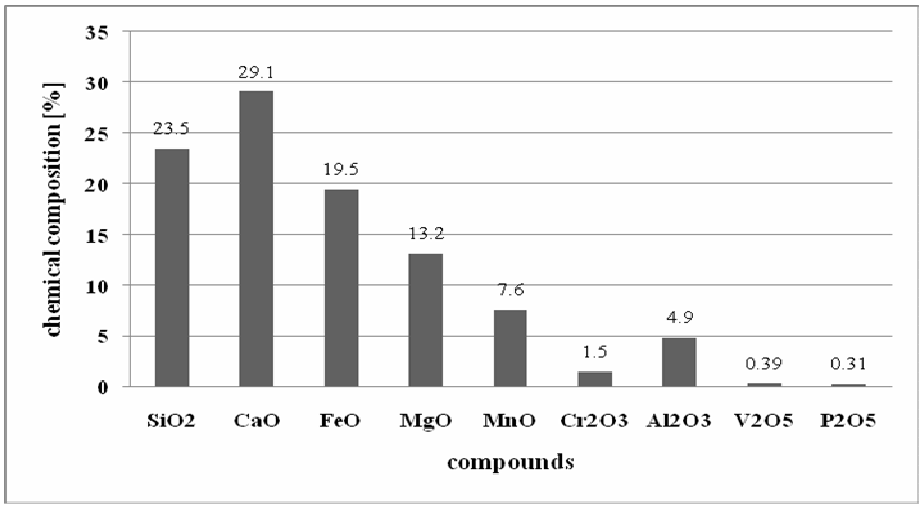

Fig.4. Chemical composition of electric steel plant slag for sample 4

CONCULSIONS

Because of the high quantities of the slag generated during steelmaking in the electric arc furnace the following are necessary:

- recovering the ferrous component from the slag;
- recovering the mineral component from the slag;
- elimination of toxic components from the slag.

The steelworks slag analyzed there were identified the following compounds: silicon oxide (SiO_2), lime (CaO), iron oxide (FeO), manganese oxide (MnO), magnesia oxide (MgO), chromium trioxide (Cr_2O_3), alumina (Al_2O_3), titanium dioxide (TiO_2), vanadium oxide (V_2O_5) and phosphorus pentoxide (P_2O_5).

The ferrous components identified in the slag samples analyzed can be used to obtain raw materials / auxiliary to steelmaking or other processes, by recovering the existing component ferrous from the slag (by reintroduction in the technological flow of the ferrous component from the slag).

The minerals components identified in the slag samples can be exploited to obtain aggregates of slag (made out of the mineral compound of slag), which can be used in the construction of roads, railways, civil engineering and hydro technical aggregates as an alternative to traditional natural rock exploited from quarries.

In conclusions, in the slag from steelmaking process in the electric arc furnace, there are components that can be recovered.

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