Abstract

In the present work a full description has been provided of the characteristics of EAF stainless steel (EAF S) slags and ladle slags, with regard to water cooling. It is shown that the stabilization of steel slag can be enhanced by such cooling in comparison with the air-cooling process that is commonly used in slag ageing yards. Comparisons were made between the properties of air and water cooled slags, i.e. their chemical compositions, mineralogy and leaching characteristics.

It was found that the chemical composition and mineralogy of the investigated steel slags, cooled by water or in air, were very similar. Nevertheless, water cooling resulted in certain mineralogical transformations of the unstable primary minerals in the slag, with the formation of secondary minerals, which can be considered to contribute towards an improved stabilization process. It was found that these secondary minerals, and not the bulk mineral phases, control the release of contaminants from the investigated steel slags, which was also confirmed by geochemical modelling.

Based on the overall measured leachate concentrations of the selected metals and other, mainly inorganic parameters, it can be concluded that the environmental impact caused by leaching from the steel slags is low. In the case of most of the investigated parameters the leaching concentrations were below the prescribed legal limits for classification as "inert waste". Some differences between the measured (low) concentrations of the selected elements were noted, with regard to the cooling path. If just the environmentally potentially problematic elements are considered, water cooling led to higher concentrations of chromium and molybdenum and lower concentrations of selenium in the leachates of the EAF S and ladle slag, and to a lower concentration of barium in the leachates of the EAF S slag. It also seems that variations in the technical process used for the production of stainless steel in an electric arc furnace can lead to differences in the leaching behaviour of chromium from steel slag.

Simulation of the long-term leaching of steel slag has shown that the concentrations of the majority of the selected elements from the water-cooled EAF S slag, including chromium and molybdenum, are lower than those measured in the case of similar but air-cooled slag, which indicates that water cooling enhances the ageing process, and leads to more rapid stabilization of the slag. In general, the overall measured leachate concentrations of the selected elements from the air- and water-cooled EAF S slag were low, and practically negligible if compared with the total contents.

The high acid neutralising capacity of the investigated EAF S and ladle slags indicated that the changes which occur in the leaching properties of steel slags due to external environmental conditions are slow, and thus take place over a long period of time.

Geochemical modelling has provided some answers as to what extent the leaching of elements from steel slag depends on mineral solubility control, sorption, and the complexation of elements to organic matter, which means that such modelling is important when investigating the possible beneficial use of steel slag in different applications. The present work has, in fact, shown that, in the case of EAF S and ladle slags, there is indeed potential for their beneficial use in the civil engineering industry, provided that the technical specifications of products in which such slag is to be used are met.

Keywords: *EAF stainless steel slag, geochemical modelling, ladle slag, leaching, water cooling*