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Effect of Surface Area During Stabilization of Electric Arc Furnace Dusts from Steel Foundries

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This study examined the effect of waste particle size on stabilization performance of hazardous electric arc furnace dusts (EAFD) from steel foundries through the measurement of the temperature rise during hydration and heavy metals leaching. EAFD was characterized by using scanning electron microscopy (SEM), X-ray diffraction (XRD), X-ray fluorescence (XRF), granulometry, and acid neutralization capacity (ANC) analysis. Portland cement was used to stabilize EAFD. Two types of paste samples, with EAFD content varying between 0% and 50% by weight, were prepared. The first type contained original EAFD, and the second contained ground EAFD with increased surface area. The increase in the temperatures of the mixes was monitored during the hydration reactions of the pastes. Ground EAFD yielded higher temperature rise rates than the original EAFD. Heavy metals leaching were determined by toxicity characteristics leaching procedure (TCLP). Pastes containing ground EAFD up to 50% yielded lower zinc and lead leaching than that of samples containing original EAFD. The results revealed that surface area of the EAFD may affect the stabilization performance and therefore care should be given to storage conditions at the foundries. © 2008 American Institute of Chemical Engineers Environ Prog, 27: 339–345, 2008

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INTRODUCTION

In 2005, approximately 1129.6 million metric tons of steel were produced worldwide [1]. Thirty-one percent of the steel produced in 2005 was made with the electric arc furnace method [1]. Electric arc furnace dust (EAFD) is generated by the electric arc steelmaking process, and amounts to approximately 2% of the steel produced [2]. One of the most important environmental problems of steel foundries is the management of the EAFD produced. EAFD has been designated by Turkish [3], European Union (EU) [4], and United States Environmental Protection Agency (EPA) regulations [5] as hazardous waste because of the high leaching potential of heavy metals it contains. Particularly, the leachability of zinc and lead can be significant. When galvanized scrap is used in the electric arc furnaces, most of the zinc from steel scrap ends up in the dust because of its very low solubility in molten steel and slag [6].

Stabilization is such a technology that treats the waste by forcing the system pH toward values where the solubility of some heavy metals is minimized [7]. Portland cement (PC) is the most common stabilizer used for hazardous waste treatment. The high pH of the cement mixture keeps the metals as insoluble hydroxides of carbonate salts. Metal ions may also be taken up into the cement matrix.

Several researchers have studied the characteristics and/or stabilization of EAFD [6, 8–15]. Machado et al. [6] carried out a chemical, physical, structural, and