Combined Statistical Model for the Leaching of Heavy Metals from Fly Ash Solidified/Stabilized Wastes

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ABSTRACT

One method that has been found adequate for the disposal of hazardous wastes without causing pollution of groundwater is the solidification/stabilization process. The method consists on combining the fly ash material with the waste to obtain a solidified form. The U. S. Environmental Protection Agency has developed the toxicity characteristic leaching procedure (TCLP) to establish the environmental acceptability of the solidified/stabilized waste for land disposal. In the test, the waste is contacted with an acidic media under non-equilibrium conditions and the concentration of material leached from the waste after 18 hours of continuous agitation is measured.

The purpose of this article is to present results on the application of a combined statistical model developed to quantify the amount of heavy metals released from the solidified/stabilized waste to the leaching solution. The TCLP test is run in a semi-batch mode during 100 hours to simulate real environmental conditions. Three metals of relevant importance in the environmental pollution are analyzed namely, chromium, cadmium, and aluminum. The model would allow selecting the most appropriate process conditions in the formation of the solidified waste and to minimize the release of the metals. The model is based on a simplex-centroid and a 2^{6-3} fractional factorial experimental designs. Fitted equations representing the maximum and final metal release to the leaching solutions are developed. A linear polynomial equation was found to quantify the amount of chromium and cadmium release, whereas a third degree polynomial was required for the same purpose for aluminum.