Investigation on the carbonation-humification of incineration residue and its effect on the leaching behavior of pollutants

YONGJIN KIM and MASAHIRO OSAKO
Research Center for Material Cycles and Waste Management, National Institute for Environmental Studies, 16-2 Onogawa, Tsukuba, Ibaraki, 305-8506 Japan
E-mail: kim.yongjin@nies.go.jp
Phone: +81 298 50 2989, Fax: +81 298 50 2830

The ideal method for treating or disposing of incineration residue is to restore it to the natural environment by stabilization, reduction and degradation of inorganic and organic pollutants. The stabilization of pollutants means having no potential to spread, which involves the fixation of metals by carbonation and clay formation, and the stabilization of organic material by humification. The authors call this the carbonation-humification process, to distinguish it from carbonation by aging. As inorganic and organic substances may attach to the mineralogical structure through this process, the leachability of pollutants might decrease.

In this study, we investigated the possibility of carbonation-humification of incineration residue through observations of the microstructure by SEM, and through extraction and identification of humic substances. We also confirmed its effect on the leaching behavior of pollutants by several leaching tests. The samples used in this study were incineration residues excavated from lysimeters 5 to 7 years from filling. The lysimeters were filled with (1) only fly ash, (2) only bottom ash, (3) mixtures of fly ash and bottom ash, and (4) mixtures of fly ash, bottom ash and 5% compost of municipal solid waste. We sampled in different layers of all lysimeters, and conducted all the experiments mentioned above.

From the results of extraction and qualification of humic substances, the top layers, which were from the surface to a depth of 50-70 cm, had no odor of incineration, and some weeds had entered through the roof, and so the layers contained a lot of humic substances compared with the other layers judging from the color and optical characteristics of extracts. Especially, humification of the lysimeter filled with a little compost had progressed through all layers, not only the top layer. Thus, some quantity of organic matter such as compost appeared to have accelerated the humification of incineration residues.

We also observed changes around a particle of fly ash by SEM and EDS. The fly ash filled with compost was surrounded with organic-rich matter, while that without compost was surrounded with calcium-rich matter resulted from incineration residue. This provided evidence of carbonation-humification on the sample with compost.

We will investigate the leachability of pollutants in advanced layers of carbonation-humification in the near future. The leachability is expected to decrease with progression of the carbonation-humification. In the long run, we will apply all of the results in this study to accelerated mineralization technology (AMT), which is a new kind of technology for utilizing incineration residue and simultaneously prolonging the life of landfill sites.