

Trace elements leachability from fly ash

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In Israel, coal fly ash (FA) is utilized in a wide range of applications including infrastructure, construction and agriculture. The environmental impact of using FA is an important factor in determining if it can be used for a given application.. Various leaching techniques have been developed for evaluating the environmental impact of substances which can also be applied to FA. As trace metal leaching depends strongly on pH level, the pH of the leaching method is critical. The method that has been used for many years in Israel, and is still the official regulation leaching test, is the American TCLP (Toxicity Characteristic Leaching Procedure). This USEPA test was developed to simulate co-disposal of industrial waste with municipal solid waste and is conducted under acidic conditions. However, the natural pH of most FA combusted in Israel is basic. The European method EN 12457-2 (EN) is a compliance test for leaching of granular waste materials and sludge. This method has been found to be more suitable for FA characterization as it is conducted under natural pH conditions.

For most elements, solubility is higher at low pH (acidic conditions) than at high pH (basic conditions). However, several elements such as antimony, arsenic, molybdenum and selenium, where the solubility actually increases with increasing pH. These elements will tend to be in higher concentrations in the EN leaching test. In the TCLP leachate conducted mostly around pH ~5, boron is the only element that seldom exceeds the Israeli criteria for usable ash. During the EN leaching procedure conducted under much higher pH range, typically in the range 9-11, molybdenum and selenium frequently exceed the non-hazardous criteria.

In the various applications in which FAs are utilized, the FA comes in contact with other substances which could influence its characteristics, such as cement in a concrete mix. Leaching tests have also been designed to evaluate trace metal leachability for a specific application. Therefore, FA characterization (e.g., chemical composition and leaching properties) alone is not sufficient in characterizing FA for environmental applications. For example, when FA is added to cementitious mixtures or blended with soil as part of a soil supplement, the leaching characteristics of the resultant material could be different than the component materials. A European procedure designed for determining the extent of leaching of inorganic components from moulded or monolithic materials is the “tank test” (EA NEN 7375:2004). This test was conducted with the Columbian FA CMC-CerD as it is characterized by high concentration of contaminants and with a low pozzolanic activity (expected to release the highest contaminants concentration). It was found that except for



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selenium, all other elements were below the Dutch regulation limit (the only available criteria).

Recently, new four USEPA methods have been approved and published as part of LEAF (Leaching Environmental Assessment Framework). These tests can be used to develop a characteristic leaching profile of the subject material under equilibrium- and mass transfer-controlled release. Each test is designed to vary a critical release-controlling parameter (e.g., pH, liquid-to-solid ratio, leaching time) to provide leaching data over a broad range of test conditions. LEAF includes the program LeachXS Lite™ for database management, enabling comparisons of leaching data for different tests or materials. The full-featured software in LeachXS Pro allows for advanced modeling and data management capabilities.

A current aim in FA monitoring and research in Israel is the implementation of LEAF. The basic approach is to characterize the main FA types combusted in Israel and study FA mixtures utilized in the various applications. Previous leaching data (from 2007) will be compiled into an Israeli dataset along with comparative information from other sources. The relevant EPA tests will be conducted for specific agricultural and infrastructure applications. In this way, it will be possible to estimate the actual contamination potential subject to varied environmental conditions.

