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Oxyanions Release from Alkaline Fly Ash to Water

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Abstract

Fly ash, like soil, contains trace concentrations of many heavy metals and oxyanions that are known to be detrimental to health in sufficient quantities. Though these elements are found in low concentrations in fly ash, their presence may cause some concern. Understanding the factors influencing heavy metals and oxyanions release from fly ash is highly critical in predicting its potential impacts on the environment.

Alkaline fly ash has received little attention with respect to their oxyanion release to the environment. Hence, the objectives of this study was to evaluate the effects of aging duration of alkaline fly ash exposed to atmospheric CO_2 and column length on the leachate pH and the dissolution rate of oxyanions as a function of leachate volume.

Fresh dry fly ash was collected directly from the precipitators in the power station. One part was stored in a sealed container isolated from the atmosphere and the other part was wetted to a given water content and exposed to the atmosphere to 3, 6 and 12 months. The moisture was kept constant during the entire aging periods.

To simulate the potential leaching of oxyanions from landfills, a set of columns of 10, 20 and 30 cm length and 5.2 cm in diameter were packed with a mixture of the alkaline fly ash at the various aging time and send grains (0.5-0.8 mm in diameter) at a ratio of 3:7, respectively. All mixtures were packed to a bulk density of 1.64. The columns were leached with distilled water at constant flow rate of 20 mm h^{-1} by using peristaltic pump. The leachate pH was measured before exposing it to the atmosphere and the leachate was collected by fraction collector. The leachate was analyzed for boron (B), Chromium (Cr), Molibdenum (Mo) and Vanadium (V) by inductivity coupled plasma atomic emission spectroscopy (ICP-AES).

The results indicated that:

1. The leachate pH decreased slowly with the leachate volume at any given aging time but decreased sharply from 13 for the fresh fly ash (aging time 0) to 8.5 after 12 months of aging. Such a sharp drop in pH due to aging had a significant effect on the leachability of oxyanion from alkaline fly ash.

2. The oxyanions concentration in the leachate decreased with the increasing of the leachate volume but increased significantly with the aging time at any given leachate volume. These results indicate that the pH is the dominant factor in the oxyanion dissolution process from fly ash at least during the leaching at the first few pore volumes.

3. While the oxyanions concentration in the leachate increased with the length of the column at any given leachate volume, no effect was observed when the oxyanions concentration was plotted against the pore volume of leachate. This information is important for estimating the impact of fly ash in landfill on the environment when the permeability of the fly ash is greater than zero. It is important to note that during the aging process, the permeability of the alkaline fly ash decrease significantly. Therefore, the results obtained in this study are the worst case scenario.