In Vivo Bioavailability of Arsenic in Coal Combustion By-products

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ABSTRACT

Coal combustion by-products (CCBs) are unburned residues that are left when coal is burned to produce power. These residues are considered to be by-products because there are many beneficial re-uses for these materials such as concrete, structural fill, and waste stabilization. A survey of metals concentrations in CCB-containing fill used as roadbed in a residential area has indicated that arsenic (As) concentrations can range from 4.7 to 97 mg/kg. Assessment of potential health risks associated with exposure to CCBs in these settings can benefit from knowledge of the amount of As absorbed from the gastrointestinal (GI) tract into the body. A study using juvenile swine as test animals was performed to measure the GI absorption of arsenic from two samples of CCB-containing fill: Test Material 1 contained 217 mg/kg As in the fraction passing through a 250 um sieve and Test Material 2 contained 80 mg/kg As in the 250 um sieved fraction. The relative bioavailability of As was assessed by comparing the absorption of As from the test materials to that of a reference material (sodium arsenate). Groups of five swine were given oral doses of sodium arsenate or test material twice a day for 14 days; a group of five non-treated swine served as a control. The amount of arsenic absorbed by each animal was evaluated by measuring the amount of arsenic excreted in the urine (collected over 48-hour periods beginning on days 6, 9, and 12). The urinary excretion fraction (UEF) (the ratio of the amount excreted per 48 hours divided by the dose given per 48 hours) was calculated for both the test soil and sodium arsenate using linear regression analysis. The relative bioavailability (RBA) of arsenic in the test soil compared to that in sodium arsenate was calculated as a ratio (UEFtest/UEFref). The As RBA estimates are approximately 72% for Test material 1 and 50% for Test Material 2. These results indicate that the As in the test materials are not as well absorbed as soluble arsenic, and these RBAs are below the default regulatory assumption of 100% absorption.

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