Florida Department of Transportation Research

Assessment of Potential Concerns Associated with the Use of Cement Kiln Dust in FDOT Concrete Mixes
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The 100+ cement plants in the U.S. emit about 7% of the nation's mercury (Hg) air pollution from stationary sources. In 2010, the Environmental Protection Agency released new rules for cement plant Hg emissions which will reduce them greatly by 2015. Air pollution controls that remove particulate matter from stack emissions (baghouses) during cement production produce tons of partially calcined byproduct. Most of this returns to clinker production, but some is used in the finishing mill as an inorganic processing addition (dust shuttling) and is referred to as baghouse filter dust (BFD), which differs from the waste product cement kiln dust (CKD) because BFD is used to make cement and must conform to ASTM C465. (Little CKD is produced in Florida due to return of captured particulate to the clinker production process.) Dust shuttling reduces stack Hg emissions, shifting Hg and other semi-volatile trace metals from stack emissions to cement and concrete products, creating the need to assess dangers to workers and the environment due to exposure to BFD and BFD-amended concrete.

In laboratory experiments, University of Florida researchers assessed potential Hg releases to air and water during BFD storage and handling and from the final concrete. Samples of BFD and cement came from a Florida cement plant, the only one in the state currently practicing dust shuttling. FDOT restricts BFD in concrete to 5%; in this project, both 5% and 10% mixes were tested.

UF researchers surveyed state departments of transportation about their knowledge, concerns, and practices regarding cement plant Hg emissions. Eighteen states responded. Several states reported BFD recycling, but only two reported awareness of the Hg issue.

BFD was tested for Hg concentration and oxidation state, which greatly affect Hg solubility and volatility. Periodic sample testing during storage monitored changes in Hg content and oxidation state. Other trace elements measured were

Limiting aerial mercury pollution is important because it is the first link in a chain through which fish, wildlife, and, ultimately, people ingest mercury.

arsenic, barium, cadmium, chromium, lead, selenium, vanadium, and zinc. Gross elemental and mineralogical composition were determined, and samples were examined with standard leaching protocols, including multiple extractions, which simulates leaching due to acid rain cycles. Vapor phase Hg from BFD and cement mixes was measured over a range of humidity. In tests of concrete amended with BFD, less than 0.5% of Hg measured in the BFD was released in the vapor phase, well within allowable worker safety limits.

Leachate from BFD exceeded risk-based thresholds for several metal elements other than Hg, but leachate from the final concrete had no concentrations above such thresholds. Leaching of monolithic concrete samples was examined over two months in submerged conditions; elemental metals of interest were rarely detectable and no concentrations of concern were found.

Concrete containing BFD as used in this project offers a worker-safe and environment-friendly means of reuse of BFD and is an important component of the plan to reduce environmental mercury. In Florida, with its abundant watersheds and fisheries, this is critically important to reducing human exposure to mercury.

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For more information, visit http://www.dot.state.fl.us/research-center