Fate of Mercury in Synthetic Gypsum Used for Wallboard Production

Jessica Sanderson, USG Corporation

This report presents and discusses results from the project "Fate of Mercury in Synthetic Gypsum Used for Wallboard Production," performed at five different full-scale commercial wallboard plants. Synthetic gypsum produced by wet flue gas desulfurization (FGD) systems on coal-fired power plants is commonly used in the manufacture of wallboard. This practice has long benefited the environment by recycling the FGD gypsum byproduct, which is becoming available in increasing quantities, decreasing the need to landfill this material, and increasing the sustainable design of the wallboard product. However, new concerns have arisen as recent mercury control strategies involve the capture of mercury in FGD systems. The objective of this study has been to determine whether any mercury is released into the atmosphere when the synthetic gypsum material is used as a feedstock for wallboard production. The project has been co-funded by the U.S. DOE National Energy Technology Laboratory (Cooperative Agreement DE-FC26-04NT42080), USG Corporation, and EPRI. USG Corporation is the prime contractor, and URS Group is a subcontractor.

The project scope included seven discrete tasks, each including a test conducted at various USG wallboard plants using synthetic gypsum from different FGD systems. The project was originally composed of five tasks, which were to include 1) a base-case test, then variations representing differing power plant: 2) emissions control configurations, 3) treatment of fine gypsum particles, 4) coal types, and 5) FGD reagent types. However, Task 5, which was to include testing with gypsum produced from an alternate FGD reagent, could not be conducted as planned. Instead, Task 5 was conducted at conditions similar to Task 3, although with gypsum from an alternate FGD system. Subsequent to conducting Task 5 under these revised conditions, an opportunity arose to test gypsum produced at the same FGD system, but with an additive (Degussa Corporation's TMT-15) being used in the FGD system. TMT-15 was expected to impact the stability of mercury in synthetic gypsum used to produce wallboard, so Task 6 was added to the project to test this theory. The final Task 7 was added to evaluate the release of mercury during the use of synthetic gypsum in wallboard production produced at a power plant firing a third coal type, Powder River Basin coal.

In the project, process stacks in the wallboard plant were sampled using the Ontario Hydro method. In every task, the stack locations sampled included a dryer for the wet gypsum as it enters the plant and a gypsum calciner. In Tasks 1, 4, 5, 6 and 7 the stack of the dryer for the wet wallboard product was also tested. Also at each site, in-stream process samples were collected and analyzed for mercury concentration before and after each significant step in wallboard production. The Ontario Hydro results, process sample mercury concentration data, and process data were used to construct mercury mass balances across the wallboard plants.

The results to date from the first six tasks of the project showed a wide range of percentage mercury losses from the synthetic gypsum feedstocks as measured by the

Ontario Hydro method at the process stacks, ranging from 2% to 55% of the mercury in the gypsum feedstock. For the tests where higher mercury percentage losses were measured, most of the losses were measured to occur across the gypsum calciner. Overall, the measured mercury loss mass rates ranged from 0.01 to 0.09 grams of mercury per dry ton of synthetic gypsum processed, or 0.01 to 0.2 pounds of mercury released per million square feet of wallboard produced.

With only six sets of wallboard plant measurements available, it is difficult to draw firm conclusions about what variables impact the mercury loss percentages across the wallboard plants. Higher purge rates of fine solid particles from the wet FGD systems appear to produce gypsum with lower mercury concentrations. However, higher percentage mercury losses observed at the wallboard plant resulted in mass release rates comparable to previous tasks without higher purge rates. There may also be an effect of the coal rank fired at the power plant that produces the synthetic gypsum. A test with gypsum produced at a power plant that fires Texas lignite (a low rank fuel) showed lower percentage and mass mercury losses across the wallboard plant than for gypsum from power plants that fire bituminous coal. The selective catalytic reducer (SCR) used for nitrogen oxide emissions was expected to increase the mercury concentration of the synthetic gypsum; however, results did not support this assumption.

Wallboard produced from synthetic gypsum was leached according to the Toxicity Characteristic Leaching Procedure (TCLP) to provide an indication whether wallboard disposed of in municipal landfills will have a tendency to release mercury into groundwater. To date, the potential of wallboard material to contaminate groundwater has been tested on 11 wallboard samples produced from synthetic gypsum (two samples were tested from Task 4 due to the change in feedstock material), using the TCLP methodology. The TCLP leachates were analyzed for up to eight RCRA metals (arsenic, cadmium, chromium, lead, selenium, mercury, and [for some samples] barium and silver). The result show that none of the 11 wallboard samples produced measurable mercury concentrations in the leachate (<0.25 μg/L), and that leachate mercury concentrations are about three orders of magnitude, or more, lower than the maximum concentration allowed for mercury for the toxicity characteristic (200 μg/L). These results suggest that mercury leaching from wallboard produced from synthetic gypsum will not be an issue if that wallboard is disposed of in municipal landfills.