Bioremediation and Sustainable Environmental Technologies—2017. Fourth International Symposium on Bioremediation and Sustainable Environmental Technologies (Miami, FL; May 2017). ©2017 Battelle Memorial Institute, Columbus, OH, www.battelle.org/biosymp. A. Barton and S. Rosansky (Chairs)

Biogeochemical Conversion of Calcium Sulfite into Gypsum in Flue Gas Desulfurization Waste

Duane Graves (dgraves@geosyntec.com), ***Linxi Chen*** (lchen@geosyntec.com),
And Jacques Smith (jsmith@geosyntec.com) (Geosyntec Consultants, Knoxville, TN, USA)
Robby White (rwhite@geosyntec.com), Brianna Wallace (bwallace@geosyntec.com), and Sarah Herr (sherr@geosyntec.com) (Geosyntec Consultants, Greenville, SC, USA)

Background/Objectives. Coal combustion generates sulfur dioxide that is removed from flue gas using a flue gas desulfurization (FGD) scrubber. In the scrubber, sulfur dioxide reacts with a lime slurry to form either calcium sulfite hemihydrate or calcium sulfate dihydrate (gypsum) depending on the amount of oxygen in the scrubber. High purity (>80%) gypsum has commercial application in wallboard, cement base, and agricultural soil amendment.
A coal fired power plant in the southeastern US has generated approximately 3 million tons of low grade (40 – 60% gypsum) FGD waste stored in a surface impoundment. Geosyntec developed and lab-tested a novel biological treatment technology to convert FGD waste into a valuable product with greater than 80% gypsum.

Approach/Activities. A sulfur oxidizing bacterial population was identified that would grow in a high sulfite FGD waste slurry. With appropriate nutrients, aeration, mixing, and bioaugmentation with sulfur oxidizing bacteria, gypsum was formed at rates approaching 5 % per day with similar loss of sulfite.Flue gas desulfurization (FGD) waste contains gypsum ($CaSO_4 \bullet 2H_2O$), hannebachite ($CaSO_3 \bullet 0.5H_2O$), residual limestone ($CaCO_3$), fly ash, sand/quartz, and trace metals and organics. Under optimal forced oxidation scrubber conditions, FGD waste consists of nearly pure gypsum. Higher purity gypsum (>92%) can be utilized in wallboard production, while lower purity gypsum (>80 – 85%) can be used in cement production and agricultural applications.

Results/Lessons Learned. This biogeochemical process provides a cost effective means of converting low-grade FGD waste into a commercially viable product. The process is a simple alternative to competing technologies which require high oxidant demand and high temperature. The technology combines chemolithoautotrophic sulfur oxidation, crystal formation and growth, and particle classification to produce gypsum approaching 100% purity starting with FGD waste that may contain 40% gypsum or less, more than 50% calcium sulfite hemihydrate and approximately 10 to 12% powdered limestone (calcium carbonate), uncombusted coal fines, and flyash. It could be employed at current and former fossil power generators with low grade gypsum ponds/stacks.