Beneficial Use Case Study

FGD Gypsum Field Application to Reduce Phosphorus Runoff

Coal Combustion Product Type
Flue Gas Desulfurization (FGD) Gypsum

Project Location
Maumee River Watershed, Ohio

Project Participants
The Ohio State University, Electric Power Research Institute, Greenleaf Advisors LLC, U.S. Department of Agriculture, Nester Ag, Beneficial Reuse Management LLC (Gypsoil), Ohio Coal Development Office

Project Completion Date
2015

Project Summary
Fertilizers and animal manure are important sources of nutrients, such as phosphorus and nitrogen, that help crops to grow more productively. But they can be a significant source of pollution if excessive amounts of such chemicals drain into lakes and rivers. Recent decades have seen a dramatic growth in the incidence of runoff-induced algal "blooms" in U.S. water basins that harm wildlife and pollute drinking supplies. Now, field testing has attempted to demonstrate that spreading flue gas desulfurization (FGD) gypsum on affected farmland can reduce concentrations of soluble reactive phosphorus draining from farm fields to improve the quality of these affected aquatic resources.

Project Description
In a three-year study led by Dr. Warren Dick, professor of soil and environmental chemistry at the Ohio State University, and supported by the Electric Power Research Institute, researchers applied FGD gypsum directly to eight corn and soybean fields in the Maumee River Basin on the west end of Lake Erie. The test sites selected were actively farmed fields of between 6 and 35.6 acres in size containing high phosphorous levels in the soil. Each site also paired a control field that that received no FGD gypsum treatment for comparison.

Application of FGD gypsum to agricultural fields can reduce phosphorus runoff. Credit: Ohio State University.

Water samples were collected during or after rainfall at the edge of each field from drain tiles installed to remove excess water from below the surface of the soil and tested for phosphorus concentrations. Over the three-year period of the study, soluble phosphorus concentrations were collected and analyzed for 87 rain events. The reduction in phosphorus concentrations for specific gypsum-treated areas varied from 0% to 93%, with reductions across all gypsum-treated fields combined averaging 54%. Results further showed that phosphorus reductions in tile drainage water persist at least 20 months after gypsum treatment, after which new application is required.

The science behind FGD gypsum's utility in this application is that, when spread on a field, it binds in the soil with phosphorus to make calcium phosphate—a far less soluble form of phosphorus. This makes it less able to run off in water. "Not only that, but FGD gypsum, which is a synthetic form of gypsum, can improve both the soil and the crops," Dick added. "Naturally occurring, mined gypsum has a long history as a soil amendment and fertilizer for farming." According to Dick, gypsum is an excellent source of sulfur nutrition for plants for improving crop yields, as it interacts with nitrogen to make it more efficient.

Shortly after this research emerged, in 2015, the USDA Natural Resources Conservation Services (NRCS) established a national Practice Standard that allows state NRCS programs to reimburse agricultural producers for the use of gypsum as a best-management practice to improve soil health and water quality.

Algal bloom in Lake Erie as captured from space. Credit: NASA.