Power Engineering

Biological Treatment for FGD Wastewater: A Few Options

By

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As of January 2016, new Effluent Limitation Guidelines (ELG) regulations for the Steam Electric Power Category (40 CFR 423) are in effect, setting strict limits on wastewater discharges from power plants. The biggest impacts are to coal-fired plants, in particular flue gas desulfurization (FGD) wastewater, which is high in chloride, with limits on nitrates, arsenic, mercury, and selenium. EPA chose Chemical Precipitation + Biological Treatment and Chemical Precipitation + Vapor Compression Evaporation as the best available technologies (BAT) for existing and new sources of wastewater, respectively. BAT means that the limits are deemed economically achievable based on operating results.

In the Technical Development Document for the ELG, EPA called these technologies "well-proven treatment systems that are available to steam electric power plants" to use for treating FGD wastewater, with 44 percent of FGD wastewater plants already using some form of chemical precipitation. At least four U.S. power plants were using chemical precipitation and biological treatment when the ELGs were developed, and there were many laboratory and pilot-scale studies available. EPA concluded that chemical precipitation followed by biological treatment was both available and effective. EPA also found that biological treatment was less costly than thermal treatment, and that it could perform consistently even with varying operating and seasonal conditions. As a result, a few biological systems are on the market, and more are in development. A few of these follow.

The ABMet system by GE is an attached growth down-flow packed-bed filter that creates anoxic/anaerobic conditions to reduce selenite and selenate. There are several successful full-scale installations operating in coal-fired power plants, and EPA studied them to develop the ELG. It is commercially available and has removed selenium to low levels in pilot-scale and full-scale plants. Physical/chemical pre-treatment is needed to remove suspended solids; post-treatment is needed to remove biological oxygen demand; and it needs a large footprint due to long reaction times. Regular backwashes are used to remove treatment residuals, with some unavoidable media loss. The residuals then must be thickened and dewatered for disposal, and media requires replacement over time.

The FBR by Envirogen is an active, fixed-film bioreactor that uses a hydraulically fluidized bed of fine media to support microbes that remove selenate/selenite and nitrates. The system can operate either anaerobically or in anoxic mode, but the anoxic mode is more effective. In pilot testing by the Electric Power Research Institute (EPRI) (South Carolina 2013) this system provided more consistent and reliable selenium removal than another system tested. Full scale systems are expected to have a smaller footprint than traditional systems, and reportedly little to

no pretreatment or backwash. However, there are no full-scale selenium treatment systems operating. Like other systems, residuals require disposal and media must be replaced over time. The SeHAWK system by Frontier is a hybrid fixed bed reactor system for selenium removal that uses a patent-pending dual stage process configuration. The system will biologically reduce selenate/selenite, nitrates, and other heavy metals. According to the manufacturer, it has a small footprint and can operate in ambient temperatures of -20°F to 120°F, with feed water temperatures down to 32°F. No full-scale selenium treatment systems are operating on FGD wastewater, but the system has been tested on mining waters. As with other systems, residuals require disposal and media must be replaced.

Passive treatment systems include some engineered pond systems and constructed wetlands treatment systems (CWTS). These systems create an environment that promotes natural selenium reduction. CWTS simulate natural wetlands to help filter and treat the water. Passive systems are designed to need very little attention or maintenance, and may be able to treat large volumes of water under the right circumstances. However, they need long residence times, require large footprints, can be subject to toxicity from chloride or boron, and may not be able to reach some very low selenium discharge limits. They are affected by climate and perform better in warmer months. One potential concern is ecological risk either due to bioaccumulation (selenium or mercury) or groundwater contamination. However, there are places where passive biological treatment can be a workable solution.

In short, GEs ABMet system is the most established and is commercially available, but other systems are developing that can provide options to the power industry and others. Passive treatment systems may have limited uses; they can provide a very low maintenance solution in the right place.