Protective Materials For FGD Infrastructure

Flue gas desulfurization (FGD) is the technology used for removing sulfur dioxide (SO_2) from the exhaust flue gases in power plants and has a long tradition with more than 50 years of traceable references. Power plants that utilize FGD usually burn coal and/or oil to generate steam used for the steam turbines that drive electricity generators. Sulfur dioxide removal has become an increasingly important issue as the power and co-generation industries strive to increase efficiencies and meet more demanding environmental regulations. For a typical coal-fired power plant, an FGD system can remove up to 90 percent or more of the SO_2 in the flue gases. Most FGD systems employ two stages – one for solids removal (precipitator or bag-house) and the other for SO_2 removal (absorber or scrubber). Attempts have been made to remove both the solids and SO_2 in one scrubbing vessel, however, most power plants still use two stages. Though there are others methods used, the most common FGD system utilized by USA power plants is called wet scrubbing.

Corrosion in FGD systems is an extremely important concern associated with wet scrubbers. After the hot SO_2-containing gasses from the boiler are quenched in a scrubber unit, the exiting flue gas is now saturated with water but still contains residual SO_2. The SO_2 reacts with pyritic iron and is converted to SO_3. The SO_3 and water combine to form highly corrosive sulfuric acid (H_2SO_4), and as the gas cools, the H_2SO_4 condenses on the downstream equipment such as fans, ducts, and the exhaust stack. The corrosive acid is more prevalent within the exhaust stack section due to increased condensation.

There are, however, two methods that minimize corrosion. The first method is to reheat the gases to above their dew point and the second is to choose construction materials and design conditions that allow equipment to withstand the corrosive conditions. Though many power plants do elect to reheat the gases to above their dew point, the post- scrubber environment is still ripe for corrosion. The cost to reheat is another major consideration. In many cases, the power plant owners opt to install a chemical-resistant lining material. The selection of such a material is influenced by the chemical composition of the flue gases and the operating temperature of the unit. The material chosen to protect the interior surface of the FGD unit must be able to withstand a potentially broad spectrum of chemicals, thermal shock, and continuous wet service conditions.

One such design that uses chemical-resistant materials is the combination of a potassium silicate polymer concrete technology with an organic polymer or an asphaltic membrane. This combination has been used as a superb dual-lining system with beneficial results and long lasting service life in many power plants, petrochemical facilities, smelters, and sulfuric acid plants. Sauereisen No. 89, the membrane component of this dual-lining system, serves as a chemical-resistant line of defense directly on the substrate such as an exhaust stack or duct. A blend of organic polymers, this asphaltic material exhibits low permeability. It also has an elastomeric nature that bridges small surface cracks while accommodating and attenuating varying rates of thermal expansion between the refractory and the substrate. The potassium silicate polymer concrete, such as Sauereisen No. 54, is then applied over the asphaltic membrane. This particular kind of concrete not only exhibits the corrosion resistance that is required for the chemical environment, but withstands water and acidic vapor without special treatment.

For lower temperature flue gas environments, organic polymer linings are appropriate. Sauereisen's FibreCrete epoxy and FibreLine vinyl ester materials are spray-applied for these applications. Fiber reinforcement within a cross-linked resin system makes these linings highly impermeable, yet flexible. The organic version of dual-lining technology is to specify approximately 40 mils of a basecoat lining topped by 10 mils of a glossy topcoat.

One final protective system worth mentioning for hot, acidic environments is that of brick & mortar. Though relatively labor-intensive in comparison to gunning a refractory or spraying a lining, a brick-lined stack offers potentially the longest service life and least maintenance. It was in the creation of an acid proof mortar that Sauereisen got into the power industry in the first place. Sauereisen's Corrosion-Resistant Mortar No. 65 is the potassium silicate formulation recommended for laying brick. It exhibits the same chemical resistance, as its monolithic "cousin", Sauereisen No. 54.

Often there are applications for both the organic coatings and inorganic refractory linings in the same plant. Sauereisen is one of the few companies capable of providing solutions within each branch of chemistry. Such diversity adds credibility to recommendations.

SOURCES:

A History of Flue Gas Desulfurization (FGD) – The Early Years. http://www.ue-corp.com/news/wp_fluegas.pdf.

Air Pollution Control Fact Sheet, US EPA, 2003.