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POWER Engineering®

July 2006

the magazine of power generation

COAL GASIFICATION

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SELECTING THE RIGHT PUMPS AND VALVES FOR FLUE GAS DESULFURIZATION

Limestone slurry needs to move efficiently through a complex process, meaning that selecting the right pumps and valves is critical.

As new coal-fired power plants come on line to meet rising demand for electricity in the U.S. and around the world, there is a growing need to scrub plant emissions to meet clean air regulations. Special pumps and valves help to efficiently run these scrubbers and handle the abrasive slurries used in the flue gas desulfurization (FGD) process.

With all the technological advancements over the last century in developing new sources of energy, one thing that has not changed very much is our reliance on fossil fuels, and coal in particular, to generate electricity. More than half of the electricity generated in the United States comes from coal. One result of burning coal in power plants is the release of sulfur dioxide (SO_2) gas.

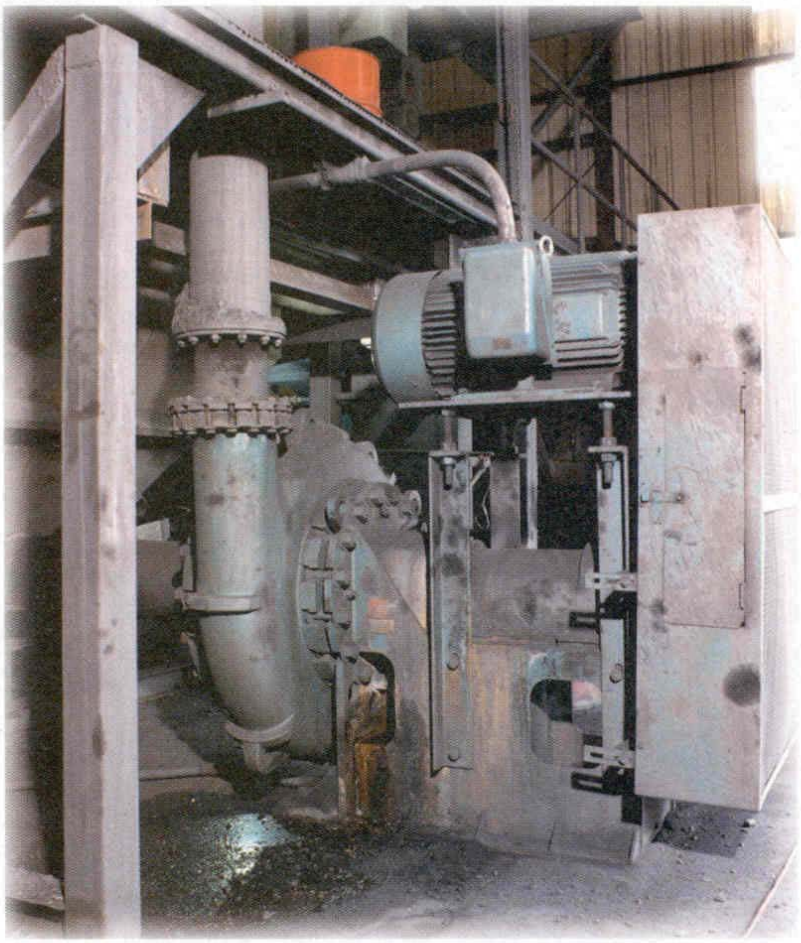
With approximately 140 new coal fired power plants on the drawing boards for the U.S. alone, the concern for meeting clean air regulations here and around the world is leading new and existing power plants - to be equipped with advanced emissions "scrubbing" systems. SO_2 is now being removed from flue gases by a variety of methods commonly known as flue gas desulfurization (FGD). According to the Energy Information Administration, which provides energy statistics for the U.S. Government, power companies are projected to add FGD equipment to 141 gigawatts of capacity in order to comply with state or federal initiatives.

FGD systems can use either a dry or wet process. The wet FGD process most commonly employed uses a scrubbing liquid – typically limestone slurry - to absorb SO_2 present in the exhaust gas stream. A wet FGD process will remove in excess of 90 percent of the SO_2 in the flue gas as well as particulate matter. In a simple chemical reaction, as the limestone slurry reacts with the flue gas in the absorber, the limestone in the slurry is converted to calcium sulfite. In a number of FGD installations, air is blown into a section of the absorber and oxidizes the calcium sulfite into calcium sulfate which then may be easily filtered and dewatered to form a drier and more stable material that can be disposed of in a landfill or has the potential to be sold as a product to make cement, gypsum wallboard, or as a fertilizer additive.

PUMP SELECTION FOR FGD

Because this limestone slurry needs to move efficiently through a complex industrial process, the selection of the right pumps and valves – with an eye toward their total life cycle cost and maintenance - are of critical importance.

The FGD process begins as the limestone feed (rock) is reduced in size by crushing it in a ball mill and then is mixed with water in a slurry supply tank. The slurry (approximately 90 percent water) is then fed by pumps to the absorption tank.



A 10" actuated knife-gate valve from ITT on a gypsum slurry line for FGD service. Photo courtesy Goulds Pumps

Because the consistency of the limestone slurry tends to vary, suction conditions may occur, which can cause cavitation and pump failure.

A typical pump solution for this application would be to install a hard-metal slurry pump built to withstand these types of conditions. The hard metal pumps would need to be built to stand up to the toughest abrasive slurry services, but also is designed for extreme ease of maintenance and safety. Critical to the engineering of the pump would be a heavy duty bearing frame and shaft, extra thick wall sections and easily replaceable wear parts. Total life-cycle cost considerations are crucial when specifying pumps in severe operating conditions such as FGD service. Because the slurry has a caustic pH, a high chrome alloy pumps are the ideal choice.

From the absorption tanks the slurry must be pumped to the top of the spray towers where the slurry is sprayed down in a fine mist to react with the upwards-moving flue gas. With a pumping volume that is typically in the range of 16,000 to 20,000 gallons of slurry per minute and a head that ranges from 65 to 110 feet, rubber lined slurry pumps are the best pumping solution. Again, to meet life-cycle cost considerations, the pumps should feature a large diameter impeller for lower operating speeds and longer wear life as well as field-replaceable rubber liners that bolt in for quick maintenance. In a typical coal-fired power plant, each spray tower would use from two to five pumps.

As the slurry collects at the bottom of the tower, more rubber-lined pumps will be required for transporting the slurry to holding tanks, tailings ponds, waste treatment facilities or a filter press. Depending on the type of FGD process, other pump models can provide service for slurry bleed, prescrubber recycling and sump applications.

A bank of ITT rubber lined slurry pumps on FGD service at a Missouri power plant.

VALVE CONSIDERATIONS FOR FGD

Depending on size and layout, the FGD process in coal fired power plants typically requires anywhere from 100 to 200 valves. In the process of transporting and handling the limestone slurry, knife-gate valves up to 60 inches in diameter may be needed. Because the limestone slurry is abrasive on the front end of the FGD process and slightly caustic after reacting with the flue gas, the knife-gate valves used in FGD are required to have upgraded materials including replaceable urethane liners.

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For FGD slurry applications, additional considerations for knife-gate valves include specifying a product with a robust seal design that does not discharge media to the environment as well as a scraper design that is incorporated into the liners to clean the gate during operation and prevents media build up in the chest area.

For smaller valve sizes, diaphragm valves provide a reliable and economic solution in FGD slurry applications. The specified valves should be able to be easily maintained in-line. Other considerations in choosing a diaphragm valve for this service is that they should feature thick rubber liners, there should be no packing glands to maintain and the diaphragm should be able to close over suspended solids.

IMPROVING LIFE CYCLE COSTS

With bottom-line operating costs always critical to the operation of industrial plants, a pump supplier should be able to provide intelligent systems to increase operating efficiencies and enable predictive maintenance. Customers engaging in this "total systems approach" generally find dramatically lower energy consumption, maintenance and overall life cycle costs.

A variable speed control system can be installed on any centrifugal pump and would help to reduce pump failures that result from process upsets or inadvertent operator error and improve pump life cycle costs through energy savings and reduced maintenance costs.

New to the market are predictive, online, machine condition monitoring systems that automatically collect and display data. These systems generate alarms based on machine health and use inputs from vibration, temperature, liquid level, liquid flush and leak detection, pressure, and speed to create alarms that plant operators of machine condition via cell phone, pager, email, and web browser. PE

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