Tech Talk
Pump and Valve Selection for Flue Gas Desulfurization

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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 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. As the SO_2 reacts with rain, the result is acid rain and its devastating effects on lakes and rivers far downwind from power plants.

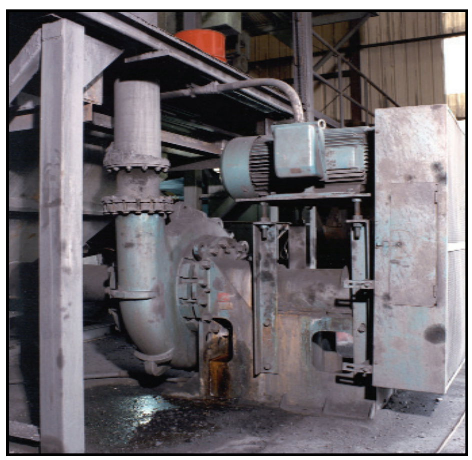
With approximately 140 new coal-fired power plants on the drawing boards for the U.S. alone, the concern for meeting clean air regulations here and around the world is leading new plants – as well as existing plants - to be equipped with advanced emissions “scrubbing” systems. SO_2 is now being removed 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.

From Sulfur Dioxide to Recyclable Materials

FGD systems can use either a dry or wet process. The wet FGD process most commonly employed uses a scrubbing liquid – typically a limestone slurry - to absorb SO_2 present in the exhaust gas stream. A wet FGD process will remove in excess of 90% 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 towards their total life cycle cost and maintenance - are of critical importance.



Goulds Model 5500 hard metal slurry pump handling limestone slurry.

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% water) is then fed by pumps to the absorption tank. 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 the installation of a hard-metal slurry pump built to

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withstand these types of conditions. The hard metal pumps need to be built to stand up to the toughest abrasive slurry services but also 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. According to Haminder Ahluwalia, a pump engineer for ITT's Goulds Pumps Ashland Operations, "because the slurry has a caustic pH, a high chrome alloy pump or rubber lined slurry pumps would be the best choices." In the North American market, rubber lined pumps have been preferred. Internationally, hard metal slurry pumps are the material of 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.

Valve Considerations for FGD

Depending on size and layout, the FGD process in coal-fired power plants typically require 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.

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 are 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.

Seen here is a 10" actuated knife-gate valve (Model XS150ULV) from ITT on a gypsum slurry line for FGD service.

Improving Life Cycle Costs with Intelligent Technologies

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

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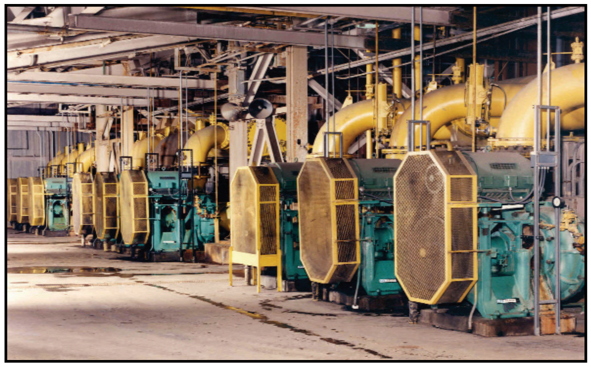
on any centrifugal pump and would help to reduce pump failures that result from process upsets or inadvertent operator error and improve pump life cycle costs through energy savings and reduced maintenance costs.

New to the market are predictive, online, machine condition monitoring systems that automatically collect and displays 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 inform plant operators of machine condition via cell phone, pager, email, and web browser.



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

For more information about ITT Goulds Pumps brand products visit: **www.gouldspumps.com**

For more information on our valve products for the power industry visit: **www.engvalves.com**

New Products

PS200 v5.0 The Newest Version of PumpSmart®

Coming August of 2006 is the much-anticipated release of V5.0 for the PumpSmart PS200. Some of the technical highlights featured in V5.0 will be SMART^{FLOW}, Advanced Pump Protection, Positive Displacement Pump Protection and SMART^{CONTROL}.

SMART^{FLOW} is a sensorless flow function which will have the ability to calculate the flow of a centrifugal pump within ±5% of the pump rated flow without the need for any external instrumentation. This function mathematically models the pump power curve with only four points of CDS pump performance curve data, BEP flow, BEP power, shut off power and rated speed.

Advanced Pump Protection (APP) is an improvement upon the already powerful Torque Based Pump Protection. APP is a sensorless pump protection function that takes into account the hydraulic and mechanical losses associated when changing the speed of a centrifugal pump. A self-calibration feature allows for an accurate representation of the pump to ensure the pump is protected at all speeds.

Positive Displacement Pump Protection (PDPP) is a sensorless pump protection feature for constant torque loads such as in positive displacement pumps. Because PDPP is used with constant torque loads it does not take into account for changes in speed such as APP. PDPP monitors for conditions such as high and low torque which can be an indication the pump has a blocked discharge or a starved suction.

SMART^{CONTROL} is an improved way to control pumps with flat head-capacity curves where a small change in speed can lead to a large change in flow. A flat head-capacity curve can make tuning a pump system difficult leaving the pump to oscillate around the setpoint. In general to increase the flow of the pump the speed is increased and subsequentially the torque increases as a result. With SMART^{CONTROL} the exact opposite happens, where to increase the flow the pump torque is increased and correspondingly the speed follows. The advantage is that the torque performance curve is much steeper relative to speed and can typically yield a control resolution 2-3 times greater then speed.

If you have any questions or specific applications, please contact Dan Kernan, Product Manager, PumpSmart Control Solutions, (315) 568-7874.

PS200 v5.0