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TECHNICAL DIGEST

The Benefits and Technologies of Flue Gas Desulfurization Systems for Power & Industry

As the regulatory environment grows increasingly stringent for the fossil fueled energy and industrial sectors, it is imperative that companies invest soundly in the technologies that will preserve and optimize these assets. This Technical Digest examines the benefits and technologies of Flue Gas Desulfurization (FGD) systems, also known as scrubbers, which have become an established industry tool towards achieving plant longevity and preservation of emission standards. Over the last decade, the number of power plants and industrial facilities installing FGD systems has increased significantly, especially in the U.S. and Canada. This trend is in response to a high demand market fueled by regulatory shifts and over three decades of refinement, which has positioned these systems as among the best in offering significant reliability and compliance while reducing costs. Presented are key topics for those considering an investment in FGD technologies, as well as those seeking to optimize existing scrubber systems. Learn the benefits of FGD for power and industrial facilities in the evolving market, the critical need of maintenance and performance monitoring for scrubber systems, and discover some of the top technologies for improved efficiency of the most utilized FGD system available today, wet-limestone scrubbing.

The Benefits of FGD Systems for the Evolving Energy Market

While alternative energies are on the rise, studies indicate that fossil fueled power will continue to be the lead resource for global markets for some time.

AS GOVERNMENTS IMPOSE stricter environmental regulations, it may seem fossil fueled energy will soon be obsolete against renewable sources such as wind and solar. However, fossil fuels are still a major energy source, and with the right technology, industry can protect the value of these assets while meeting tougher standards.

Over the last year, a growing number of fossil-fired power plants, especially those powered by coal, have opted to close due to stricter environmental regulations. Yet, top energy authorities, such as the International Energy Agency (IEA), have projected that fossil fuels will remain a key part of the global energy mix for the next several decades.

A report from the International Energy Agency determined that fossil fuels will provide as much as 75 percent of the world's energy consumption in 2035. While this does represent a slight decrease from the 81 percent fossil fuels provided as of 2010, the data shows fuels like coal and natural gas will continue to remain important contributors to the world's energy supply.

Supporting these findings is a report released in March by the World Economic Forum's Energy Industry Partnership, which also highlights the call for fossil fuels will remain strong. In the last decade, global demand for coal increased 10 times more than renewables. Additionally, 87 percent of the world's energy demand is currently met by oil, coal and natural gas, while wind, solar, geothermal and other renewable sources account for just 1.6 percent.

While these projections are encouraging, the increasing cost and uncertainty associated with expanding regulatory standards still presents significant challenges. So how can industry help get the most out of its existing fossil fueled assets and pave the way for future development? As new technologies are established and navigate regulatory approvals, implementation of environmental controls for new and existing assets remains one the most effective routes.

Among the current environmental technologies for aiding industrial and energy companies comply with increasing environmental regulations is Flue Gas Desulfurization (FGD). According to a report from the UK Department of Trade and Industry, FGD is widely applicable as a means of controlling sulfur dioxide (SO2) emissions from larger, stationary sources such as power stations, refineries and metallurgical plants.

The report goes on to highlight that while there are several ways to address SO2 emissions, in many applications one the most efficient means of controlling this pollutant is to remove the SO2 from the flue gases before they are released into the atmosphere.

Over the course of the last ten years the number of power plants and industrial facilities installing FGD systems has increased greatly, especially in the U.S. and Canada where new regulatory standards and continuing low market prices have had greater impact.

Analysis from the Energy Information Administration (EIA), revealed owners of coal-fired power stations invested more than $30 billion in FGD systems between 2007 and 2011. According to the report, FGD systems were installed at coal-fueled stations across 34 states during this period, to represent just slightly less than 60 percent of the coal-fired generation capacity in the U.S. This significant investment served to reduce SO2 emissions in 2011 to levels 68 percent lower than those in 1990.

This continuing advancement in the implementation of FGD systems is the results of great strides in the improvement of scrubber technologies. Over the last two decades, FGD systems have refined their design and process chemistry to offer significant reliability and efficiency, while reducing costs.

It is important to also note that FGD systems are not just adept at removing SO2 emissions. Often overlooked is the ability of these technologies in removing significant amounts of particulate matter and chlorine gas, further addressing the needs of industry in adapting to current and evolving environmental standards.

Along with improvements to FGD design and supportive components such as heaters, fans and steam injection technology, modern scrubbers represent a truly competitive option for emissions controls for the evolving energy market.

The Value of Maintenance, Performance Monitoring for Scrubber Systems

FLUE GAS DESULFURIZATION (FGD) systems, also known as scrubbers, can offer enormous benefits for fossil fueled energy and industrial assets, but only when they are working. In this editorial, PennEnergy outlines the critical need for an established preventative maintenance and performance monitoring routine in achieving longevity and preservation of regulatory standards.

To ensure FGD systems function as intended, proper maintenance and monitoring is essential. A comprehensive upkeep and monitoring routine offers the advantage of ensuring regulatory compliance, while also serving as a means of early detection before issues evolve into cost prohibitive breakdowns.

Although the mechanisms and complexities of FGD systems vary by site, investment in the preservation of equipment performance and reliability across all system types have been shown to yield similar results. Like all power and industrial plant processes, FGD systems that are well maintained serve to boost availability, extend equipment life, enhance safety, and lower overall operating costs.

One of the primary obstacles to implementing appropriate measures for FGD maintenance and monitoring is often connected to concerns related to the return on investment for such programs by operators. However, when weighing the potential loss of capitol due to violations, lost efficiency or the need to purchase replacement power due to unexpected shut-downs the value of a well instituted maintenance and monitoring routine comes quickly into focus.

Analysis presented by the Journal of the Air Pollution Control Association (1) outlines the methods of FGD system upkeep commonly utilized by maintenance engineers as Preventive and Scheduled, Planned, and Emergency. Each of these targets specific areas of FGD upkeep to maintain reliability and efficiency.

According to the report, Preventive and Scheduled maintenance involves tasks performed at regular intervals for the servicing, upkeep, or overhaul of FGD systems. The breadth of these tasks can vary dependent on site-specific conditions and generally consists of basic equipment monitoring.

Planned maintenance is defined as non-urgent upkeep and overhauling tasks that can be scheduled to best meet the needs of a facility. An example provided is planned maintenance during low boiler load operation, when FGD equipment is not operating at full capacity.

Emergency maintenance is related to the repair of equipment that has failed with minimal or no warning. The understanding is this classification is reserved for equipment breakdowns that must be addressed as quickly as possible.

Planned implementation of these maintenance methods can go a long way in optimizing FGD systems in service to generation and industrial assets. Establishing a comprehensive preventative maintenance and performance monitoring routine, including thorough crew training, helps pave the way for operators to reap the highest return on investment from their scrubber systems.

[1] L. N. Davidson, R. A Goffredi, C. P. Wedig
The Importance of Maintenance for Lime Flue Gas Desulfurization Systems
Stone & Webster Engineering Corporation, Boston, Massachusetts, USA
Published online: 08 Mar 2012.

Technologies for Improved Efficiency of Wet Limestone Scrubbing

FOSSIL-FUELED PLANTS ACROSS the globe know flue gas desulfurization (FGD) systems offer a number of benefits. These systems control sulfur dioxide, sulphur trioxide and particulates making it possible to continue operations while adhering to increasingly stringent air quality standards.

The control of sulfur dioxide emissions from fossil fueled boilers has progressed dramatically over the last three decades. Wet limestone scrubbers have become the state-of-the-art method of choice for achieving SO2 removal, yielding efficiencies as high as 98 percent. As of 2010, more than 100 FGD units installed at U.S. fossil-fueled plants were using this process.

There are a number of components and technologies designed to support and enhance the wet limestone process to ensure optimum performance. PennEnergy explores some of the top measures and technologies available to get the most of out of wet-limestone FGD.

Heavy-duty pumps

Utilizing the best pumps and valves will help limestone slurry move quicker through the FGD process. The consistency of limestone slurry can vary, so insufficient pumps and valves can cause suction issues and, subsequently, pump failure.

In order to combat this problem, hard-metal slurry pumps have proven to be the best performing in a unit's slurry line. These pumps are built to handle a variety of conditions and optimize the efficiency of the scrubber system. Hard-metal slurry pumps need to have a heavy-duty bearing frame and shaft as well as extra-thick walls and parts that can be easily replaced after wearing. Moreover, large pumping volumes will be best handled by rubber-lined slurry pumps.

Optimal valves

With regard to the most effective valve choices, larger knife-gate valves have shown to be optimal for transporting slurry. Valves will also need to utilize upgraded materials like replaceable urethane liners that can handle varied conditions of limestone slurry. In the beginning of the FGD process, the slurry is quite abrasive, but after reacting with flue gas, it becomes somewhat caustic. Finally, a sturdy seal is also vital to the functionality of valve systems, ensuring substances are properly contained.

Steam injection technology

Slurry is produced when limestone is crushed and mixed with water. It then converts to calcium hydroxide during the slaking process of FGD. Because the surface area of the calcium hydroxide is responsible for the efficiency of the scrubber, formation of extremely small calcium hydroxide particles is a primary objective. One variable impacting conversion efficiency is water temperature. Use of hot water, generally between 100 and 120 degrees Fahrenheit, can accelerate slaking to yield smaller average particle size.

Steam injection technology provides an instantaneous and reliable source of hot water at precisely controlled temperature. Slurry make up normally imposes a steady demand for hot water. A steam injection heater is perfectly suited for applications of this type, but can also be designed to accommodate variations in steam and water demand. Thorough review of design parameters with the vendor will yield optimum heater performance.

Monitoring chloride

Chlorine in coal can create hydrogen chloride HCl during combustion that reacts with limestone to make calcium and magnesium chloride. However, if chloride concentrations become too high, severe corrosion can form. Fortunately, there are several techniques available for power plant operators to monitor chlorides. Ion chromatography is one option and the most sophisticated choice. However monitoring chloride by ion specific electrode is a cheaper alternative. In this method, the electrode senses the ion of importance. Titration analysis offers data on chloride concentrations typically found in wet scrubbers of FGD systems.

Monitoring alkalinity of scrubber slurry

Because limestone is the principal agent in wet scrubbers, it is important to keep watch on the alkalinity in scrubber modules. Too much alkalinity can cause power plants to waste reagents while too low alkalinity will make the FGD less effective at removing sulphur emissions. Proper pH monitoring will help keep levels in check. Power plant operators should constantly monitor these levels and use the data to control reagent feed rates. A pH range of 5.6 to 5.8 is a common level for scrubber modules.

Keeping density levels low

Slurry densities increase when sulphur dioxide is absorbed and water evaporates, but slurry circulating pumps can only handle so much mass before damage to the FGD occurs. Scrubbers are typically equipped with density monitors, but power plants need to make sure to monitor these tools and track densities to ensure monitors are operating as they should. The pycnometer method, which is when a vessel is filled with water, weighed and then rinsed and filled with slurry and weighed, is a popular way to ensure all density tools are working correctly. This test offers a slurry vs. water gravity ratio, which can be used to find the density of a slurry.

Process Heating Solutions for the Energy Industry

Increase Efficiency with Direct Steam Injection

Pick Heaters, Inc. is the leading manufacturer of direct steam injection heaters. The Power Industry relies on Pick Heaters to provide an uninterrupted supply of heated water at precisely controlled temperature for lime slurry make-up for FGD, regeneration of anion beds, tempering of water to improve R/O efficiency, and pre-heating boiler feed water.

Flue Gas Desulphurization

Power plants employing flue gas desulphurization (FGD) to control sulfur dioxide (SO_2) emissions can improve slaking efficiency and reduce lime consumption with direct steam injection heaters. Slurry is produced by crushing limestone in a ball mill and mixing it with water. During this slaking process, conversion to calcium hydroxide is achieved. Surface area of calcium hydroxide particles is the critical factor for scrubber efficiency. Use of hot water supplements heat of reaction.

Accurate temperature control throughout the entire operating range yields optimum results and conserves energy. The Pick Direct Steam Injection Heater maintains precise temperature control to within 1°C or less in many systems.

Regeneration of Anion Filter Beds

A Pick Heater provides an uninterrupted supply of heated water for regeneration of anion filter beds in the water treatment plant. Optimum efficiency is achieved with a water temperature at or near 120°F. A Pick heater provides exceptional temperature control to achieve this efficiency while protecting the resin bed against damaging temperature extremes. High maintenance ancillary components associated with indirect heat exchangers, such as the trap and condensate return pump are eliminated. Pick can provide the heating system only or expand scope of supply to include caustic injection pump and all related instrumentation and controls.

Reverse Osmosis Systems

Pick Heaters are proven as a dependable source of tempered water to increase water flux and overall efficiency of R.O. systems. Although a simple, straightforward application, precise temperature is critical to protect the membrane from damage. In comparison to indirect methods of heating, the Pick Heater is the most cost effective and simplest design.

Pre-heat Boiler Feed Water

Pick Heaters are used to heat boiler make up water upstream of the deaerator. Steam injection simplifies the piping system and reduces installed cost by elimination of the trap and condensate piping. Condensed steam is fully captured in the feed water and returned to the boiler.

Pick Heaters Features/Benefits

:: Improves Efficiency

:: Precise Temperature Control

:: Compact Design

Additional Links

:: **Steam Injection for the Power Industry:**
http://www.pickheaters.com/energy-power.html

:: **How Pick Direct Steam Injection Works:**
http://www.pickheaters.com/how-dsi-works.html

:: **Energy Efficiency of Direct Steam Injection**:
http://www.pickheaters.com/pick-energy-efficiency.html

:: **Request for Information:**
http://www.pickheaters.com/find-a-rep-and-request-additional-info.html

Dependable and Energy Efficient Direct Steam Injection Heaters

Steam Injection Heating System

The power industry demands reliable water heating equipment offering precise temperature control. Pick direct steam injection heaters satisfy both requirements. Pick's proven, robust design provides continuous service with minimal maintenance. Discharge temperature is held to extremely close tolerance – within 1°C or less – while providing rapid yet controlled response to changing process conditions.

Pick steam injection heaters provide 100% heat transfer efficiency – eliminating flash and heat losses inherent with indirect exchangers. This alone can save you up to 17% in fuel costs. In addition, Pick's compact design saves valuable floor space and the heater is easily disassembled when service is required, thus reducing down time. All this, combined with an unlimited supply of hot water, the widest operating range of any steam injection heater, and low water pressure drop makes Pick Heaters the right choice for:

• Anion Bed Regeneration • FGD Lime Slurry Make-Up
• Boiler Feed Water
• Reverse Osmosis • Condensate Mixing

Cutaway View of Steam Injection Heater

Contact us to find out more about the advantages of direct steam injection
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