UPGRADING YOUR WET FGD SYSTEM

By Richard Staehle

Wet flue gas desulfurization (WFGD) technology has undergone numerous improvements and changes since first being introduced to electric utilities over 30 years ago. Many of these changes have been brought on by improvements in technology/equipment as well as by the lessons learned as WFGD experience in start-up and operation was gained over the decades. Improvements in reliability are evidenced by the fact that today, single FGD absorbers are typically installed for boilers up to 1000 megawatts and, in some cases, multiple smaller boilers are today serviced by single WFGD absorbers. The old design philosophy of supplying multiple absorbers with spares is rarely - if ever - seen anymore.

Many utility WFGD systems in operation today were considered “state-of-the-art” when installed 20 or 30 years ago but face new hurdles as their age and design are being challenged by new and changing tasks. Examples of these drivers are the ratcheting-down of allowable emissions and switching to higher sulfur coal. New, lower emissions requirements can be dramatic when compared to original design levels. This may require the elimination of an existing partial bypass, which will strain the system not only process-wise but also create higher flow and pressure drop in the absorber and greater strain on the mechanical systems. Some utilities wish to burn alternative, lower cost coals with a higher sulfur content (well beyond that originally designed for) that promise to further compound the demands on older WFGDs. In some older plants, the modification of oxidation mode has been done in order to provide a more beneficial gypsum by-product or to eliminate a disposal issue. Various chronic maintenance chores can sometimes be eliminated or reduced greatly by modification of the problem area to a modern, higher reliability design.

The application of current improvements in technology, equipment, process improvements and general know-how to provide better operation, maintenance and performance to existing WFGD systems (i.e. “Upgrades”) are becoming more of a necessity as the older systems are asked to do more and more relative to their original functions.

SO_2 Removal Efficiency Upgrades

The need to remove more SO_2 due to more stringent regulations and/or fuel switching is a common need. This need can manifest with a requirement to boost SO_2 removal efficiency percentage from the high 80’s or low 90’s to upper 90’s. Another reason can be due to the elimination of existing partial gas bypass. For plants with spare absorbers and/or spray levels, this can result in ongoing usage of spare spray levels and/or spare absorbers on a normal basis. In this case, the shortcomings of original design relating to reliability must be addressed as the backups will not be available. An additional approach is to boost the ability of the existing absorbers to capture SO_2. The typical upgrade approaches are to increase reagent slurry recycle flow (L/G), improve spray patterns/nozzle layout, and to install (in an open spray tower) Absorber Liquid Redistribution Devices (ALRDs) or perforated trays.

Marsulex Environmental Technologies, or MET) received a U.S. Patent in 2003 for ALRD technology which is incorporated in MET's OEM designs today. ALRDs improve SO_2 efficiency by significantly reducing the gas sneakage in an open spray tower due to the tendency of gas to hug the walls of the absorber vessel. The ALRDs do this, as well as "kick-out" slurry run-down from the walls back into the gas stream, making better use of the L/G delivered to the spray banks. In a 3% sulfur fuel WFGD, past retrofits of ALRDs alone boosted removal efficiency equivalent to an L/G increase of 15-25% a negligible (less than 0.1" w.c.) pressure drop penalty. ALRD technology is further discussed in an article in WPCA newsletter no. 11 in 2007, found at www.wpca.info

Perforated trays can be another approach to attempt to boost SO_2 removal. The trays provide a bubbling bed of slurry froth in which mass transfer is enhanced. The back-pressure to the system imposed by the tray can also act to improve gas flow uniformity problems. Depending on the site-specific FGD unit and operating requirements, if the FGD is afterwards operated at a lower L/G ratio (i.e., less slurry recycled) the savings in recycle pump power will act as an offset to the penalty of increased absorber pressure drop (i.e., pump versus fan power).

Both the ALRD and tray approach have been used to upgrade absorbers of the 1970-1980's vintage absorbers originally designed with banks of wetted-film contactor (i.e., packing) that were prone to scaling, buildups and plugging as well as wear and the need for cleaning & regular replacement. Elimination of packing in modern tower design (or by retrofit of ALRDs or trays in packed towers) adds a large measure of reliability and provides savings on plant costs.

Upgrading the absorption chemistry is another fundamental means of boosting SO_2 performance. Usage of alternative reagents, modifying the type or grind fineness of limestone used and chemical additives (such as DBA) can be used to meaningfully improve capture of SO_2.

SO_2 Removal – FGD Upgrade Case Study

A mid-western plant firing 2.5 – 3.5% sulfur coal operated with a single, open spray tower limestone WFGD designed to use 4 operating (with 1 spare) spray levels. The baseline SO_2 efficiencies were approximately 95.7% with 4 operating spray levels and 93.8% with 3 operating levels. ALRDs were retrofitted at 2 elevations with a very negligible increase in system pressure drop. The ALRDs increased efficiency to 98.7% (3 points higher) with 4 operating levels and to 96.1% (2.3 points higher) with 3 levels on. Thus, this unit was then able to operate with one less spray level at a higher removal than before, or to operate at a significantly higher removal with the 4 levels on. Even higher levels of removal were demonstrated by modification to the operating pH of the slurry.

Ancillary Equipment/System Upgrades

Areas that also need to be examined during the upgrade planning include the reagent preparation, water make-up, dewatering and ductwork to insure compatibility with new factors relating to the future improved operation. Some areas may need to have materials of construction reviewed to make sure they are adequate to meet the new operating conditions.

Other Problems Solved by FGD Upgrades

Common problems or situations with older FGDs include the need to modify the characteristics of by-product gypsum, optimize the use of limestone reagent, economize on the usage of water and power, and to address operating problems such as scaling, buildups and plugging of mist eliminators. Engineered solutions can be sought as an alternative to spending the time, resources and money to merely live with the problems. Examples of such solutions include forced oxidation conversions, redesign & replacement of absorber spray headers and/or nozzles, recycle sump agitator revisions, modifications to instruments & FGD process control, and improved mist eliminator cleaning systems. Engineering studies, fluid dynamics models and chemical process reviews will many times identify effective means and measures to mitigate the various situations in a justifiable, cost-effective and long-term manner.

Conclusion

As U.S. utilities strive to economize in the operation and maintenance of existing FGD systems, they are also faced many times with the simultaneous need to have the FGD perform better and/or differently than originally designed. Aspects of design of current FGD technology are generally available and can be incorporated in the previous generations of operating units to provide better performance and solutions to problems or needs. All key areas of many older FGD systems – absorber, reagent preparation and de-watering - may benefit by the engineered retrofit of modern upgrades.

For additional information, contact Rich Staehle, rstaehle@marsulex.com or at Dave Murphy, dmurphy@marsulex.com.