SBS Injection™ Technology for SO_3 Control: Summary of Operating Performance and Economics

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Summary

With the addition of SCR technology for NO_x control, the levels of SO_3 in coal-fired boiler flue gases have increased significantly in recent years. The increasing use of higher sulfur coals has also lead to higher SO_3 levels and emissions. Both of these factors have contributed to increased visible sulfuric acid opacity from coal-fired power plants, and in some cases, plume touchdowns adjacent to the plants. Furthermore, elevated SO3 levels have resulted in increased corrosion of "back end" equipment, energy efficiency reductions, and significant constraints on the operation and performance of SCR systems.

The SBS Injection™ technology is a process for the selective removal of SO_3 from flue gas by the injection of sodium-based chemical solutions. The proprietary process is owned by Codan Development LLC and offered jointly with URS Corporation who provide process design, detailed engineering, procurement, and installation, startup, and operations support. The sodium-based reagent (sodium bisulfite, sodium sulfite, or sodium carbonate) is either received as a dry powder which is then batch mixed, or as a concentrated chemical solution. After dilution, the reagent is injected into the flue gas stream through atomizing nozzles. The resulting liquid droplets evaporate producing a very small reactive solid particle, which reacts with the flue gas SO_3 to produce primarily sodium sulfate. Subsequently, the dried reaction product is collected in the downstream particulate collection device along with the fly ash.

The SBS Injection process has been applied commercially to 13 generating units at six different power plants, representing over 8500 MW of capacity. Installations are located in Pennsylvania, Alabama, and Indiana. Design SO_3 levels range from approximately 40 to 110 ppm. Injection occurs upstream of the air preheater at half the installations, and downstream at the other half. A variety of reagents are used including sodium carbonate, which is the most cost effective. Some installations operate only during the ozone season, while others operate year-round. The first system was installed in March 2003 and now has more than three years of continuous operation.

The most recent installation has been at the Duke Energy Gibson Generation Station. The process was installed on all five 650 MW boiler units at the station, which are all equipped with SCR. The reagent is injected downstream of the air heaters at Gibson because of geometry and residence time constraints in the ductwork between the SCR and air heaters. Performance test data has shown SO_3 removal levels of 95-99% with inlet SO_3 levels as high as 70 ppm. Testing conducted with both sodium carbonate and sodium bisulfite reagent has shown no difference in SO_3 removal performance between the reagents. Finally, with SBS Injection, the visible sulfuric acid plume opacity has been completely eliminated, essentially yielding a "clear stack". Other installations have also reported similar reductions in SO_3 levels and elimination of the visible sulfuric acid "blue" plume.

Some balance of plant impacts have been experienced with the SBS Injection process. For the earlier installations, deposition resulted primarily from poor atomization of the injected liquid, or buildup of solids on the injection lances themselves. Poor atomization was linked to plugging and leaking of injection nozzles, as well as a reduction or loss of atomization air flow to the nozzles. These problems have been remedied in subsequent installations and deposition due to poor atomization has rarely been experienced since. Ductwork deposition due to buildup on the injection lances has also been experienced, and has been more problematic for applications downstream of the air heater, due to condensation of sulfuric acid and accumulation of ash on the lances. Several improvements have been made to the injection lance to reduce this and other

mechanisms that can lead to solids deposition. These improvements have been implemented in part or whole on all of the "downstream" applications. When combined with regular process monitoring, lance inspections, and maintenance, the systems have operated reliably with virtually no ductwork deposition.

The SBS Injection technology offers an efficient and cost-effective approach for SO_3 control. The economics of the process have been determined for a typical Midwestern power plant (500 MW) burning a high sulfur coal (3.0% S) operating with SCR and SBS Injection year round (85% annual capacity factor) with a total SO_2 to SO_3 conversion of 2.0%. Operating costs are based on a sodium carbonate reagent cost of $200/ton, aux power cost of $25/MW-hr, and annual technology license fee of $200/MW. Based on the above, the estimated total annual operating cost is $870,000 with the reagent representing over $600,000 of the cost. This corresponds to a removal cost of approximately $400/ton of SO_3 removed, but can vary from $350-500/ton of SO_3 removed, depending on plant specific factors. Total installed capital costs for the technology have generally ranged from $5-10/kW depending on the size of the plant and the number of units, with actual costs ranging from $2 to $18 million.