Sourcing Sulfur

Gary Siegel, Beltran Technologies Inc., USA, examines the effectiveness of modern wet electrostatic precipitator technology.

Sulfuric acid is a major industrial chemical used to produce end products, such as fibers, chemical compounds, paints, detergents, and dyes. The most abundant amount of sulfuric acid production is purchased to manufacture phosphate fertilizers, calcium dihydrogen phosphate, and ammonium sulfate for fertilizer manufacturing.

Today, a large amount of the valuable sulfuric acid supply (approximately 70%) is derived from the metallurgical industry as a byproduct from the roasting, smelting, and refining of nonferrous metals. Other sources of sulfuric acid production come from natural gas processing, electric power generation, and spent acid regeneration. These industries are usually heavy emitters of particulates, sulfur and nitrogen oxide gasses, sulfuric acid mists, and other pollutants. They are also under the watchful eye of environmental agencies worldwide with strict regulations.

Case study: Mopani Copper

Mopani Copper Mines Plc, a unit of Switzerland-based Glencore Xstrata, operates sulfuric acid production facilities at its copper smelter plants in Mufulira and Kitwe in Zambia. The sulfuric acid plants currently have nine wet electrostatic precipitators (WESPs), designed and engineered by Beltran Technologies, for sulfuric acid gas cleaning.

When concentrations of sulfur dioxide from mining operations exceed 5 – 7% of exhaust-gas volumes, a common and cost-effective solution is the incorporation of a downstream sulfuric acid manufacturing plant. Mopani is able to

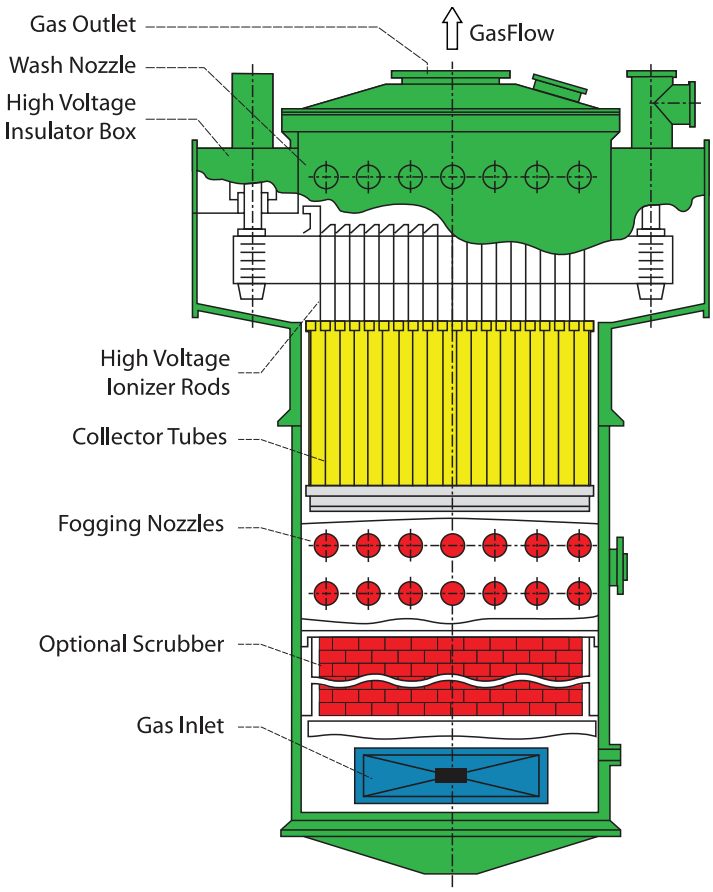

Figure 1. A wet electrostatic tubular precipitator.

capitalise on the high industrial market value of purified sulfuric acid, while achieving greater operating efficiencies and easier regulatory compliance.

An efficient sulfuric acid manufacturing process requires the maximum possible removal from input gas streams of fine particulates, acid mists, condensable organic compounds, and other contaminants. This high level of gas-cleaning efficiency is necessary to prevent poisoning of the catalysts and fouling or plugging of the catalyst beds. An optically pure input gas is essential for avoiding the formation of a 'black' or contaminated acid end-product.

The engineers at the Mopani Copper have operational goals consistent with all WESP installations. These include the following:

- Achieving a high level of efficiency in removing particle and submicron particulate.
- Cleaning high volumes of source gasses with fast throughput speeds.
- A large reduction of cost relative to the investment in capital equipment systems, including operating costs, energy consumption, maintenance, and long-term equipment replacement.

Wet electrostatic tubular precipitators

Beltran Technologies Inc. has developed a wet electrostatic tubular precipitator as a result of considerable research and development. The typical Beltran WESP is a vertical-flow hexagonal or square tube-type precipitator.

The flue gases typically enter at the bottom of the system and flow upward through the precipitator. There are generally two types of spray headers: fogging and washing. The first set continually sprays fine droplets into the flue gases, if necessary. The second set are wash spray headers; they are at the top and directly below the collector that washes the collector and electrodes. These are operated on a periodic, as needed basis.

The WESP consists of a series of ionising sections and a collection section. The discharge electrode is in the form of a rod or tube with a number of sharp corona generating discharge points. Various collecting tube geometries have been used over the years, the most common shape being round. The square configuration and/or the hexagonal shape is chosen because these geometries are more space efficient than the round shape and produce a greater collection efficiency in a given volume.

The Beltran WESP uses solid ionising rods instead of wires. Also, the electrode design allows for the generation of a corona field four to five times more intense than standard wet or dry ESPs. This higher current and field strength results in higher particle migration velocities that translate into a higher efficiency or a reduced collector area.

Solid particulate matter and mist droplets that enter the electrostatic section are charged by the high voltage and current produced by the electrode and collected on the grounded plates. Most of the particulates are flushed down into the bottom of the housing.

The high-voltage insulators are kept clean continuously using a purge-air system. These features result in very low maintenance. Internal scrubbers to remove acid gases can be installed in the lower part of the housing for tail gas cleaning. In some installation, WESPs have been mounted on top of existing scrubbers as a polishing device.

Since fine particles do not have a significant mass, they generally go through scrubbers or other low-pressure drop devices, with minimal collection. Also, high pressure drop is associated with venturi scrubbers. The Beltran WESP has less than a 1 in. water column drop and is low in maintenance.

The WESP provides low-energy collection of submicron particles regardless of the physical or chemical nature of the collected material. Due to the high dust and acid removal requirements that are necessary, the wet electrostatic precipitators operate at collection efficiencies of 99.7% –199.9%, depending on process requirements.

The corrosive nature of the flue gases demands that special attention be given to the materials of construction. Therefore, the Beltran WESPs are fabricated using fire-retardant fibreglass reinforced plastic (FRP) or high nickel-chromium molybdenum alloys. While many electrostatic precipitators used for acid mist applications have been constructed from lead, fire retardant composite precipitators are less expensive, easier to construct and to maintain, and are extremely corrosion resistant. The electrically conductive sections of the precipitator are made from special conductive graphite composites. Beltran also supplies WESPs made of high nickel-chromium molybdenum alloys. Its compact design enables great reduction in cost over conventional WESP designs made from metal. WF