Wet electrostatic precipitators: the proven technology for sulfuric acid gas cleaning

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Fifty years ago the engineering team at Beltran Technologies set out to design advanced dry and wet electrostatic precipitators. These systems produced excellent emission control results in plant operations of textile wet finishing, pulp and paper, electronics, metallurgical mining, and more.

Since the wet electrostatic precipitator (WESP) achieved emission control of gas streams by removing up to 99.9% of the submicron particulate matter, it was evident the WESP system would be a perfect solution for sulfuric acid gas cleaning.

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 optimum pure input gas is essential for avoiding the formation of a “black” or contaminated acid end-product.

Most electrostatic precipitators are designed with the same common principal, yet there are differences in the engineering. The most efficient design when considering compactness, economic design, and collection efficiency is the square tube collector configuration. The square tube collector completely utilizes the cross-section of a square or rectangular vessel, and can be effectively used in both round and hexagonal vessels. Due to the square tube’s high utilization of the vessel cross-section, it can be operated at a lower velocity, so that the required tube length is shorter, making it more efficient and easier to wash, since the wash sprays penetrate the collector. Further, the high voltage frame is more rigid, does not swing, and stays more accurately aligned, resulting in more efficient and reliable performance. Because of the shorter tube length, lower stabilizing insulators are not required, and the insulators can be mounted on the clean gas side of the WESP, reducing the requirement for heated purge air and more reliable WESP operation.

Beltran WESPs are designed with multi-pointed star discharge electrodes that charge and repel some of the submicron particles, which enables the next star to increase its corona power, and so forth as the phenomenon repeats almost 100 times as the gases flow up the tube. This type of electrode can produce considerable efficiency in single or multiple pass WESPs, usually utilized in acid plants. The system is designed using a vertical flow upward through the precipitator with continuous aqueous flushing. The system usually has two sets of spray headers. The first set continuously cools and saturates the flue gases. The second set, positioned at the top and directly below the collector, washes the collector and the electrodes, operating on a periodic and as-needed basis. The continuous flushing greatly minimizes the problem of re-entrainment of particles from the collection surfaces back into the gas streams that dry operating electrostatic precipitators experience due to the use of mechanical or acoustical rapping units. The Beltran WESP design eliminates the need for rappers.

WESPs can be utilized in various configurations, such as: a single WESP; two WESPs in series; two WESPs in parallel; and multi-WESPs in parallel and two in series. Smaller gas flows are usually treated with one WESP. This also depends on the efficiency requirements; however, one WESP unit can produce reliable service at 99.5% efficiency, for smaller flows. Typically plants have two WESPs in series, so that one WESP can be washed while one operates. Sometimes two WESPs are designed to be utilized in parallel, for similar purposes. Two in series has the advantage of the first WESP overcoming the current suppression condition, while the second WESP operates at full power. This will depend on the gas flow rate, inlet and outlet process conditions, amount of particulate, mist, and aerosol at inlet and outlet, etc. Larger plants will require more WESPs in parallel and usually two WESPs in series; so one WESP can be taken off line for washing or maintenance, or washed online.

The corrosive nature of the flue gases at most sulfuric acid plants requires that special attention be given to the materials used in constructing the precipitators. Beltran WESPs are fabricated using fiberglass reinforced plastic (FRP) and high nickel-chromium alloys. Although precipitators used in acid mist applications historically have been made with lead, engineers have found FRP components to be less expensive, easier to construct and maintain, and extremely corrosion resistant. The electrically conductive sections of the WESPs are made from a special, conductive FRP material. The high-voltage insulators are kept continuously clean using a purge-air system, further reducing maintenance costs.

Wet electrostatic precipitators are employed in various metallurgical processes such as zinc roasting plants, nickel flash smelters, lead sinter plants, copper flash smelters, as well as sulfuric acid regeneration plants. Beltran’s advanced WESP design is the most efficient, cost-effective acid mist and submicron particulate collector. Its collection mechanism is electrical charging as opposed to the inertia impact mechanism of scrubbers or other gas cleaning equipment.

Beltran Technologies has more than 1000 installations and more than 100 WESP installations operating in sulfuric acid plants worldwide. For more information, visit www.beltrantechnologies.com.