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Presentation by Marcos D. Riano

THE LATEST IMPROVEMENT IN SULFUR SPRAY NOZZLES

The contact sulfuric acid process which was developed in the late 1800's went through many years of change until a major design breakthrough was made. In 1927, Chemico introduced a pressure atomized sulfur burner gun to the industry. This innovation, which is now commonplace, greatly simplified the process. It eliminated the need for solid sulfur handling and the gas cleaning section which was required on earlier plants.

Since this major breakthrough, the flow diagram for a sulfur burning sulfuric acid plant today still bears a close resemblance to that of fifty years ago. Molten sulfur is burned in pre-dried air. The gas is cooled before going to the converter and the converted SO_2 gas is absorbed in a packed tower.[1]

For the past 30 years I have been associated with the phosphate industry where I operated various plants, with a particular emphasis on sulfuric and phosphoric acid plants - operation and maintenance. Over the years, I developed a special interest in sulfur and sulfur handling equipment in the sulfuric business. I found that the majority of the middle to large sized plants were frequently facing certain problems due to the lack of proper equipment to handle the sulfur in the furnace. So, I committed myself to design a better sulfur nozzle.

In my mind, some of the shortfalls of existing equipment were: plugging, that caused shutdowns and poor burner efficiency, which caused sulfur to pool in the furnace and consequently damage to the brickwork.

In the early months of 1977, I built a prototype nozzle which I tried with water in my backyard. Based on my practical experience, I could see a remarkable superiority in my new design, so I proceeded to apply for a patent on it which was granted in early 1979 (U.S. Pat. No. 4,154399). At that time, I was already working for Occidental Chemical Company at White Springs, Florida, in the sulfuric department, so I decided to approach my bosses with the idea of trying my new device - which today I call the "Super-Nozzle"$_{TM}$ - expecting that it was going to be successfull. Luckily, they believed me. The area manager became enthusiastic who in turn assigned the area's superintendent to the project.

In October, 1980, the newly designed nozzle was put into operation at Occidental's 2,000 T/D plants and since then it has been providing an excellent service, to the point that it is the only type of sulfur nozzle in use at our plants.

The following report is based on the operation of a newly designed style of sulfur burner gun nozzle, over a period of one and one half years. The data that was compiled on this nozzle design shows remarkable improvements over existing nozzles currently in operation in many sulfuric acid plants. I should point out that this particular information is not necessarily intended to be a selling presentation, but rather a brief description of a device that has not only eliminated expensive and frequent "shutdowns" of our sulfuric plants, but of a multimillion dollar chemical complex including Occidental's power generation plant.

The initial testing of the new nozzle indicated a 10 to 14% rate increase above the plant's design using the existing sulfur pump. In actual plant testing, three "Super-Nozzles"$_{TM}$ have outperformed five nozzles of another design used in most large sulfuric acid plants. The burner's efficiency was visibly superior over the existing burners. The furnace gases were clearer and there was no pooling of sulfur on the furnace bottom.

It is difficult to define which of the many advantages offered by this piece of equipment is the most important. But, undoubtedly its greater output represents one more significant advantage since plants designed to run with two or more guns can be run with fewer nozzles which makes it possible to utilize existing gun ports in the furnace for reduced sized nozzles. The combination of nozzle sizes allows for production rate adjustments to be made without the need of trottling a gun. Of course, throttling a pressure atomizer nozzle will adversely affect the device's performance.

This new "Super-Nozzle"$_{TM}$ has been performing very well since it was first put into operation and, during this period of time, there has not been any downtime due to nozzle plugging and it shows no sign of decreased efficiency. An inspection of the nozzle after eleven months in operation revealed no visible wear.

Design simplicity of this device, united with the high quality material of construction, provides a remarkable operating reliability which is not found in other nozzles currently in use. It is less prone to plug because, we believe, of the scrubbing action in the exiting liquid imparted by the swirl chamber. The device is installed in a manner to achieve the best possible protection from the steam chamber which does not exist with the majority of sulfur guns in use today. This undoubtedly contributes to its extremely long life and lack of plugging tendencies. It is my personal opinion that simplicity is a key priority in any kind of sulfur handling equipment design.

The greater output of this newly designed nozzle permits the use of fewer sulfur guns in operation while maintaining good atomization. The mentioned 10% increase in flow is because of a reduction in pressure drop across the nozzles for the same flow, and this pressure drop reduction means less discharge head is required at the sulfur feed pump. This feature alone amounts to $900/year in electrical power savings for a plant operating at 2,000 T/D, 360 days/year, based on electricity at $0.05/kWH. While power savings are important, in my opinion one of the biggest savings offered by this device is what I

call the "long term savings", the one which normally can be only confirmed once a year, i.e. during turnaround. The improved burner efficiency will result in longer life of the furnace brickwork and other downstream equipment.

In Occidental's case, the internal inspection of our plants during turnaround revealed no sulfur accumulation, other than slight slag in the furnace and no refractory damage either in the furnace or on the boiler. The boiler tubes were also found clean, so no cleaning was required. In other words, the above mentioned device gathers enough quality to meet the requirements in most adverse operating circumstances.

Finally, based on these advantages: 1) simple design which makes it reliable, 2) improved efficiency which extends the furnace's life, and 3) increased output which among other benefits allows operation flexibility, I do believe this new design in sulfur spraying equipment can be classified as a "Super-Nozzle"$_{TM}$.

Now I want to thank Occidental's management for allowing me the opportunity to pass this information on to other sulfuric acid producers. Thank you, too, for your attention.

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1. J. B. Rinckhoff and L. J. Friedman, Development of the Sulfuric Acid Contact Process, 1979 paper presented at AIChE National Meeting, Philadelphia, PA.

TM The "Super-Nozzle", a trademark of Marcos D. Riano (U.S. Pat. No. 4,154399)