COVERING MAINTENANCE SOLUTIONS FOR THE INDUSTRY

# Sulfuric Acid TODAY

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Fall/Winter 2013

## Synergy is the key for Cornerstone Chemical Company PAGE 7

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# Sulfuric Acid TODAY

Vol. 19 No. 2 Covering Maintenance Solutions for the Industry Fall/Winter 2013


## FROM THE PUBLISHER

Dear Friends,

Welcome to the Fall/Winter 2013 issue of *Sulfuric Acid Today* magazine. We have dedicated ourselves to covering the latest products and technology for those in the industry, and hope you find this issue both helpful and informative.

As we all know, some things were just meant to go together: pen and paper, phosphate and fertilizer, planning and execution, methyl methacrylate and sulfuric acid. Cornerstone Chemical, featured on our cover story this month, sees made-for-each-other pairings as a perfect way to grow their business. The synergy between their product lines has helped reduce costs while increasing productivity and streamlining their production cycle. Read all about the facility's spent acid regeneration plant, recent turnaround and future ammonia plant starting on page 7.

Another perfect pairing? *Sulfuric Acid Today* and Australia! We hope you'll be able to join us for our 2014 Australasia Sulfuric Acid Workshop, which will take place March 24-27, 2014, in Adelaide, SA, Australia. We will have Co-Sponsor displays and presentations, as well as panel discussions selected by the registered plant participants. The workshop will also include hospitality events to encourage networking and the casual sharing of ideas between peers that makes such a difference in an industry like ours. Look for further details on our event's website www.acidworkshop.com.

We hope that this issue of *Sulfuric Acid Today* will provide you with some innovative technologies or assistance with your profession. In this issue are several articles regarding the latest technology available to the sulfuric acid industry. Be sure to read such articles as "Global sulfuric acid market–length continues as year-end nears" (page 12), "Reducing acid mist emission in an acid plant during cold start-up" (page 14), "The importance of pump maintenance" (page 16), "Advancements in sulfur spraying: new hybrid gun and predictive modeling" (page 18), "Innovative wet electrostatic precipitators assure competitive edge in acid marketplace" (page 22), "Be smart, don't get s'MACT'ed" (page 26), and "Simple solutions for high ash content levels" (page 28).

I would like to welcome our new and returning *Sulfuric Acid Today* advertisers, including Acid Piping Technology Inc., Beltran Technologies, Central Maintenance & Welding, Chemetics Inc., Corrosion Services, El Dorado Metals Inc., FLEXIM, Haldor Topsøe A/S, Integrated Turbomachinery Inc., Kimre, Koch Knight LLC, MECS Inc., NORAM Engineering & Constructors, Outotec, Southwest Refractory of Texas, Spraying Systems Co., The Roberts Company, Tenova Minerals, Thorpe Engineering and Construction Group, VIP International and Weir Minerals Lewis Pumps.

We are currently compiling information for our Spring/Summer 2014 issue. If you have any suggestions for articles or other information you would like included, please feel free to contact me via e-mail at kathy@h2so4today.com

I look forward to hearing from you.

Sincerely,
Kathy Hayward

## ON THE COVER



## DEPARTMENTS




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# Mosaic, Ma'aden agree to phosphate facility joint venture

PLYMOUTH, Minn. — The Mosaic Company recently announced that it has entered into a Shareholders' Agreement with Ma'aden and the Saudi Basic Industries Corporation (SABIC) to participate in integrated phosphate production facilities in the Kingdom of Saudi Arabia. The companies have been working toward the agreement since a Heads of Agreement was signed in March. Ma'aden, Mosaic and SABIC will own 60, 25 and 15 percent of the joint venture, respectively.

The approximately $7 billion greenfield project, to be known as the Wa'ad Al Shammal, or Northern Promise, Phosphate Project, will be built in the northern region of Saudi Arabia at Wa'ad Al Shammal Minerals Industrial City, and will include further expansion of processing plants in Ras Al Khair Minerals Industrial City, which is located on the east coast of Saudi Arabia. The joint venture will develop a mine and chemical complexes that will produce phosphate fertilizers, animal feed, food grade purified phosphoric acid and sodium tripolyphosphate for sale to customers worldwide. The highly cost-efficient facilities are expected to have a production capacity of approximately 3.5 million tonnes of finished product per year. Of that, Mosaic estimates production of 2.3 million tonnes/year of DAP/MAP, 0.7 million tonnes/year of NPKs, 0.25 million tonnes/year of animal feed, 0.088 million tonnes/year of STPP and 0.082 million tonnes/year of purified phosphoric acid. Markets will be geared to the Middle East, Asia and Africa. Operations at the new facility should commence in late 2016.

Ma'aden will serve as the operating partner, but the joint venture will have a fully functioning, independent management team and Board of Directors. Mosaic will provide employees in several critical operational roles, including the VP of Operations.

The project will create 1,700 permanent jobs with 60-85 percent of those openings filled by Saudi citizens, in accordance with Ma'aden's operating philosophy of "community localization."

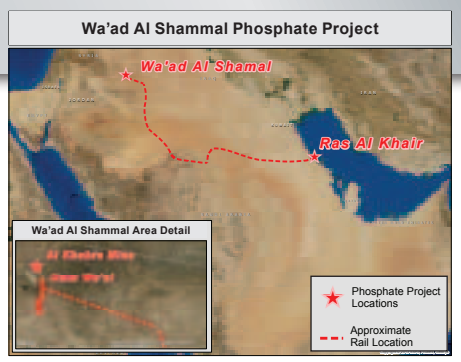
"We are pleased with the progress on our joint venture with Ma'aden and SABIC," said Mosaic President and Chief Executive Officer Jim Prokopanko. "This cost-effective project will allow Mosaic to extend our ability to serve key growing agricultural markets. Our growing global reach further enables us to fulfill Mosaic's mission, to help the world grow the food it needs, while delivering compelling shareholder value."

Under the terms of the agreement, Mosaic would contribute expertise to the design, construction and operations of the new facilities and acquire a 25 percent ownership stake. In connection with its equity share, Mosaic would market approximately 25 percent of the production of the joint venture, which should increase the company's global market share by 2-3 percent. Subject to final financing terms, Mosaic's cash investment would be up to $1 billion, funded over a four-year period beginning in 2013.

The facility will incorporate the latest technology and best practices from Mosaic and others in production, energy and sustainability, including state-of-the-art spill capture, containment and re-use, along with state-of-the-art water re-use and gypsum disposal. Emissions at the zero discharge facility, with full FSA capture, will meet BACT standards in all production units.

Three 5,000 MTPD, state-of-the-art, sulfur burning, double absorption contact acid plants will be included in the facility, with an expected $H_2SO_4$ output of 5.05 million tonnes/year. An HRS is being considered, as well as other proprietary energy efficient technologies, including advanced designs for sulfur burners, absorbing tower and converters.

The Mosaic Company is the world's leading combined producer and marketer of concentrated phosphate and potash crop nutrients. Mosaic is a single source provider of phosphate and potash fertilizers and feed ingredients for the global agriculture industry.




**The phosphate project will be built in the northern region of Saudi Arabia at Wa'ad Al Shammal Minerals Industrial City, and will include further expansion of processing plants in Ras Al Khair Minerals Industrial City, which is located on the east coast of Saudi Arabia.**

Ma'aden is a leading mining and metals company in the Kingdom of Saudi Arabia, with a diverse portfolio of mineral assets at various stages of development including exploration, development and production. Ma'aden's objective is to become a world class diversified mining and minerals company, and to enhance overall value for its shareholders. Ma'aden's mission is to be a profitable, publicly owned, international mining company, while maintaining the utmost concern for human resources, health, safety, environmental and social issues.

*For more information on The Mosaic Company, please visit www.mosaicco.com. For more information on Ma'aden, please visit www.maaden.com.sa.* ❑

IN MEMORY OF ...

# Industry mourns loss of Haldor Topsøe

The industry suffered a great loss on May 19 when Dr. Haldor Topsøe, the founder of Haldor Topsøe A/S, died just 5 days before his 100th birthday.

Born on May 24, 1913, Haldor Frederik Axel Topsøe was the eldest son of Captain Flemming Topsøe and Hedvig Sofie. He grew up in Copenhagen during a time of social unrest, and his father's involvement in voluntary social work, covering vital services during general strikes, made a lifelong impression on him. Throughout his life he recognized the importance of overcoming the boundaries between social classes to enable people to work together. During the 1930s, Haldor Topsøe studied physics under eminent physicist Niels Bohr and chemical engineering at the Technical University of Denmark, where he developed his life-long passion for scientific research. He graduated in 1936 and married his long-time fiancée, Inger.

In 1940, shortly after the German occupation of Denmark, Topsøe decided to strike out on his own. In founding Haldor Topsøe A/S, his goal was to use his knowledge of chemical engineering to enable him to pursue his passion for establishing a scientific basis for making advances in industrial processes. He also recognized the importance of creating a "good place to work, and to have worked."

Topsøe hoped to use his company to bring the benefits of chemical engineering, particularly catalysis, to industries worldwide. He was able to attract talented, dedicated scientists and engineers; and the company's first products, using catalysis to speed up the production of sulfuric acid, came to market in 1944. In 1961, the company expanded to include its American subsidiary, Haldor Topsøe Inc. Today the company employs 2,500 people on four continents. Haldor Topsøe A/S catalysts are used in the production of 50 percent of the world's fertilizers, helping the agriculture industry meet the global demand for food. The company's catalysts, technologies and plant design lie at the heart of the efficient, sustainable production of plastics, fuels and fertilizers worldwide. From research into nano-technology, catalysts and catalytic processes, to the after-sales service of plants and refineries all over the world, Haldor Topsøe A/S integrates each component of production into an efficient industrial process that makes for a sustainable business.

**Dr. Haldor Topsøe**
**1913-2013**

Although Topsøe chose industry over academia, he was presented with honorary doctorates from Aarhus University, the Technical University of Denmark and Chalmers University in Sweden. His influence and unique results have been recognized worldwide with numerous awards and distinctions. These include the prestigious Hoover Medal in 1991 for his "technical abilities and entrepreneurship, and his involvement with leaders in Third World countries, which have significantly contributed to an increase in world food production through technology transfer." Topsøe was made a knight of the Grand Cross of the Dannebrog Order in 2008 for his outstanding contribution to business.

Not one for retirement, Topsøe remained actively involved in the daily operations of Haldor Topsøe A/S as Chairman of the Board until a few weeks before his death. He will be succeeded in that position by his son, Henrik Topsøe.

"On behalf of the entire Topsøe family," Henrik Topsøe said, "I express our deepest sorrow at the loss of our beloved father, grandfather and great-grandfather. We have lost the inspiring and loving head of our family—just as science and business have lost a brilliant leader, and the larger world has lost a great man. Due to his perseverance and dedication, and his technological and scientific contributions, my father improved the lives of millions. He has set standards within many fields, and he never stopped pushing the technological boundaries."

The family remains fully committed to maintaining ownership of the company, and to the continued support of the long-term growth strategy as well as the continued development of the company in the spirit of its founder. In Haldor Topsøe's own words: "The corporate world in itself means nothing unless it improves the lives of people and the conditions in poor countries." ❑

## FACT hoping to house sulfuric acid plant

KOCHI, India—Fertilizers and Chemicals Travancore (FACT) is planning to host a proposed common sulfuric acid plant for public sector fertilizer companies to source raw materials as a consortium.

Several Indian public sector undertakings have decided to band together to attain self-sufficiency in raw materials. As part of these efforts, there is a plan to set up a common sulfuric acid plant. The plant is part of FACT's Vision 2020 plans, unveiled early this year, which include investments of roughly $1 billion to achieve a total sales turnover of $1.13 billion and a profit of $48.5 million.

Members of the Ministry of Fertilizers, the Indian Fertilizer Association and heads of public sector fertilizer companies recently visited Russia to open talks on sourcing raw materials commonly. The talks ended on a positive note and miners were open to the idea of long-term contracts provided the fertilizer companies readied the logistics for transportation.

FACT is an enterprise of the government of India and has business interests in the manufacturing and marketing of fertilizers, caprolactam, engineering consultancy and fabrication of equipment. The company also has interests in petrochemicals, hydrometallurgy, chemicals and pharmaceuticals.

*For more information, please visit www.fact.co.in/default.aspx*

## Kennecott still recovering from landslide

SOUTH JORDAN, Utah—More than six months after a massive landslide, Rio Tinto Kennecott's Bingham Canyon Mine is trying to get back to full operations.

Four massive trucks have been returned to work after crews dug them out from underneath 165 million tons of debris. One was found resting on its rear tires—each 12 feet tall; others were found suspended in the dirt.

The company has retrieved 11 of the 13 trucks buried in the slide. The path of the slide stretches nearly three-quarters of a mile from a ridge line down to the bottom of the pit. The April slide may be the largest human-caused landslide in history. Kennecott officials had anticipated it and safely evacuated everyone from the mine, but the size of the slide exceeded predictions. Since then, Kennecott workers have been trying to get it back to full operation. The slide cut the company's production at the site by 50 percent.

Current projects include carving a road through the path of the slide to allow waste removal from the bottom of the pit. Once the waste is removed, extraction of copper, gold, silver and other ores from the area can continue.

After the slide, Kennecott laid off about 100 workers, while more than 100 others took early retirement incentives. The company is currently estimating that it will be back to pre-slide levels of production by the end of 2015.

As the second largest copper producer in the United States, Rio Tinto Kennecott comprises nearly 25 percent of U.S. copper production. Kennecott's Bingham Canyon Mine is one of the top producing copper mines in the world, with average production at more than 19 million tons.

*For more information, please visit www.kennecott.com.*

## MBAC begins SSP production

TORONTO—Project developer MBAC Fertilizer Corp. said recently it had started single super phosphate (SSP) powder production at its Itafós Arraias project in Brazil, becoming the first large-scale fertilizer producer in the agricultural Cerrado area.

MBAC said it expected to be in a position to start delivering granulated SSP product to settle existing contracts later this month. The company would also continue to refine the processes to improve the efficiency of the operations and the product quality in the ordinary course of ramping up operations. The company planned for the project to reach its nominal production this fall.

The project had received the final operating license from the Tocantins State Environmental Agency at the end of June. The operation was expected to include significant benefits for local farmers by supplying quality fertilizer with reduced logistics costs, as well as benefits to the community it serves through additional jobs, social programs and infrastructure.

MBAC expected to sell between 175,000 tonnes and 225,000 tonnes of SSP this year at $280 per tonne. The company expected to reach full capacity at Itafós in 2014, producing 330,000 tonnes of phosphate rock concentrate grading 28 percent phosphate, which would be mixed with sulfuric acid and reprocessed to produce 500,000 tonnes per year of SSP.

*For more information, please visit www.mbacfert.com.* ❑

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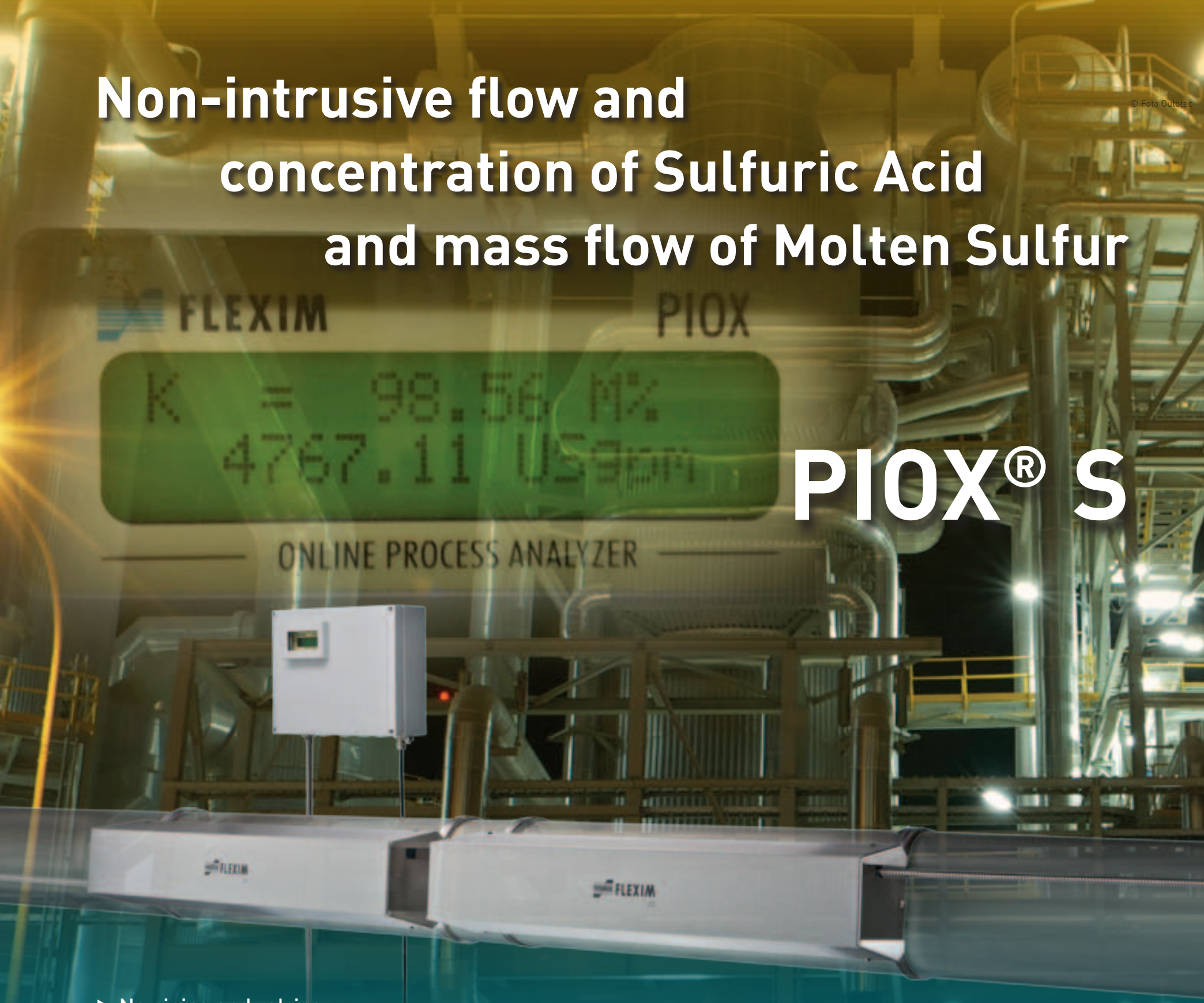


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Cornerstone's Fortier complex lies along the Mississippi River in Waggaman, La..

# SYNERGY

## IS THE KEY FOR CORNERSTONE CHEMICAL COMPANY

By: April Kabbash

For some companies, it's all about the relationships. Figuring out how products, co-products and recoverable spent products can fit together in the most efficient way. Understanding which processes can be tweaked to better fit within the overall vision for a plant. Cooperating with other organizations to ensure mutually beneficial results. It takes hard work, dedication and initiative—three qualities that the staff at Cornerstone Chemical's Waggaman, La., facility has shown, time and again, since the opening of the facility 60 years ago.

American Cyanamid began development of the site, located on the Mississippi River, in 1953. The property was originally a sugar cane and rice plantation owned by Eugene Fortier in the late 1770s, and became known as the Fortier facility. Not far from the site, a large gas field was discovered and several chemical companies moved into the area. The original complex at Fortier produced ammonia, acetylene, hydrogen cyanide, sulfuric acid, acrylonitrile and ammonium sulfate. Today, the company produces urea, melamine, acrylonitrile, hydrogen cyanide, sulfuric acid and oleum. Tennant companies also produce methyl methacrylate and acrylamide.

In 1957, the first sulfuric acid plant expansion at Fortier took place. This original acid plant was shut down in 1971, to be replaced in 1978. The replacement plant had a capacity of 1,600 tons per day, using a double absorption process pioneered by American Cyanamid. Then in 1993, the company completed a spin-off of the chemicals businesses that later became known as Cytec Industries Inc. The sulfuric acid plant was converted to a sulfuric acid regeneration (SAR) unit, allowing the site to recover spent acid from the methyl methacrylate plant.

In 2011, HIG Capital, a private equity firm, acquired the Building Block Chemicals business — consisting of the Fortier complex — from Cytec Industries, to form Cornerstone Chemical Company.

### Products

Cornerstone currently produces a variety of products that improve our daily lives. Fortier is currently the only North American producer of melamine, used in hard plastics, laminated countertops and engineered wood flooring. It is also used to make a product that gives materials flame retardant properties; when used in the production of polyurethane foam, melamine makes that foam fire retardant. In plywood, the addition of melamine to the resin adhesives reduces formaldehyde emissions. The Fortier facility has an annual melamine capacity of 170 million pounds.

Another major building block of modern life, acrylonitrile, is produced at an annual capacity of 500 million pounds at Fortier. Acrylonitrile is used to manufacture hard plastics, synthetic fibers, synthetic rubbers and acrylamide. Cell phones, televisions, appliances and even Lego bricks, as they exist today, are possible because of acrylonitrile.

Pete Brown, Business Manager, Sulfuric Acid

Neal Roussel, process supervisor, right, is pictured in the sulfuric acid plant control room with Mark DiGeorge, operator.

Fortier's sulfuric acid team includes, from left, Ched Dantin, manager, manufacturing; Mike Hawco, operator; Joey Mezzic, manufacturing technician; and Rick Bywater, sulfuric acid manufacturing superintendent.

Acrylonitrile also makes clothing and fabrics more durable and hold color and shape longer.

Additionally, acrylonitrile is the major raw material used in acrylamide (AMD) production. The acrylamide business is owned by Kemira and operated by Cornerstone employees. Products made from acrylamide help to purify water, make arid lands more productive and give paper strength when wet. Acrylamide products are added to the soil by organic farmers in areas that have limited rainfall, helping to increase food production. In times of heavy rain, the acrylamide retains water and minerals, and in times of drought, the roots of plants are able to tap the retained moisture and minerals allowing them to survive. Products made from acrylamide are also used in enhanced oil recovery to help release trapped pockets of oil, thereby extending oil well life and increasing oil recovery, as well as the hydraulic fracturing of natural gas wells.

A co-product of acrylonitrile is hydrogen cyanide (HCN). The Fortier site currently has an HCN capacity of 90 million pounds. It is piped directly to the methyl methacrylate (MMA) unit, owned by Evonik. MMA is a strong, lightweight, clear plastic replacement for glass. Vehicles use less fuel and therefore produce less tailpipe emissions because automotive products made from MMA weigh less than glass and metal. The optical properties and strength of MMA made it the choice for the Aquarium of the Americas in New Orleans. Without MMA, the aquarium would not have its largest tanks or the walk-through tunnel so popular with visitors.

Sulfuric acid is used in one of the reaction steps during the manufacture of MMA, generating a spent acid by-product. In 1993, the company modified the original sulfur burning unit into a new acid regeneration plant to convert this spent acid back to a high quality product. Regeneration allows recovery of raw materials and is beneficial to the environment.

"The success of the whole Fortier site is based on the synergies between the different manufacturing units," Pete Brown, business manager, sulfuric acid, said. "The MMA unit is a very important customer of ours for the fresh acid we supply them and the spent acid we use. Our acid plant is much larger than just what MMA needs, with an annual capacity of 800,000 tons, so it's important that we maintain a broad customer base for the output of the plant as well. About one third of the sulfuric acid that we make is consumed on-site." Fortier's sulfuric acid production is primarily sold to a broad group of industries in the Gulf South region and transported via truck, rail, barge and some small vessels. Grades of sulfuric acid include 20-percent oleum, 98-percent, 96-percent and 93-percent.

During a recent turnaround, the plant's existing economizer was replaced with MECS-designed technology.

## Conversion to spent acid regeneration

The conversion of the existing sulfuric acid plant to a SAR unit was no small undertaking. A new front end combustion chamber and an MECS DynaWave® wet gas scrubber section were constructed. "At the time, it was one of the largest regen conversions around," said Rick Bywater, sulfuric acid manufacturing superintendent, "with a new nameplate of 1,840 tons per day from the original sulfur burning 1,600 tons per day." Over the past several years, it has become the plant's mission to regenerate all the spent acid available, so as the MMA process is expanded and debottlenecked, the regeneration process has to keep up with it. Today, the facility is at an instantaneous rate of 2,300 tons per day. Since the conversion, the company has implemented several new strategies to debottleneck.

"In 2007, we added oxygen enrichment and several other items engineered by MECS to allow us to burn more spent acid," Bywater said. "Oxygen enrichment is a wonderful thing. It allows you to up your rates without investing substantially larger capital for bigger equipment."

"Cornerstone is very committed to growing the business. They want us to debottleneck where we can, look at new projects and new opportunities," said Brown.

"This year's annual quality plans focused on: achieving excellence in SHE performance—the goal is zero injuries or environmental incidents, integrating cesium catalyst in the first and fourth pass of the converter and executing a $6.5 million turnaround in the spring," Ched Dantin, manager, manufacturing, said.

Fortier's acid plant has recently gone from an 18-month turnaround cycle to a two year cycle. "It's workable, but like a lot of plants, those last few months are worrisome," said Bywater. Turnarounds at the facility generally take three to four weeks. Cornerstone depends on several trusted companies to help make the process as smooth as possible. "During a turnaround we have VIP International vacuum and screen catalyst in the first pass and one other pass; we rotate the other three passes but we always do the first pass like most other plants do. And before the shutdown, we normally have MECS come in and do a PeGASyS test to sample the gas and this helps us decide whether we need to do any tube testing in the exchangers," as well any additional catalyst screening work that is necessary, said Bywater.

During last spring's turnaround, a catalyst upgrade was also completed, with a cap of cesium placed in both the first and fourth beds. This will help reduce $SO_2$ emissions, as well as enable operation without having to raise the temperature in the converter as high as before.

"We also replaced steam bundles in our boiler. The bundles in a water tube boiler in a regen plant, unfortunately, have a fairly short life. Over time we've learned 'where the cliff is' so that we don't have any in-run failures at inopportune times," said Bywater. "We, like many, see the greatest erosion/corrosion in the areas of the soot blower lances. You have to clean that build-up to get back your heat transfer and to also generate more steam. So it's sort of a dual-edge sword—blowing more often to maintain a higher heat transfer makes more steam, but shortens the lifespan of the tubes. Being on a two-year turnaround cycle, the best lifespan we can achieve is four years on the coolest (convection section) bundles. Our goal is to make enough improvement to make it six years."

The plant also had to address a common problem among acid plants: maldistribution of process gas. This led to thermal differences in the exchangers which caused different stresses and failures that were also accelerated by corrosion. "We've also had individual tube failures. Right now all is good,

however, this is something that's on our radar screen," said Bywater.

During the turnaround, pressure drops were also addressed. "We had some issues with our converter where we saw some high pressure drops across the passes. We identified a problem with infiltration in the drying tower duct outlet that allowed moisture to come into the process causing some caking downstream," Bywater said. Many duct sections were replaced, and more will be replaced during future shutdowns. The plant's economizer was also replaced with MECS-designed technology. The old economizer was designed for a 1,600 tons per day acid plant and Cornerstone was often running at higher rates, so this addressed a prominent bottleneck.

One aspect of the Cornerstone regeneration plant that sets it apart from others is the use of spinning cup atomizers instead of nozzles for feeding in the spent acid. It's a choice that has worked well in the long run. "Nozzle technology at that time in this country was very small, maybe 10 gallons per minute. We were looking to feed more like 100 gallons per minute and MMA had plans to expand, so it could be more like 150 gallons per minute down the road. There was also a concern about the solids/tar content in spent coming from the MMA plant, and having so many plugged nozzles would be a maintenance headache. So we went with the spinning cup atomizers because they could feed a lot more spent and there's virtually no chance of plugging. We tweaked them and now they are a very reliable piece of equipment," said Bywater.

"We are operating an aging facility with limited capital, so our technical and production teams have come up with innovative ways to stretch this capital to generate the greatest returns," said Dantin. "'Necessity is the mother of invention' has been our approach over these last couple of years with techniques deployed in the unit to continue to extend the service life of the vessels until the point of replacement."

## Innovative landfill gas project

Cornerstone's dedication to streamlining processes and reusing products that would otherwise go to waste has led to an interesting partnership with a local landfill. In 2006, the Fortier facility began participating in the Jefferson Parish Landfill gas project, which provides the spent acid regeneration plant with an alternative to highly-priced natural gas. The Jefferson Parish Landfill, just south of Fortier, wanted to market the naturally-occurring landfill gasses, and found a customer at Fortier. The partnership has been beneficial to both parties.

"The project drivers were energy cost reduction, overall reduction in $CO_2$ emissions and an environmentally beneficial project that was a win-win for all," said Bywater. Currently, by substituting landfill gas, Cornerstone uses about 1,000 MBtu per day less of natural gas, reduces overall $CO_2$ output by 61 short tons per day and has improved controls and operability of the SAR's air preheater, which the gas fuels.

## Adding ammonia

As part of their dedication to streamlining, Cornerstone is again looking toward the future. The company recently began a cooperative project with Dyno Nobel, a subsidiary of Incitec Pivot. In August, ground was broken on an 800,000 metric ton per year ammonia plant. The plant, expected to cost $850 million, is being built by Dyno Nobel at Cornerstone's Fortier complex. Dyno Nobel plans to begin ammonia production in mid- to late-2016. The project will create 65 new direct jobs, with 60 new personnel at Cornerstone and another five employed by Dyno Nobel. During the peak of construction, another 750 jobs will be created by the project.

The project is another example of Cornerstone's dedication to a synergistic approach to manufacturing.

New duct work was installed as part of Cornerstone's turnaround earlier this year.

Innovative technologies, including oxygen enrichment and the use of green technology landfill gas as a source of heat, help Cornerstone produce more while spending less.

The Fortier acid plant was converted to a spent acid regeneration plant in 1993.

Currently, the major raw materials used at the complex are carbon dioxide, propylene and ammonia. After completion of Dyno Nobel's plant, both ammonia and carbon dioxide, a co-product of ammonia production, will be pipelined within the facility.

"This site at Cornerstone Chemical met our needs for a number of reasons: a competitive gas price, a responsive government regulatory process, a brownfield site and a professional business environment, which when combined, makes for a compelling investment in Louisiana," said Paul Brasher, chairman of Incitec Pivot, Dyno Nobel's parent company. "This plant will be the benchmark, the standard to which others hold themselves. Waggaman [Fortier] will be the place where other companies come to learn how to operate one of the safest and most-efficient ammonia production plants in the world."

## Safety and community

"We believe an injury free workplace is possible and that safety is the responsibility of everyone in the business," said Dantin. To that end, Cornerstone created Cornerstone Employees Eliminating Exposures. Based on behavioral-based safety technology, the program looks at all facets of the job where exposures exist, including systems, work environment, facilities, equipment and workers. The goal of the process is to increase awareness and promote overall improvement in employee safety. "We believe that all injuries can be eliminated by recognizing that exposure exists, that we can learn from that exposure and take corrective, preventative measures to prevent our employees from getting hurt," said Dantin.

In addition to the company's focus on employee safety, Cornerstone places a premium on the safety and trust of the residents of the surrounding area. With more than 450 permanent employees, the Cornerstone Fortier facility is a significant employer in the area. More than 50 percent of the site's workforce lives within 10 miles of the facility. Each year, the facility generates a payroll of more than $47 million, which cascades through local purchases and investments across the region.

Corporate citizenship is a large part of the company's mission, with a focus on actively contributing to making communities better places to live and work. Cornerstone supports a variety of educational and mentoring programs, contributes time and money to local charities, sponsors community events and conducts outreach programs.

The company also created a community advisory board that meets on-site about six times per year with approximately 20 members of the community and surrounding areas. Members are encouraged to voice their needs, problems or suggestions, and company representatives do their best to address them. This responsiveness and sense of working together creates an atmosphere of trust. "Our new ammonia plant announcement occurred the same day as the ammonium nitrate incident at the West Texas fertilizer plant," said Dantin. "We were supported by the community advisory board members and there was a high level of comfort locating the plant here. The safety of our employees and our community is number one to us," said Dantin. "We want to be considered not just a good neighbor, but a great neighbor."

Throughout its history, Cornerstone has worked hard to build relationships, both with other organizations, and between its product lines. This focus on cooperation and teamwork has led to innovative solutions and unexpected opportunities, and is sure to bring continued success to the company in the future. ❑

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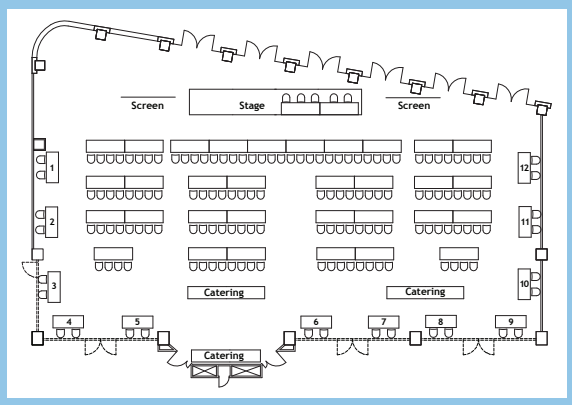


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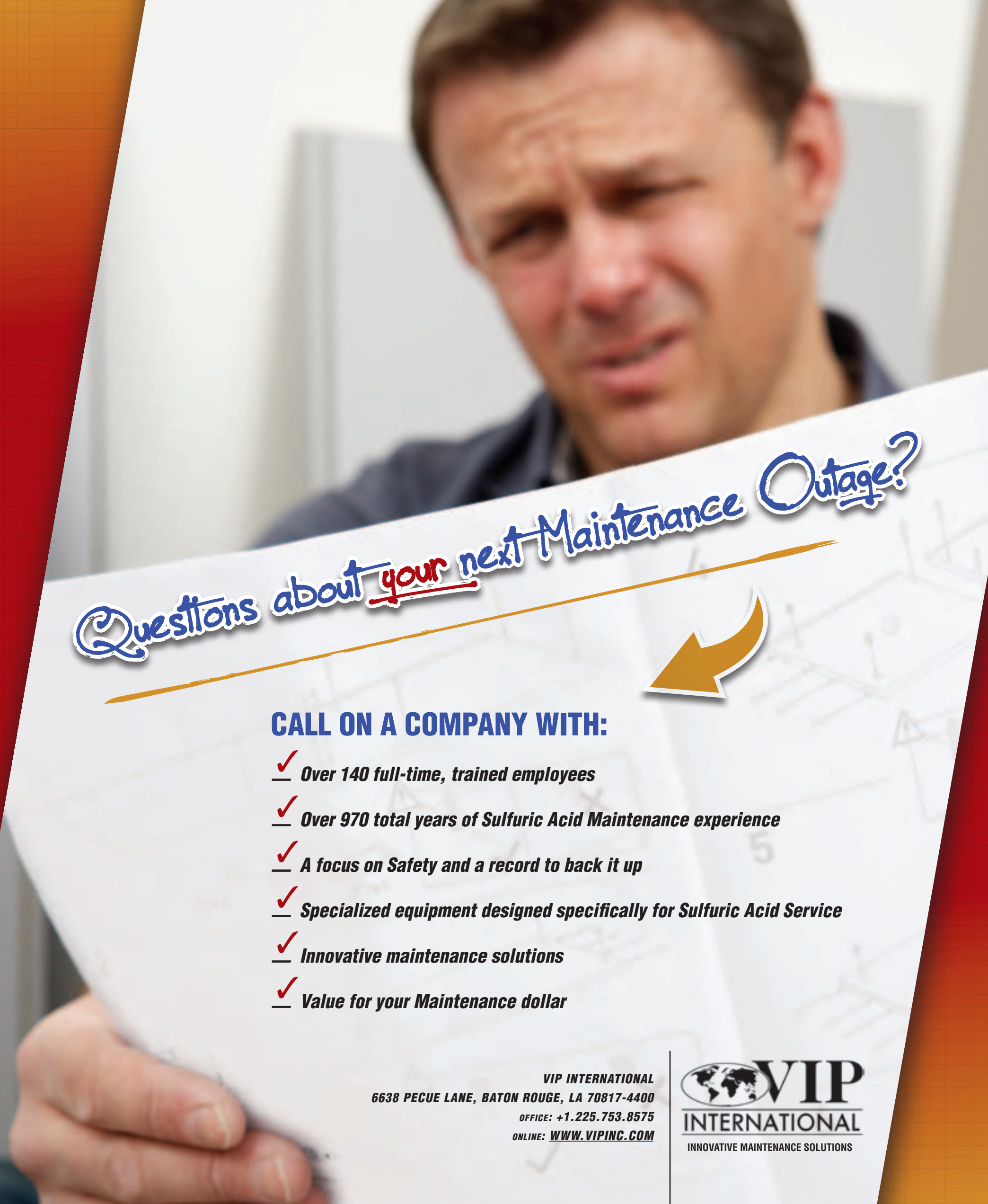


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# Global sulfuric acid market–length continues as year-end nears

By: Fiona Boyd, Argus Media and edited by Freda Gordon, Argus Media

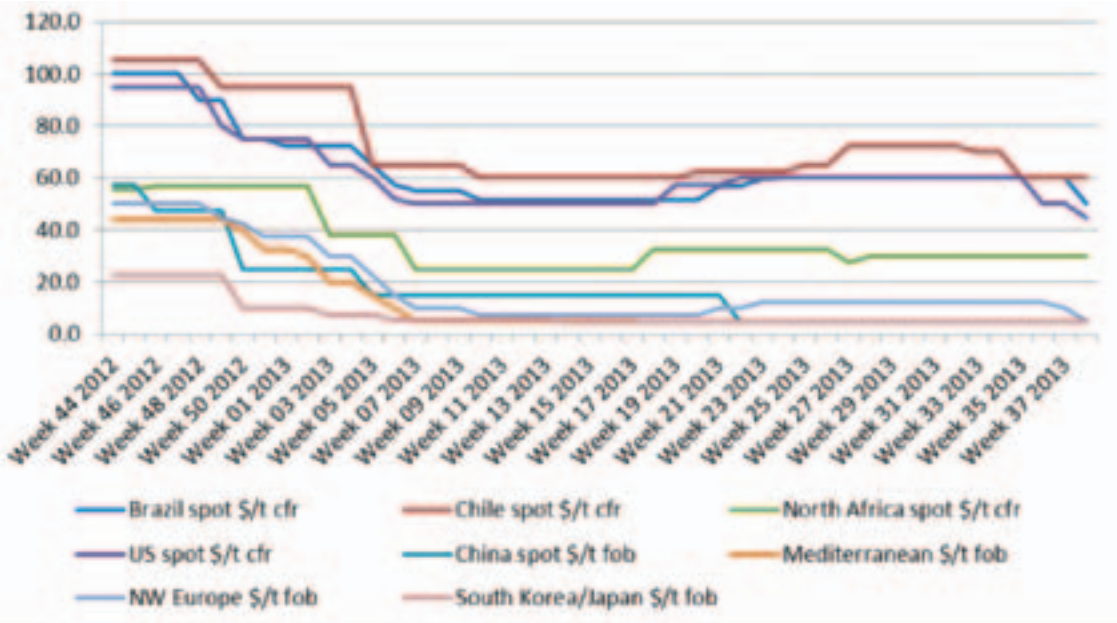
The key question in our last article in the Spring/Summer 2013 issue of *Sulfuric Acid Today* was when the sulfuric acid market would turn around after exhibiting length in the first quarter of the year. Since then, there was some stability as supply tightened on account of turnarounds, but as the end of the year approaches, excess supply is once again overhanging the market.

Supply continues to outstrip demand as base metals smelters have operated consistently because fundamentals for copper, nickel and zinc have supported production. Sulfuric acid produced as a by-product through the smelting of base metals is what drives global trade and sets prices. Since the acid is produced on an involuntary basis, it must be placed into the market to avoid containment issues that would affect core operations.

On the consumption side, industrial demand for sulfuric acid has been steady but not robust. But, a contributing factor to reduced acid consumption has been the weakness in the global phosphate fertilizer market. While most sulfuric acid used by phosphate fertilizer producers is produced internally through the burning of elemental sulfur, the industry still consumes a significant volume of incremental sulfuric acid tonnage. This plays a key role in balancing the globally traded sulfuric acid market.

Reduced demand for phosphate fertilizer products has continued throughout the year and producers in some regions of the world have curtailed production in response. This has resulted in reduced demand for spot sulfuric acid purchases to augment sulfur-based production to support phosphoric acid production.

While this is the same situation that plagued the market in the first quarter of this year, we expected demand for phosphate fertilizers to improve from April onwards after India's annual diammonium phosphate (DAP) import requirements were made clear. However, high stocks of finished DAP in the country reduced overall needs and the situation was exacerbated by the rapid devaluation of the nations' currency, the rupee. As an indication, Indian buyers agreed to initial contracts with suppliers, albeit on a smaller scale, in May in the $500-520/tonne (metric) cfr India range. As of press time, prices had dipped below $400/tonne cfr and India's buying on a hand-to-mouth basis continued. India's import requirements have therefore not supported global phosphate production or helped to absorb merchant sulfuric acid.




Because of these conditions, sulfur demand has declined as well with notable price decreases exhibited in July. In North America, the key Tampa sulfur benchmark was settled at $95/long ton (lt) delivered, a $60/lt drop from the second quarter price. As a result, sulfur-based sulfuric acid producers who supply the merchant market were able to reduce production costs and pass that on to buyers resulting in sulfur-based production being available at prices comparable to smelter acid available in the market from both offshore and domestic sources.

We noted in our last article that the differentiating factor between the sulfur and sulfuric acid markets was that sulfur supply has been tight since 2010. However, the forecast deficit for this year has been revised downwards because of reduced sulfur demand to support sulfur-based sulfuric acid production for fertilizer production.

It is important to note that sulfuric acid supply in the North American market became tighter following an April mine slide at Kennecott Utah Copper's operations in Utah. The slide meant reduced concentrate availability to feed the smelter and therefore sulfuric acid production was down from its normal output of 1 million ton/yr. In response, consumers of Kennecott's smelter acid purchased spot volume from domestic sources, which helped remove some length that was overhanging the market. However, after an initial interruption, sulfuric acid production at the smelter increased through smelting of stockpiled ore, freshly mined ore from an unaffected mine area and through the purchasing of third party concentrates. Since May, customers have reported receiving sulfuric acid at close to historical levels. As a result, some length from domestic supply sources began to re-emerge and offshore volume continued to be targeted at the U.S. because of poor demand in the global market.

Meanwhile, in Chile, it has become apparent that when the Noracid sulfur-based burner is operating consistently, as it has done this year, Chile's import requirements are not as great, particularly if operational issues at copper mines are preventing full consumption. In order to balance the market in the face of ample domestic and regional supply as well as imported contract volume, Chile exported material to the U.S., Brazil and Cuba. This also supports the expectation that Chile's sulfuric acid import requirements are peaking as it has added sulfur-based supply to secure consumption requirements with more projects in the pipeline.

Clearly Chile's spot purchase needs this year have been limited because of these conditions. During the first seven months of the year, Chile imported 1.6 million tons compared with close to 2 million tons in prior-year period. With reduced demand from Chile, available sulfuric acid on a global basis has been pointed to alternative markets, including the U.S.

As of press time, a European cargo was sold to the U.S. at $40/ton cfr, the lowest price since the first quarter. Additional cargoes for the balance of the year are on offer as well, indicating suppliers are anxious to place volume now as supply from Europe will increase during the fourth quarter when key smelter turnarounds are complete.

The accompanying price graph reflects average prices for key import and export markets on a weekly basis from November through mid-September and illustrates the decline in prices in line with demand and excess supply.

We expect downward pressure to continue for the balance of the year and through the first quarter of next year primarily because we do not expect a recovery in global phosphate fertilizer prices until then. On a positive note, however, we expect stable industrial demand to support continued offtake although not enough to balance the market.

Looking long term, demand for phosphate fertilizers to serve a growing population with improving dietary needs will likely increase, requiring more sulfuric acid to support production. Industrial demand should increase in line with global growth. At the same time, sulfur production is expected to increase as well while large scale projects related to oil refining and natural gas processing come on stream globally. Sulfuric acid production from base metals smelting will also increase, driven in part by legislation that reduces sulfur dioxide emissions from smelters.

In response, we expect sulfur prices to not rebound to levels seen in the second quarter because of increased supply capacity that will outstrip any growth in demand. Acid prices will be under downward pressure in response as it is used as a feedstock to produce sulfuric acid. Therefore increases or decreases in sulfur prices impact sulfuric acid as some sulfur-based producers sell acid into the merchant market using a sulfur price index.

*Argus Media publishes weekly global reports on sulfur and sulfuric acid as well as reports on fertilizer-related products including nitrogen, ammonia, potash and phosphate. In addition, a North American-focused sulfur and sulfuric acid publication that includes in-depth analysis of the domestic market was launched in September 2013. For more information on Argus and its portfolio of fertilizer publications, please visit www.argusmedia.com/fertilizer.* ❑

# Reducing acid mist emission in an acid plant during cold start-up

By: Dr. Alfred Guenkel, Process Engineer, NORAM Engineering and Constructors Ltd.

This article describes the successful installation of an acid warm-up heater in an acid plant to reduce cold start-up acid mist emissions. This improvement can, in principle, be made to any sulfur burning acid plant.

Problem Definition: When an acid plant is first brought on line by firing sulfur, a mist plume is often seen lasting for about a half hour, after which the stack normally clears up. Aware of these phenomena, operators often delay firing sulfur when the wind is too weak to prevent exposing personnel to stack down-drafts. Operators generally prefer to bring the plant on line when there is a steady wind blowing in the "right" direction, so that mist can be safely dispersed.

Prior to start-up on sulfur, the gas side of the plant will have been heated to the required start-up temperatures following normal industry practice, but the acid inventory including the towers and packing will be cold. From an energy balance standpoint, it can be shown that for a cold start-up the final acid tower will take about 30 minutes to reach its normal operating temperature by absorbing energy from the hot gas coming from the last catalyst bed. This coincidental timing is strong evidence to suggest that it is the low acid temperature that is responsible for the start-up plume.

The Cause: The start-up plume is caused by gas entering the acid tower and contacting cold acid at about 25 degrees C. Under normal operation the temperature will be about 110 degrees C and no mist is generated. Cold acid will not absorb $SO_3$ with the same efficiency as hot acid.

During normal steady operation, the hot $SO_3$ gas first comes into contact with the hot acid raining down from the packing at the bottom of the absorption tower. Here $SO_3$ diffuses through the gas side boundary layer surrounding the acid drops and transfers into the acid side boundary layer to react with $H_2O$ to form $H_2SO_4$. In this gas boundary layer, $SO_3$ will encounter $H_2O$ vapor, which will be present due to the partial pressure of $H_2O$ over the acid. The gas phase reaction between $SO_3$ and $H_2O$ will cause some gas phase condensation giving rise to fine mist formation. In this context, it is noted that in acid plants, where the absorption towers run hot to allow recovery of energy, it is the high partial pressure of $H_2O$ that generates significant mist formation. Once $SO_3$ has transferred to the acid side boundary layer, it has to find the $H_2O$ to form $H_2SO_4$. The rate controlling step is counter-diffusion of $H_2O$ from the bulk acid phase. In a typical acid plant, the molar ratio of $H_2O$ to $SO_3$ passing countercurrently through an interpass tower is about 2.2/1, and the acid to gas mass flow ratio is about 8/1. As long as the diffusion rate of $SO_3$ through the acid phase is less than the counter-diffusion rate of $H_2O$ in the acid phase, there will be no build-up of $SO_3$ at the interface.

In a cold start-up situation, where the hot $SO_3$ gas encounters cold acid, the diffusion rate on the gas side is largely unaffected. The partial pressure of $H_2O$ will be at least 3 orders of magnitude smaller so that the gas phase reaction between $SO_3$ and $H_2O$ will become negligible. However, the diffusion rate of $H_2O$ on the acid side will slow down by almost an order of magnitude. Theory predicts that in general, the liquid diffusivity varies as the reciprocal of the viscosity. The viscosity of 99 percent $H_2SO_4$ at 25 degrees C is about 21 cP, while at 110 degrees C it is 3 cP. The diffusion rate of $H_2O$ in cold acid will be slower than in the hot acid by a factor of 7. The result is that $SO_3$ can accumulate at the interface in a layer, which will then essentially be oleum. The acid temperature at the interface will increase somewhat due to the reaction between $SO_3$ and $H_2O$, but this temperature rise will be limited because the interface will be quickly starved of $H_2O$. This will limit the reaction heat released locally from the conversion to $H_2SO_4$. The thermal inertia of the acid far exceeds that of the gas so that the acid temperature controls the temperature in the boundary layer. In effect, the interface will consist of cool oleum, which is a recipe for mist formation. Once oleum mist is formed, it will remain dispersed in the gas phase. It will not be absorbed in the packing, but will partially be captured in the candles.

It is thought that, during the first few minutes of a cold start-up on sulfur with the plant running at low rate, as much as 10 percent of the $SO_3$ in the gas may end up as oleum mist in the stack.

The Solution: The strategy for reducing the start-up plume is simple: Heat the acid, including the tower and packing, prior to burning sulfur.

Acid warm-up heater in fabrication shop.

Execution: NORAM implemented the acid warm-up concept in a 3/1 double absorption plant that has a dedicated pump tank and acid cooler for the final tower and a common acid pump tank and cooler for the drying and interpass coolers. The blower is a pusher with respect to the dry tower. Both acid coolers have isolation valves on the acid side and acid by-passes for acid temperature control.

Two acid "warm-up" heaters were designed and supplied by NORAM to take fairly small slip-streams in parallel to the cooler by-pass pipes. These small "warm-up" heaters were heated with low pressure steam. They were sized on the basis that the time available for warming up the towers was 10 hours so that they would be put in service only during the very last stage of the gas side warm-up cycle. The duty was obtained from an energy balance taking into account the weight and specific heats of the acid towers, packing, piping, pump tanks, acid inventory, as well as the convective heat losses. The duty due to the acid energy take-up was only about 25 percent of the total duty. In the case of the drying tower, heat losses due to cold air passing through the tower were also taken into account. During warm-up, acid flow through the acid coolers is blocked by closing the isolation valves. The cooler by-pass valves are fully open. During normal operation a small flow of acid is allowed to pass through the warm-up heaters to protect against freezing in winter, while the steam side is isolated after warm-up is completed.

Results: The plant reported that, on start-up, only a "whiff" of a plume was seen for about a minute after which the stack stayed clear. The designed warm-up time was achieved and the plant eliminated the white plume that previously occurred during start-up.

*NORAM provides equipment and performs engineering studies for the sulfuric acid industry. For more information on acid warm-up heaters and other equipment, please contact Guy Cooper, Director Sulfuric Acid, NORAM Engineering and Constructors at gcooper@noram-eng.com or 604-696-6910.* ❑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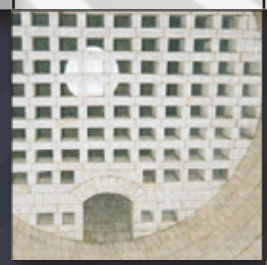

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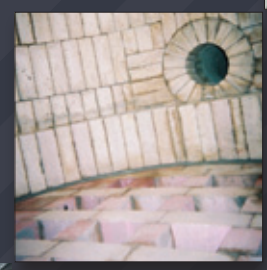

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# The importance of pump maintenance

By: David Hall, Product Manager, Weir Minerals Lewis Pumps

Maintenance is one of the key components of any successful operation, whether it is a sulfuric acid plant, a manufacturing company or even your personal auto. In today's economic climate, with each of us asked to do more with fewer resources, a quality maintenance program has never been more important.

For our purposes, maintenance can be broken down into four basic categories: emergency, routine, preventative and predictive. Each of these serve a purpose and each take a different toll on our resources. Let's look at each category in a little more depth.

The first is emergency maintenance. This is the situation that occurs when you have a catastrophic failure of your equipment—for example, the shaft on your pump breaks or you have a tire blowout on the highway. This is the most costly of the four categories because you can't plan for it. When it happens you could face overtime labor charges, expedited parts charges and most importantly, costly unplanned downtime. In some cases, these failures can't be avoided, but the second maintenance category—routine maintenance—can eliminate some emergency situations.

In the routine maintenance program we set a maintenance schedule, usually based on past performance of the equipment. At predetermined intervals we remove the equipment from service, inspect it and repair as needed. A well-developed routine maintenance program can eliminate most of the emergency outages by ensuring that the equipment is always serviced and ready to perform as required. The downside to a routine maintenance program is that it can be a costly operation as you must have spare equipment, parts and labor to perform the on-going maintenance. To reduce the costs of a comprehensive routine maintenance program, many plants have started using the third type of program—preventative maintenance.

A preventative maintenance program is usually used in conjunction with routine maintenance. With a preventative program, maintenance managers track the time between failures and the wear rates of various parts. Then, at key points, they replace those parts before they would be anticipated to fail. For example, if the average bearing life is 10,000 hours, you might plan to service and replace the bearings every 9,500 hours. Preventative maintenance saves time and money by targeting repairs as they are needed, instead of replacing all the wear parts at the same time whether they meet the threshold for replacement or not.

The final program type is called predictive maintenance. Predictive maintenance is a hybrid of the programs because rather than simply tracking failures or scheduling routine repairs, you observe the performance of the equipment and determine if its performance has changed in a way that indicates an impending failure. We do this by looking at indicators such as bearing temperature, vibration, reduced pumping capacity or increased power consumption.

It is not enough to simply identify that a problem exists, repair it and place the equipment back into service. While many parts are designed to wear over a period of time, the premature or unusual wear of parts in our pumps requires further investigation to determine the causes and point to solutions that will allow for longer run times between repairs. Some of the issues that we face with pumps are cavitation damage, erosion, corrosion, foreign object damage, excessive bearing wear and seal failure. Let's look at some examples of these types of failures and damaged equipment issues.

Cavitation is the formation of vapor pockets or bubbles in the flow of the liquid being pumped. The problem with cavitation is that these "bubbles" implode or collapse when they contact the surface of the impeller and volute causing damage (see fig. 1). Cavitation causes a loss of performance and if left unresolved will eventually lead to failure of the impeller. Cavitation is a system-based issue; it occurs when the net positive suction head available (NPSHa) at the pump intake is less than the net positive suction head required (NPSHr) by the pump to perform as shown on the pump performance curve. Resolving the issue can be as simple as partially closing a valve in the discharge line, or it could point to a more complex, system-related issue. When you are dealing with cavitation damage it is important to evaluate what changed in your system, to gather data on the flow of the pump and the system head. Then you can compare this data to your design curve and make decisions about what changed and what changes need to be made to resolve the problem.

**Fig. 1: An impeller damaged from pump cavitation**

Erosion and corrosion have similar effects on a pump. Both result in material being removed from the parts of the equipment exposed to the fluid being pumped. Erosion occurs when tiny particles or solids are forced through the fluid stream and rub against the volute, the impeller and the discharge pipe. The result is wear of these surfaces—like taking sandpaper to a piece of wood. The most effective way to combat erosion is to use erosion-resistant materials in your equipment. Corrosion similarly removes material from the wetted parts of your pump. The difference between the two is that corrosion is happening all the time and to all parts exposed to the corrosive fluid. Similar to erosion, combating corrosion is tied to selecting the right materials for the fluid you are pumping. In sulfuric acid production, it is critical that you control the process and eliminate or minimize the formation of weak acid. Weak acid can corrode materials that are suitable for strong acid in a very short amount of time, causing premature failure of equipment and ultimately costly repairs and downtime (see fig. 2).

**Fig. 2: A badly corroded shaft**

Foreign object damage is another cause of critical failures in pumps. This type of damage is just as it sounds—a piece of debris or an object that should not be in the fluid you are pumping gets sucked into the suction side of the impeller, wedging itself between the impeller and the volute, causing damage to the pump. The best case is that the centrifugal force of the pump is able to break the object it sucked into the intake and you simply break a piece of your impeller. The worst case is that the object brings the pump to a quick and sudden stop resulting in a sheared impeller bolt, broken motor coupling or a broken shaft (see fig. 3). Installing a suction strainer will help prevent foreign objects from entering the pump; but more importantly, ensuring that the rest of the system is well maintained and free of debris will prevent this type of catastrophic failure.

**Fig. 3: A broken shaft, the result of debris inside the pump**

Finally, let's look at some of the more insidious failures such as bearing failures, seal failures and coupling failures. Often these failures result from one of two issues, the first being missed routine maintenance—in other words, failure to perform the manufacturer's recommend service such as greasing the bearings or coupling at regular intervals. This leads to excessive wear and ultimately premature failure. The second and more devious method of failure comes when another part of the pump is not functioning correctly and, in turn, causes these components to fail. Having a pump that is not set properly, a shaft that is not properly aligned, or attaching a discharge pipe that places a significant amount of pipe strain on the pump all can lead to a misaligned pump that vibrates. Over time this vibration will cause the running components of the pump to wear excessively, causing the vibrations to further intensify and premature failure to occur. When vibrations begin to develop, it is imperative that a full analysis of the equipment is performed so the underlying issue is resolved.

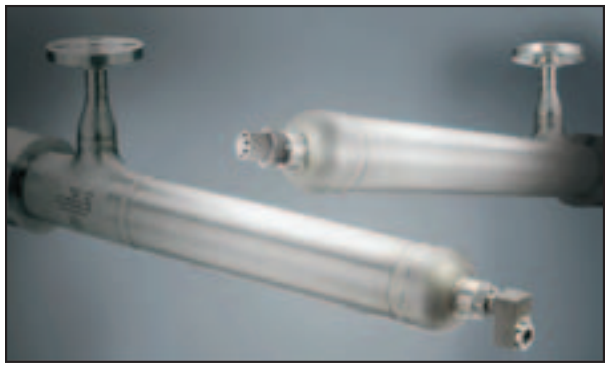
As with any piece of machinery, having a proper maintenance program for your pumps is critical to their long-running operation. Being able to analyze why a failure occurred and what changes need to be made to prevent that same failure in the future will pay dividends throughout the plant. When in doubt, contact the company that supplied the original equipment and the engineer who designed the system to enlist their help in analyzing the issues that are occurring.

*For more information, please contact David Hall of Weir Minerals Lewis Pumps at (314) 843-4437 or visit the company's website at www.lewispumps.com.* ❑

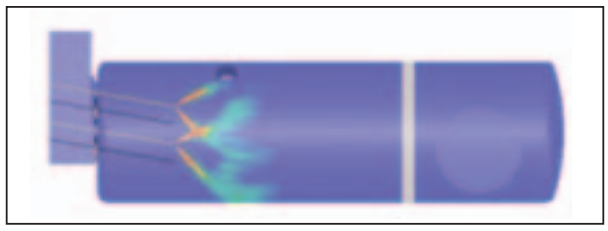
# Advancements in sulfur spraying: new hybrid gun and predictive modeling

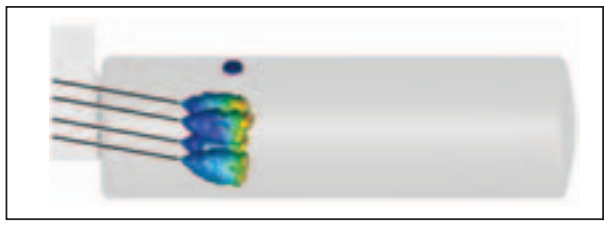
Hydraulic nozzles have long been the standard for spraying molten sulfur, but the benefits of using air atomizing nozzles can be significant. The smaller drops produced by air atomizing nozzles typically improve combustion and eliminate carryover and damage to downstream equipment. Until now, testing guns equipped with air atomizing nozzles required purchasing new guns to equip an entire furnace.

A new hybrid sulfur gun has been introduced by Spraying Systems Co. The guns can be easily converted from hydraulic operation with WhirlJet® BA nozzles to air atomizing operation with FloMax® nozzles. In addition, the guns can be converted back to hydraulic operation if air atomizing performance doesn't meet expectations. The hybrid guns offer producers an easy and risk-free way to evaluate air atomizing nozzles in their operations.



Hydraulic nozzles can be replaced with air atomizing nozzles on hybrid sulfur guns providing producers with an easy and economical way to compare performance between nozzle types. See animation: www.spray.com/hybridgun





CFD shows impingement with base of combustion chamber using hydraulic nozzle (left) and no impingement using air atomizing nozzle (right).

## Using modeling tools to optimize spray performance and identify potential failures

Optimizing molten sulfur spraying is dependent on many variables including atomization, drop size, residence time, placement of the gun, furnace baffle locations and operating conditions in the furnace. Many producers are turning to Computational Fluid Dynamics (CFD) modeling to improve performance. Common studies look at both gun placement to avoid sulfur impingement on walls and drop size to determine the optimal size for complete vaporization and full combustion. Fluid Structure Interaction (FSI) modeling is also gaining rapid acceptance. One recent study looked at the thermal and structural properties of a sulfur gun and the effect of flow-induced vibrations. The study validated the thermal integrity of the sulfur gun but identified a structural weakness that could result in gun failure. The gun was redesigned to include support collars to counteract the vibrations.

More information on sulfur gun technology is available at www.spray.com/hybridgun including the following topics:
— Animation of hybrid sulfur gun conversion from hydraulic to air atomizing
— Presentation: *Optimizing Sulfur Spraying*, Sulfuric Acid Roundtable 2013
— Sulfur gun fluid interaction study
— Sulfur gun and spray nozzle overview ❑

NEWS BITS

# With rising acid demand, International Process Plants announces sulfuric acid plant for sale

HAMILTON, N.J.—International Process Plants (IPP) announces a Lurgi double-absorption type sulfuric acid plant available for sale. This sulfuric acid plant presents an opportunity for phosphate fertilizer manufacturers to vertically integrate their supply chain, reducing costs and hedging against market fluctuations.

According to a report released in September 2012 by Market Research & Consulting Ltd, demand for sulfuric acid is on the rise, specifically linked to the fertilizer industry. The report forecasts that sulfuric acid demand will reach nearly 120 million tons in 2017, with the highest growth in Central and South America (a 3.7 percent CAGR).

The Lurgi double-absorption type sulfuric acid plant started production in 2000 and shut down in December 2010. The plant is rated for 2,400 metric tons/day of sulfuric acid (100 percent basis), and can run as low as 960 metric tons/day. The plant produces sulfuric acid at 98.5 percent concentration and sends less than 300 ppm of $SO_2$ out of the exhaust stack. Also included at the site is a small oleum plant with a capacity of 150 metric tons/day (103 percent sulfuric acid).

This plant location has excellent transportation options by road, rail and water. Barges and ships can be loaded only a few kilometers from the plant site. The process control system is Honeywell TDC 2000. All field instrumentation is electronic.

International Process Plants (IPP) is a self-funded global buyer and seller of surplus manufacturing facilities, process plants, industrial real estate and individual equipment that are no longer needed by their original owners. Eighty percent of IPP's purchases are from multinational companies and 20 percent are bought in distress situations. IPP's business model provides the opportunity for companies to acquire such assets at competitive prices and in a fraction of the lead time of building or buying new. IPP also serves as an outlet for companies looking to divest surplus assets quickly in a fiscally and environmentally conscious manner. IPP currently owns 17 complete plant sites including the land, buildings and equipment, 85 complete processes to be moved and operated elsewhere and a stock of 30,000 major pieces of process equipment. One of the largest firms in this business, IPP operates globally from its headquarters in the U.S. and its company-owned operations in 16 other countries. In business for over 35 years, IPP serves 160,000 clients in the chemical, agrichemical, petrochemical, oil and gas, paper, plastic, power generation, metallurgical, fertilizer, artificial fiber, pharmaceutical and food industries.

Lurgi double-absorption type sulfuric acid plant for sale by IPP.

*For more information about IPP or the sulfuric acid plant that is for sale, please visit www.ippe.com.* ❑

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**Field Installation:** *CMW* has an impeccable reputation for expert quality workmanship and finishing on time and on budget. Our field crews are some of the best in the business and our close to 50 years of making sure your plant is back on line provides the confidence you need in making your contractor decision.

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# Innovative wet electrostatic precipitators assure competitive edge in acid marketplace

By: Michael Beltran, President and CEO, Beltran Technologies, Inc.

The unsteady global economic recovery continues to subject many core industries to persistent volatility in profits, prices, markets and capital investments. However, some analysts remain optimistic about the global international trade in sulfur in all forms, particularly sulfuric acid.

This versatile mineral acid is both the world's most widely used chemical, and the one with the highest production volume. Its use as both a primary and intermediate raw material spans hundreds of industrial processes, especially agricultural fertilizer manufacturing, which consumes 70 percent of $H_2SO_4$ production. This application alone may continue to fuel a vigorous global trade in this chemical. Sulfur provides both a direct nutritive value for plants, as well as an indirect value as a soil amendment. It also facilitates a plant's use of the three other major nutrients: nitrogen, phosphorus and potassium.

Growth in the fertilizer industry, and consequently in the global sulfuric acid trade, is expected to be driven by the following factors:

—The increasing demand for foodstuffs by burgeoning global populations.

—A decrease in accessible arable land due to rapid industrialization and urbanization, especially in developing countries.

—Concern over sulfur deficiency in soils resulting from intensive farming techniques; higher-yielding crop varieties; higher-volume irrigation systems; less use of traditional manures and other sulfur-rich fertilizers; and—ironically—a significant reduction in the amount of atmospheric sulfur available for soil deposition due to more stringent emission control regulations.

As global trade in sulfuric acid accelerates, acid plant operators will be under increasingly intense competition to supply the purest, highest quality product. At the same time, operators must remain price-competitive by achieving maximum cost-efficiency as they maintain these high levels of purity.

Most sulfuric acid on the market today is sourced as a non-discretionary by-product captured from ferrous and non-ferrous smelting. This industry faces some of the most complex and onerous air pollution-control challenges, and some of the tightest environmental regulations, among all industrial sectors. Ore concentrators, smelters, roasters, converters and other refining equipment can release an array of toxic pollutants into the atmosphere. High concentrations of fine particulate matter and sulfur dioxide are attracting the most concern due to their serious impacts on human health and ecological systems.

In an effort to reduce these emissions, plant designers have deployed an arsenal of gas cleaning equipment and techniques, including wet and dry flue-gas scrubbers, venturis, cyclones and fabric filters. In addition, thanks to innovative technological enhancements, plant operators are turning with renewed interest to modern wet electrostatic precipitators (WESPs), which can clean flue gases of acid mists, condensed organics or fine particulates down to submicron scale with up to 99.9 percent efficiency.

To remain competitive in price and quality, 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 is necessary for protecting downstream components such as catalyst beds from corrosion, fouling and plugging, as well as for preventing the formation of a "black" or contaminated acid end-product. Proper gas cleaning also results in lower costs for maintenance, operations and equipment replacement.

WESPs can vary greatly in design, materials, gas flow rates and durability, as well as collection efficiency. It is thus important for engineers to recognize the key differences among these various systems.

Today's advanced WESPs are designed around a multistage system of ionizing rods with star-shaped discharge points, enclosed within square or hexagonal tubes which are lined with grounded collection surfaces. The unique electrode geometry generates a corona field 4-5 times stronger than that of ordinary wet or dry ESPs. The multistage charging configuration also avoids corona quenching due to high particle densities, and assures maximum corona field strength with a minimum of energy load.

As flue gas travels through the tubular array, these intense corona fields induce a negative charge, propelling even submicron-size particulates and acid mists toward the collection surfaces, where they adhere as cleaned gas is passed through. The surfaces are cleansed of residues by recirculating water sprays. A heated purge-air stream should be used to keep the high-voltage insulators dry, reducing maintenance costs. Since fine particles have little significant mass, they generally pass through scrubbers, venturis and other devices, but are captured with remarkable efficiency by advanced WESP equipment.

The cool, saturated environment in the WESP is highly effective on condensable or oily compounds, which can elude conventional equipment. The continuous aqueous flushing process prevents re-entrainment of particles, sticky residue build-ups and particle resistivity. By eliminating the need for mechanical or acoustical rappers, the cleansing system also minimizes energy costs.

With very little pressure drop through the WESP, gas velocities can be extremely high, boosting efficiency. Plant engineers can use smaller-scale, less costly equipment and still achieve superior collection efficiencies.

Other critical features to look for in WESP equipment are sophisticated electronic controls linked to a close-coupled gas flow management system. These components can squeeze even more efficiency out of the system by optimizing such operating parameters as gas velocity, saturation, temperature, corona intensity, etc.

Forward-thinking industrial plant operators around the world constantly seek out and deploy more advanced gas cleaning technologies throughout their enterprises, not only to stay ahead of the regulatory compliance curve, but also to achieve superior operating performance and to control maintenance and other costs in a competitive marketplace. In this context, the role of wet electrostatic precipitators should continue to grow as an essential primary or adjunct gas treatment option.

*For more information, contact Beltran Technologies, Inc., at (718) 338-3311 or beltran@earthlink.net, or visit the company website at www.beltrantechnologies.com.* ❑

# Difficult situations lead to lessons learned

By: Orlando Perez, OP & Associates-$H_2SO_4$ Consultants

## Thawing sulfur lines

Molten sulfur from nearby refineries is normally transported to the plant by trucks and unloaded directly into sulfur pits or aboveground storage tanks. If the plant is near a waterway, barge transport can be used more economically. The plant in this particular example uses both methods of transport.

Offloading from barges requires a pump and piping system. The pump draws molten sulfur from the storage tank in the barge and pushes it through a carbon steel pipeline to an elevated aboveground storage tank situated a considerable distance away. After emptying the barge, any remaining sulfur in the pipeline stays there until the next unloading batch. To keep the residual sulfur in its molten state and to prevent it from freezing during downtimes, it is important that all components of the pipeline, including the pump, be heat traced and properly insulated.

During one of the downtimes in this particular plant, the steam tracing encountered a problem and the molten sulfur that remained in the line froze. Steam tracing was eventually restored and thawing of the line started. After a few hours, a loud noise was heard and molten sulfur was seen spewing from a portion of the pipeline. What went wrong? The pipe experienced a thick-lip rupture as shown in Fig. 1. This rupture is indicative of over pressurization. Investigation revealed that only a section of the pipe was being thawed and the molten sulfur was blocked in. The inability of molten sulfur to thermally expand created over pressurization of the pipeline.

**Lesson Learned:**

Always start thawing frozen sulfur lines from one end to the other to allow free thermal expansion of molten sulfur. Procedures must be set in place and heat tracing must be designed to allow this.

**Fig. 1: Thick-lip rupture of 8" sulfur pipe.**

## Profiling is good practice

A pressure profile of the entire acid plant is one of the important metrics for gauging the current condition of a plant. It is an excellent tool for predicting the maximum attainable production capacity of the plant, troubleshooting equipment, scheduling much needed equipment inspection and maintenance, and planning for replacement of equipment.

Pressure surveys should be religiously taken on every piece of equipment and the data gathered must be trended and reviewed regularly for the surveys to be effective. Failure to perform these steps will result in serious consequences. Such is the case for a plant that stopped gathering and trending data on some equipment because the pressure points were plugged with sulfate due to lack of maintenance. This continued for a long time and the drying tower and absorber tower packing were allowed to operate beyond their operational limits. The result was loss of absorption efficiency, as evidenced in Fig. 2, and serious acid entrainment, which in turn caused the following effects: damage to downstream ducting, the sulfur furnace windbox and catalyst, as well as higher than normal acid condensation in the cold end of the cold-reheat exchanger. It should be noted that loss of absorption efficiency in drying and absorbing towers can also be the result of plugged trough distributor orifices and/or down comer tubes.

The packing in the towers was found partially plugged with sulfate. This required separate shutdowns months apart to repack the towers. Much repair was needed because the ducting and catalyst-screening loss was higher than expected.

On a similar note, ignoring the data and continuing to run with higher than allowed pressure drop would also result in serious consequences. Such is the case for another plant that ran converter bed 1 pressure drop up to 52" WC. The plant shut down on account of higher than normal bed 2 exit temperatures and an increase in stack $SO_2$ emissions. On inspection, it was found that the pie-shaped catalyst bed support separated at the seams and at the core tube by at least 2" allowing catalyst to fall off. The core tube also had vertical cracks that propagated by at least 3" above the catalyst bed support.

**Lesson Learned:**

Pressure profiles must be taken at least during each operational shift and the data gathered should be trended and reviewed on a regular basis to be able to identify potential problem areas.

Pressure points must be maintained and kept open and clear of sulfate at all times.

Never exceed the operating limits of the equipment.

**Fig. 2: Drying tower mesh pad corrosion due to loss of absorption efficiency.**

## Lower pressure drop is not always good

One of the most effective and economical strategies employed by designers to increase the capacity of an existing acid plant is to reduce equipment pressure drop wherever it may arise. In addition to increasing the plant throughput, this strategy also decreases power consumption.

The absorption section of an acid plant is a potential area for reducing equipment pressure drop. Some plant's drying and absorbing towers to date still use cast iron trough-, pipe- and even pan-type distributors. The pipe-type distributor is normally buried in the packing to minimize acid mist formation; the pan-type and sometimes the trough-type are laid just above the saddles. These placements block a good portion of the tower cross-section, thus contributing to pressure drop.

The use of cast iron distributors and piping also contribute to pressure drop as the ferrous sulfate, which is a product of corrosion, gets deposited in the packing, complicating things further. Designers have been pushing for and now most plants are moving towards alloy distributors to eliminate ferrous sulfate formation.

Use of low-pressure drop packing is also increasing. Some designers have been replacing the traditional 3" + 2" Intalox saddle-packing combination with all 3" Intalox or Super Intalox saddles. All this for reducing pressure drop; which is good, but not always!

A case in point is an acid plant that repacked a brick-lined absorber tower with structured packing. This job included replacing the cast iron pan-type distributor with an alloy pipe-type distributor. The design change was done at the plant using in-house engineering support. The placement of the distributor was above the 2" saddles that are atop the structured packing. The realized pressure recovery was tremendous, but absorption efficiency suffered significantly. The plant had to perform emergency measures to put back some pressure drop at the distributor level.

Another case in point is an acid plant that used all 3" Super Intalox saddles to replace the 3" + 2" saddle-packing combination in drying and absorbing towers in order to decrease pressure drop. Some pressure loss was gained, however higher moisture off of the drying tower was measured and a hazy stack occurred after the repacks.

**Lesson Learned:**

Always perform a proper technical review with the help of an external consultant before proceeding with design changes. All modifications should be properly vetted to minimize risks.

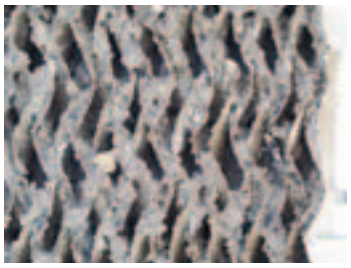


**Fig. 3: Clogged bottom section of heat transfer fill.**

## Don't ignore the cooling tower

Cooling towers provide heat removal through evaporation of the plant's process water. Most plants use induced draft, cross- or counter-flow type, with or without heat transfer fills. They are usually constructed out of redwood or Douglas fir lumber. They are reliable pieces of equipment. Except for maintenance of water chemistry and rotating equipment, plants normally don't pay attention to maintenance of structure, especially when new. During turnarounds, work is mostly focused on cleaning the basin, but inspections to check for structural integrity are not normally scheduled. Such is the case for an acid plant in North America. The heat transfer fills were ignored and no inspection was performed for many years. It was only when the water outlet temperature crept up to 10 degrees that Operations was prompted to schedule an inspection. It was found that the heat transfer fill was almost plugged up with silt at the bottom section, as shown in Fig. 3. The top section was fouled but not clogged as shown in Fig. 4. Clogged heat transfer fills add load to the supporting structure. In this particular case, the increased weight of the fill was found to be six times the original installed weight. Luckily, the supporting structure did not collapse.

**Fig. 4: Fouled top section of heat transfer fill.**

**Fig. 5: Broken wooden column inside a cooling tower**

In another North American acid plant, a worker who was climbing down the stairs of a cooling tower broke one of the treads and sprained an ankle. This prompted inspection of the cooling tower's structural components. The inspection revealed that the wooden components had deteriorated so badly that even some of the posts inside the cooling tower were broken, as shown in Fig. 5. Corrosion was so bad that the cooling tower was at critical risk of collapsing. Emergency measures were set in place to stabilize and prevent the tower from collapsing under high wind conditions.

**Lessons Learned:**

Cooling towers require regular inspections for corrosion, fouling, and mechanical/structural integrity of their components, just like any equipment in direct contact with acid, $SO_2$ or $SO_3$.

Heat transfer fills can easily get fouled, especially when water chemistry is not under control, and can easily get clogged in dusty environments. Deposits can add a few hundred pounds to the heat transfer fill's own weight.

*For more information, please call (604) 428-3300 or email orlando.perez@outlook.com.* ❑

# Be smart, don't get s'MACT'ed

By: Steve M. Puricelli and Kirk W. Bailey of MECS, Inc.

The EPA has sulfuric acid plants in their sights for emission reductions. And, although you may feel safe with a valid air permit, what you may not know is that emission standards are subject to change. What many producers have found out the hard way is that replacing equipment in your plant may make you eligible for review and compliance with MACT (Maximum Achievable Control Technology) standards.

In 1970, the Clean Air Act was promulgated and National Ambient Air Quality standards were established. The target for sulfuric acid plants was set in 1974 at 4 lb/ton of $SO_2$, 0.15 lb/ton mist and less than 10 percent opacity. In 1990, the Clean Air Act was revised to require the issuance of "technology-based" standards for major sources. Thus, the EPA was able to establish new emission standards based on "maximum achievable control technology" or "MACT" standards. These MACT standards have been the driving force for ever tightening $SO_2$ targets.

But, what is the justification for further reductions in $SO_2$ emissions? The EPA has calculated a societal cost for health issues related to $PM_{2.5}$ (particulate matter < 2.5 µm), which is related back to $SO_2$ and NOx that is transformed in the atmosphere to particulate sulfate and nitrate. To estimate $PM_{2.5}$, $SO_x$ and $NO_x$ emissions data is plugged into a complex model that calculates sulfuric and nitric formation in the atmosphere and predicts ground level $PM_{2.5}$ concentrations. The model is then checked against monitoring station data and corrections are made. The resulting values are used to quantify health effects, visibility (haze) and sulfate/nitrate deposition. Fig. 1 is a graphic representation of the predicted particulate matter concentration in the continental U.S. with and without the Clean Air Act Amendment (CAAA).

The health effects are estimated by comparing the differences between the "with" and "without" Clean Air Act Amendment $PM_{2.5}$ concentrations. The "without" scenario assumes no further controls on pollutants, aside from those already in place in 1990. To estimate the health effects, historical health data is used to create a baseline and changes in health effect incidence are estimated using health impact formulas and the calculated exposures. Premature mortality is the largest contributor to the monetized health benefits of $PM_{2.5}$ control. A list of the health effects are shown in Table 1.

In addition to health benefits, the EPA assigns a financial benefit to enhanced forest and agricultural plant growth, the aesthetics of improved visibility, reduced damage to buildings and structural materials and reduced acidification of freshwater bodies.

When the health and other benefits are all monetized, the EPA estimates the societal value of improved air quality at $2.0 trillion dollars in 2020, of which, $1.7 trillion is attributed to reductions in premature mortality. A detailed breakdown is shown in Table 2.

It should be no surprise that in the coming years, the bar can only go lower as new technologies are introduced to the market and MACT is reset. In the eyes of the EPA, the benefits of reduced $PM_{2.5}$ are enormous.

So, what does the future look like for sulfuric acid producers? Recent permits have been in the range of 1.5 to 2 lb $SO_2$/ton $H_2SO_4$ emissions (99.89 percent - 99.85 percent conversion), which can be accomplished by catalyst alone. But, new challenges are on the horizon. The Sierra Club is litigating to eliminate startup, shutdown and malfunction emission variances (SSM). If their lawsuit is successful, plants will be required to implement technologies that eliminate or significantly curtail short term excursions. There are also some local and regional permitting regulations that currently require emission to be less than 1.0 lb $SO_2$/ton $H_2SO_4$. In summary, it is getting much more difficult to operate a plant under all conditions.

As we look to the future, the first question to ask is: what is the capability of the current workhorse of the industry, double absorption?

For a typical sulfur burning plant with 11.5 percent gas strength, a 3x1 converter can reasonably be expected to achieve 99.85 percent or 200 ppm with conventional catalyst and 99.9 percent or 140 ppm with Cs catalyst in passes 1 and 4. A 3x2 converter can achieve 99.87 percent or 180 ppm with conventional catalyst and 99.93 percent or 100 ppm Cs catalyst in passes 1 and 5. Catalyst loadings range from 190 L/ST to 250 L/ST.

Keep in mind that for existing units, the maximum achievable conversion may be limited by the catalyst holding capacity of the converter or the inability to operate at the optimum converter temperatures.

Going beyond 99.93 percent conversion is possible when the oxygen content in the tail gas is favorable (for example, oxygen enriched smelting operations). Unfortunately, ultra-high conversion in sulfur burning plants is limited by oxygen diffusion and equilibrium in the later passes. While 99.93+ percent may be achievable, the margin of error will be so narrow that the plant must operate at optimum conditions for the entire campaign, which will be difficult.

In summary, adding catalyst is the most economical way to reduce emissions because minimal capital modifications are required outside of the converter. But, many plants operating today have been debottlenecked over time, limiting the potential for catalyst addition. For these units, there is a high probability that end-of-pipe-treatment will be necessary for future ultra-low emissions or for controlling startup and shutdown variances. In these cases, a tail gas scrubber is the next most economical solution.

Also keep in mind that there are no time limits on MACT. What is good today may not be good enough tomorrow, requiring further capital investment. One solution is to negotiate a no recourse period in the agreement with the EPA. If that is not possible, then it may be prudent to invest in technologies that can deliver lower emissions today.

Wet scrubbing is one of those solutions. It can reduce $SO_2$ to very low levels (<10 ppm) with a modest capital investment. But, the ongoing cost of reagent and disposal of sulfate wastes must be taken into consideration. For example, the order of magnitude total installed cost (TIC) for a 1,000 MTPD tail gas scrubber using caustic as the reagent is ~$5 million. Over a 20 year life, the straight line depreciation is about $0.70/ton and the reagent cost is $0.75/ton $H_2SO_4$ produced, based on $400/ton NaOH.

The wild card is the disposal of the sulfate waste. If the waste water treatment system can tolerate additional dissolved solids, the disposal cost is minor. However, in some cases, the limitations of the waste water treatment system can be a deal breaker.

An alternative is to use $SO_2$ and NaOH to produce a commercial product like sodium bisulfite (SBS). Because this process is more complex (generally a multi-stage system), the initial investment is higher. Another drawback is that SBS is a non-discretionary, fatal product that is subject to supply and demand of the food additive and waste water treatment industries. This option is not for everyone, but in some cases, the financial incentives outweigh the uncertainty of product movement and pricing.

Another alternative reagent is hydrogen peroxide. The advantages of peroxide scrubbing is that the capital costs are moderate, at $8 million for 1,000 MTPD (or $1.15/ton $H_2SO_4$ depreciation), and that the scrubber by-product is 40 percent sulfuric acid, which can be recycled to the acid plant and used as dilution water. The disadvantage is the cost of the reagent. Assuming that peroxide can be obtained for $600/ST, the reagent cost is in the range of $0.95/ton $H_2SO_4$. But, this cost is also offset by the $H_2SO_4$ recovered, to the tune of $0.45/ST with acid valued at $150/ST. Unfortunately, the economics of using peroxide as a scrubbing reagent are highly dependent on the local availability/cost of the reagent and the value of the acid, which varies dramatically from region to region.

New technologies are also emerging and one of the more interesting technolo-

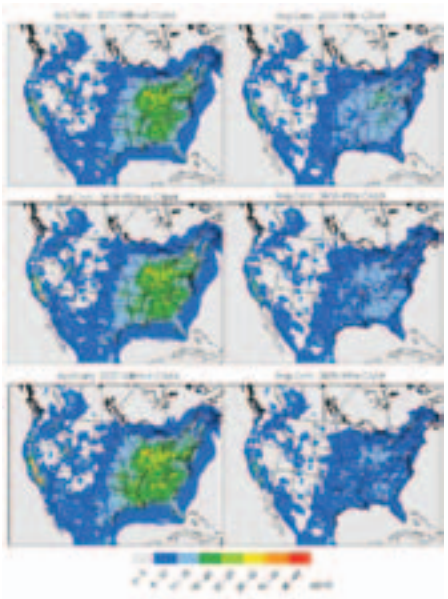


Fig. 1: $PM_{2.5}$ concentrations (µgr/M³)

| BENEFIT CATEGORY | MONETIZED BENEFITS (MILLION 2004$) BY TARGET YEAR | | | NOTES |
|---|---|---|---|---|
| | 2000 | 2010 | 2020 | |
| Health Effects | | | | |
| Pm mortality | $170,000 | $1,200,000 | $1,700,000 | Pm mortality estimates based on Walbolt distribution derived from Pope et. al. (2002) and Laden et al., 2006. |
| Pm morbidity | $17,000 | $46,000 | $68,000 | |
| Ozone mortality | $10,000 | $23,000 | $35,000 | |
| Ozone morbidity | $400 | $1,300 | $2,100 | Ozone mortality estimates based on pooled function |
| Subtotal Health Effects | $250,000 | $1,300,000 | $1,900,000 | |
| Visibility | | | | |
| Recreational | $4,100 | $9,000 | $18,000 | Recreational visibility only includes benefits to the region analyzed in Chestnut and Rowe, 1990 (i.e., California, the Southwest, and the Southeast). |
| Residential | $13,000 | $27,000 | $49,000 | |
| Subtotal Visibility | $17,000 | $36,000 | $67,000 | |
| Agricultural and Forest Productivity | $1,000 | $5,500 | $11,000 | |
| Materials Damage | $56 | $80 | $140 | |
| Ecological | $6.9 | $7.5 | $8.2 | Reduced acidification benefits to recreational fishing assuming effect threshold of 50 ueq/l per liter. |
| Total: all categories | $270,000 | $1,300,000 | $2,000,000 | |

Note: See Chapters 5 and 6 of this report for detailed results summaries. Values presented are mean from results reported as distributions. Estimates presented with two significant figures.

Table 1: Human Health Effects of $PM_{2.5}$

| POLLUTANT/EFFECT | QUANTIFIED AND MONETIZED IN BASE ESTIMATES[a] | UNQUANTIFIED EFFECTS[b,c,d] – CHANGES IN: |
|---|---|---|
| PM/Health[e] | Premature mortality based on both cohort study estimates and on expert elicitation[c,d]<br>Bronchitis: chronic and acute<br>Hospital admissions: respiratory and cardiovascular<br>Emergency room visits for asthma<br>Nonfatal heart attacks (myocardial infarction)<br>Lower respiratory symptoms<br>Minor restricted-activity days<br>Work loss days<br>Asthma exacerbations (asthmatic population)<br>Upper Respiratory symptoms (asthmatic population)<br>Infant mortality | Subchronic bronchitis cases<br>Low birth weight<br>Pulmonary function<br>Chronic respiratory diseases other than chronic bronchitis<br>Morphological changes<br>Altered host defense mechanisms<br>Cancer<br>Non-asthma respiratory emergency room visits<br>UVb exposure (+/-)[e] |

Table 2: Summary of Primary Benefit Results

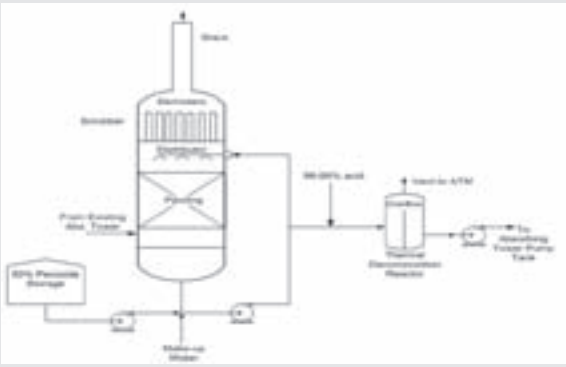


Fig. 2: Peroxide scrubber flow diagram

Fig. 3: Peroxide scrubber reference plant

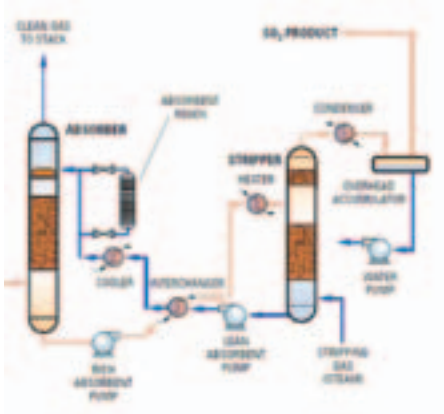


Fig. 4: Simplified SolvR flow diagram

gies is regenerative scrubbing. It addresses ever more stringent regulations while recovering a raw material and does not create a secondary waste problem. However, the capital cost of regenerative systems is about 75 percent of the cost of double absorption, so it is more suitable as a replacement for double absorption than a retrofit technology for double absorption.

As with any new technology, regenerative scrubbing has some advantages and disadvantages.

On the plus side, the sulfuric acid plant only sees the added pressure drop of the regenerative scrubber absorbing tower. Since the absorber is normally packed with structured packing to accommodate the low liquid flows, the pressure drop should be under 5 in WC. $SO_2$ product from the stripper is recycled back to the drying tower for conversion to sulfuric acid.

On the minus side, the stripper requires steam to regenerate the solvent. The steam requirement is dependent on the $SO_2$ concentration in the tail gas. Efficient systems utilize 5 to 10 lb steam/lb $SO_2$. Steam can also be a significant operating expense. There are also solvent losses to consider. Natural oxidation of $SO_2$ absorbed by the solvent to $H_2SO_4$ is inevitable. For some solvents, the $H_2SO_4$ reacts with the solvent, forming a heat stable salt that reduces the effectiveness of the solvent. In the MECS® solvent, sodium sulfate is formed, but the solvent remains unaffected. In either case, impurities must be separated from the solvent and makeup reagents added. Depending on the amount of losses, the cost of the solvent and disposal costs for spent solvent (hazardous or non-hazardous), can add up to a significant operating cost. Availability and delivery of replacement solvent must also be considered for when the occasional upstream operating upset potentially damages a full charge of solvent.

In sum total, weighing the pluses and minuses, regenerative $SO_2$ scrubbing looks like it has enough benefits to earn a place in the future of sulfuric acid. But, just how big of a part?

With a new emissions control tool in hand and a clean sheet of paper, MECS, Inc., is breaking free of classical design constraints and will be able to bring to the market lower cost or higher energy recovery hybrid designs that may very well redefine the industry, the way that double absorption did for sulfuric acid plants in the 1970s.

MECS calls this new hybrid plant, which marries MECS® SolvR™ Regenerative $SO_2$ Scrubbing Technology to a single absorption sulfuric acid plant, MAXENE™ for MAXimum ENErgy. This design offers the benefits of ultra-low $SO_2$ emissions (<20 ppm) and energy recovery in the range of ~1.5 T/T of 900 psig/900 degrees F (60 barg/480 degrees C) steam. Alternatively, flow schemes are being developed that will minimize the initial capital, albeit at the expense of energy recovery.

Looking to the future, MECS® SolvR™ Regenerative $SO_2$ Scrubbing Technology appears to have all of the right attributes needed for success: lower installed costs, lower operating costs and extremely low emissions.

Today's reality in the U.S. is that 1.0–2.0 lb $SO_2$/ton $H_2SO_4$ is the new standard. But the world is changing. Newer technologies are promising $SO_2$ emissions as low as 20 ppm or 0.2 lb/ton. What will be the MACT of tomorrow and which technology is best for you today and into the future? ❑

Reference:

The Benefits and Costs of the Clean Air Act: 1990 to 2020, U.S. EPA Office of Air and Radiation, August 2010.

# Simple solutions for high ash content levels

Many sulfur burning plants are plagued by high ash content levels, and subsequent contamination of the waste heat boiler and the catalyst bed in the converter of the acid plant. The answer to this problem is the installation of a liquid sulfur polishing filter after the pressure leaf filter. The liquid sulfur polishing filter with ceramic elements will drastically improve the run time of the sulfuric acid plant.

The filter holds ceramic filter tubes. This is a combination of surface and depth filtration. The sulfur flows from the outside to the inside of the filter element. Solids are retained on the surface of the filter tube and clean sulfur comes through the outlet of the filter to the sulfur storage. The filter is cleaned by injecting steam in the reverse direction. The operation of a liquid sulfur polishing filter is demanding and in some cases problematic. Some of the possible problems, along with recommended solutions, are:

—Design: Most filters are designed on flow rate, containing ash levels as low as 20 ppm at the inlet. However, when problems are encountered at the pre-filter, the ash content can build up fast and the polishing filter will be plugged. A flow-based overdesign of 10-20 percent is a must to avoid possible breakthrough of ash, preventing short cycles and overloading the filter with solids.

—Cleaning: The ceramic filter tubes are cleaned by injecting high pressure steam in reverse. The steam will follow the path of lowest pressure drop, so clean filter tubes will allow steam to pass through, while plugged filter tubes will not be cleaned efficiently. The solution in this case is to use individual outlets. One register of filter tubes is cleaned, followed by the next. The cleaning will be much more efficient and the lifetime of the filter tubes often doubles.

—Sealing of ceramic filter tubes: ceramic filter tubes have glued-on gaskets. Often, due to high temperatures, the sealant gets damaged and the gaskets get loose. A specially designed filter tube holder keeps the gaskets in place and assures a good seal. The tube holder also makes it possible to expand the length to fit a double length filter tube.

**Polishing filters, filled with ceramic filter tubes, help solve the problem of high ash levels.**

—Blocking cake discharge outlet: When high amounts of solids are accumulated in the polishing filter, the solids can block the cake discharge opening. This can be prevented with a special heated cake outlet valve, which can be supplied with an up to 16 inch opening.

—Steam vapors around the filter: When the filter is cleaned by back flushing with steam, vapors will be released from the bottom outlet. This is a dangerous situation for operators around the filter and can cause corrosion on the filter and surrounding equipment. Sulphurnet has designed a special cake discharge drum so the steam can be directed to a safe zone. When using this cake discharge drum, high pressure air can be used for a thorough and efficient cleaning instead of steam.

Implementation of the above features not only provides ceramic filter tubes with a longer lifetime, but makes the operation safer and more reliable. Reliability can be obtained by installing pressure instruments to measure the pressure differential, and also by automating the system.

*For more information, please contact Jan Hermans of Sulphurnet at sulphur@sulphurnet.com or by phone at +31651317332.* ❑

PEOPLE ON THE MOVE

# The Roberts Company announces new chief operating officer

WINTERVILLE, N.C.–The Roberts Company (TRC), with offices in Winterville and Raleigh, recently announced that R.M. "Monty" Glover will be assuming the position of Company COO.

Glover brings 30 years of construction, engineering and plant operations experience in a variety of industries including power, pulp and paper, chemical, mining, manufacturing and hydrocarbons for international and domestic projects. For more than 13 years, the industry expert worked with The Shaw Group Inc., serving as President of the Construction Division, the Fossil Division and Energy & Chemicals Group. Prior to those positions, Glover was Vice President of Construction Operations.

R.M. "Monty" Glover, chief operating officer

"Monty brings a vast amount of experience in the industries that TRC currently serves, as well as industries we are working to emerge into in the near future," stated Chris Bailey, President & CEO. "We are very excited to have Monty join our team and take part in the significant growth that is ahead of us."

Founded in 1977, TRC provides fully integrated engineering, fabrication, construction and plant services for heavy and light industrial clients. The engineering group has extensive capabilities to meet all civil, structural, mechanical, piping, electrical and process engineering requirements. TRC Fabrication Services offers unlimited steel plate fabrication specializing in custom complex ASME code pressure vessels and heat exchangers. In addition, TRC Field Services provides a full service project solutions group for grass roots projects as well as a Plant Services group to handle maintenance turnarounds, shutdowns and emergency mobilizations.

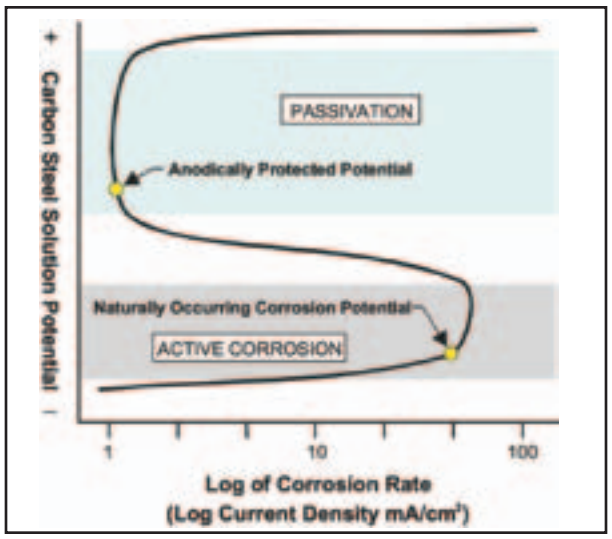
Fully licensed in 13 southeastern states, TRC can manage capital projects or emergency plant repairs as needed. Our project management group consistently provides planning, scheduling, procurement and site management services to a full spectrum of industrial clients.

*For more information, contact Chris Bailey at (252) 355-9331 or visit www.robertscompany.com.* ❑

# Maintain acid purity and control corrosion with anodic protection

TORONTO—As acid temperature rises, the corrosion rate of a 93-98 percent sulfuric acid tank increases rapidly, contaminating the acid and decreasing service life. Anodic protection is an economical solution that reduces iron pick-up and extends tank life by minimizing the corrosion rate.

For a typical acid tank, an anodic protection system consists of cathode and reference electrode hardware installed through the tank roof (so it does not require tank entry) and an automatic potential controlled rectifier installed



adjacent to the vessel. The installation is straightforward and can be done by a local contractor. Unlike expensive applied coatings the system can be installed on acid tanks which are in operation, reducing the need for costly shutdowns.

Initially, direct current (DC) is applied to the vessel, moving the corrosion potential of the vessel from the high corrosion region to the passive region where a tenacious film of oxide forms on the metal surface. After this initial passivation, nominally 5 percent of rated current is required to maintain the passive film.

Corrosion Service Company Limited (CSCL) has over 60 years of experience applying Anotection® Anodic Protection systems for acid tanks and piping globally. Anotection® increases the life span of infrastructure and the quality of the acid with respect to iron content, an important criterion for acid purchasers. This makes Anotection® particularly beneficial in the manufacture, storage and transport of acids. Anotection® systems feature complete automatic system operation. Remote monitoring service is available at a low cost to ensure the system operation is optimal, with minimal maintenance requirements.

*For more information, contact Corrosion Service Co. Ltd. at (416) 630-2600 or e-mail acid@corrosionservice.com* ❑

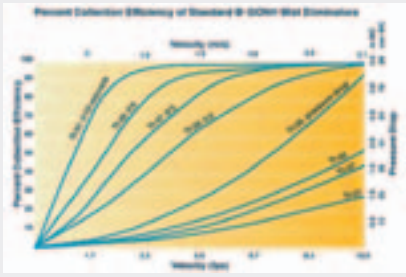
# Kimre grows into world supplier of clean air technology

MIAMI, FL—Kimre, Inc., began offering air pollution control products to the chemical processing industry in the early 1970's. Since then, Kimre has grown into an important part of the world community by offering innovative, cost effective solutions in diverse applications in air pollution control, gas cleaning functions and liquid cleaning functions.

Though its main sales headquarters and manufacturing plant are in Miami, Kimre reaches customers outside the United States through its site in Belgium, as well as distributors and independent manufacturers positioned globally.

Kimre products and technology are well known, with many manufacturers of wet scrubbing equipment in the United States, Europe and Canada using its products. Most Fortune 500 companies, in fact, have installations of equipment using Kimre technology.

The company has gained successful experience supplying a wide variety of mist elimination equipment for use in sulfuric acid production. Kimre's products, based on B-GON® and KON-TANE® media and enhanced by fiber-bed filter technology, handle even the most difficult acid mist challenges.



**Percent Collection Efficiency of standard B-GON mist eliminators**

Available in PFA-TEFLON® and ETFE polymers, as well as other plastics, Kimre products can support any sulfuric acid operation up to temperatures of 400 degrees F.

Successful applications in the sulfuric acid industry include the areas of feed gas clean up, drying and absorption towers, and ammonia tail gas scrubbing.

With respect to feed gas, B-GON® mist eliminators and KON-TANE® tower packing are used for a variety of applications in raw gas clean-up operations. They are widely used in the gas cleaning and contact sections of sulfuric acid plants.

In drying and absorption towers, B-GON® mist eliminators are used to replace knitted mesh and improve candle performance, as well as for pre-cleaning. They are the most plug resistant mist eliminators available, the company states. The hardy structural design ranks the B-GON® mist eliminator as the number one choice for plants with insufficient gas cleaning.

The Kimre™ Candle Fiber Bed Coalescing Filters can also be used to meet the most difficult mist elimination situations. These filters can achieve efficiencies greater than 99.9 percent on particles smaller than 1 micron and outlet loading below 15 milligrams per cubic meter.

B-GON® mist eliminators have also been highly successful in ammonia tail gas scrubbing.

Kimre has the knowledge and experience to provide innovative mist elimination solutions for new and existing plants. Kimre B-GON® mist eliminator and fiber bed filters can provide reduced pressure drop and energy consumption, longer operating cycles, reduced maintenance and reduced emissions to the atmosphere.

*For more information, please visit www.kimre.com.* ❑

# DuPont hosts dual 2013 best practices workshop

DuPont Sustainable Solutions Clean Technologies hosted its 27th Annual Best Practices Workshop this year in Asheville, N.C. The workshop consisted of two distinct events, each highlighting a different technology. The two events, the STRATCO® Alkylation Workshop and the MECS® Sulfuric Acid Regeneration (SAR) Workshop, both took place at the Grove Park Inn Resort during an overlapping period from Sept. 8-13.

The DuPont conference brought together customers from around the world for focused learning, information sharing and networking. Topics covered global market conditions, technology configuration and selection, technical design considerations, operations and maintenance, as well as technology troubleshooting and performance optimization. Workshop attendees included operations personnel, process and mechanical engineers, engineering supervisors and technology specialists.

The primary goal of the MECS® SAR Best Practices Workshop was to allow plant attendees to walk away with a better understanding of the sulfuric acid regeneration technology. The workshop is an important part of the MECS Inc. (MECS) customer service commitment. Participants were able to seek answers to any technical issues they might be having as well as gain better familiarity with the services and support that MECS provides. The resort venue also enabled attendees to network with their peers in a relaxed setting.

Topics for the SAR workshop included decomposition furnace chemistry and design; combustion fundamentals; SAR and Alkylation interactions; materials, corrosion and fouling; sulfuric acid storage tanks; sulfuric acid safety; operator training solutions; strong acid systems; sulfuric acid pumps; gas cleaning systems; industry advancements; converters; heat exchangers; turnaround maintenance; plant expansion techniques; emissions control; mist eliminators; and instrumentation.

In additional to technical aspects of the conference, participants were able peruse vendor exhibits during hospitality receptions as well as attend special planned dinners throughout the week. ❑

**John Recar, process supervisor for MECS Inc., welcomes attendees to their Sulfuric Acid Regeneration Workshop, held in conjunction with the STRATCO® Alkylation Workshop in Asheville, N.C.**

**Over 150 participants attended the STRATCO® Alkylation Workshop and the MECS® Sulfuric Acid Regeneration Workshop, Sept. 8-13 in Asheville, N.C.**

**Participants to the MECS® Sulfuric Acid Regeneration Workshop were treated to an offsite dinner in the pastoral settings of Claxton Farms just outside of Asheville, N.C.**

**Enjoying the evening's hospitality and exhibits, are, from left, Mick Cooke of Weir Minerals Lewis Pumps, George Wang of Solvay, and Rob Schlegel of Solvay.**

# Acid Piping Technology — The world leader in reliable and cost effective products for the sulfuric acid industry since 1991


**MONDI™ Piping Systems** – Special ductile iron alloy for 92-99% sulfuric acid at temperatures up to 300 degrees F (149 degrees C). Unique alloy and heavy wall construction provide 20-plus years of reliable service. APT step ring gaskets provide leak-free seal in hot acid.

- Proven performance in acid plants since 1983 for recirculation and transfer systems
- Tough sulfate film formed results in low corrosion rates
- Good tolerance to weaker acid excursions due to process upset or shutdown conditions
- Industry standard used in over 800 acid systems worldwide including World Class 4500+ ton per day plants
- APT maintains large inventory of pipe and fittings for routine and emergency requirements

**Valves & Instrumentation** – Valves are gate, globe, check, plug, ball and butterfly in iron, steel, bronze, stainless steels, alloy or lined with PTFE, PFA, and FEP. Valves are supplied in class 125 psi through 2500 psi. APT has a complete automation facility for valve actuation to supply complete automated package.

Instrumentation products include thermocouples, RTD, thermowells, orifice plates, pressure and temperature gauges.

**APT High Performance Ceramics** – High quality products which meet ASTM C-279 chemical porcelain. Products have excellent chemical resistance, high mechanical strength and low porosity.

- Tower packing saddle sizes in 3", 2", 1 1/2", 1", 3/4", 1/2" and #1, #2. #3, Super Saddles
- Cross Partition Rings, Grid Blocks and Ceramic Balls
- APT maintains large inventory of saddles and supports for routine and emergency requirements

**ASC Acid Plant Valves** --- Have been supplied to acid plants for gas duct applications since 1993. These valves are used for many applications within the plant. There valves can have manual gear operators or actuators.

- Butterfly valves (BV – metal step 1 percent leakage) for flow control around towers, equipment and heat exchangers
- Powercam® BV valves (ANSI Class IV – 0.01 percent leakage) for preheater isolation
- Flex-Wedge valves for blower isolation
- Refractory BV and Jug valve used on boiler by-pass for flow control

**ACID PIPING TECHNOLOGY**

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Telephone: (636) 296-4668 • Fax: (636) 296-1824 • Email: info@acidpiping.com • Website: www.acidpiping.com

# Keeping current at the 2013 Sulfuric Acid Roundtable

A record setting 180 attendees travelled from across the U.S. and the globe to share ideas and experiences at the 2013 Sulfuric Acid Roundtable in Scottsdale, Ariz.

Maintaining the tradition of continuous growth and learning, members of the sulfuric acid industry reconvened this spring in Scottsdale, Ariz., for the 2013 Sulfuric Acid Roundtable. A record setting 180 attendees travelled from across the U.S. and the globe to share ideas and experiences for the mutual benefit of the industry. The conference, spanning four days from April 8-11, was sponsored by *Sulfuric Acid Today* and many corporate co-sponsors who provide equipment and services to the industry.

Conference guests included employees of the corporate co-sponsors as well as an unprecedented number of delegates from sulfuric acid producers. The producer attendees represented sulfuric acid companies from across North and South America. These companies include: Agrium Canada, Agrium U.S., Areva Resources, Border Chemical Co., CF Industries, Chemtrade Canada, Chemtrade Logistics, Climax Molybdenum, Cornerstone Chemical Co., DuPont, El Dorado Chemical, Freeport McMoRan, Freeport McMoRan Miami, General Chemical, Innophos Fostadoes de Mexico, JR Simplot Co., Langeloth Metallurgical Co., Martin Resources, Mexicana de Cobre S.A. de C.V., Mosaic Fertilizer, PCS Phosphate, Phillips66, Potash Ridge Corp., PVS Chemicals, Savannah Acid Plant, Sherritt International, Solvay Group, Southern Peru, Tesoro Refining, Xstrata Copper and Wisconsin Public Service.

Though the meeting's purpose centered on the safe and efficient production of sulfuric acid, guests began the conference, held at the Scottsdale Resort and Conference Center, with events that were purely social. Kicking off that first afternoon, 14 teams of guests turned out on the golf course to swing and slice in a friendly golf tournament. After working up an appetite on the green, everyone was treated to a Cajun spread consisting of jambalaya, crawfish étouffée, corn machoux and bread pudding. The dinner was sponsored by VIP International and Weir Minerals Lewis Pumps, and demonstrated the culinary talents of VIP International delegates who prepared the entire meal on site.

The next day began with a keynote address by Fiona Boyd of Argus Media, who provided an insightful outlook for sulfuric acid in North America. After the keynote and for the remainder of the event, the conference format consisted of presentations by acid producer plant attendees and co-sponsors, intermingled with panel discussions featuring plant attendees as panelists.

The presentations included:

—"Unique Solutions for Reliability and Process Improvements," presented by Kirk Bailey & Randeep Malhan of DuPont/MECS

—"A Double-Track Road: Acid Plant Size," presented by Peter Ernst of Outotec

—"Innovative Heat Exchanger Repair Techniques," presented by Jack Harris of VIP International

—"Acid Coolers – Selection, Operation and Maintenance for Maximum Reliability," presented by Michael Fenton of Chemetics

—Panel Discussion: Heat Exchangers (acid coolers shell & tube/plate/gas-gas) with presentations by Jacob Lenzi of Freeport McMoRan-Safford and Kleber Jurado of Southern Peru

—"Sulfuric Plant Materials of Construction," presented by Kevin Bryan of The Roberts Co.

"Design of High Silicon Alloy Acid Equipment," presented by Kim Nikolajsen of NORAM Engineering & Constructors

—Panel Discussion: Materials of Construction (acid towers/coolers/pump tanks/piping/valves/pumps for hi temp)

—"Main Blower Solutions and Controls for the Challenges in Sulfuric Acid Plants," presented by Jacque Shultz of Siemens Energy

—"Aspects of Sulfuric Acid Mist Precipitator Design, Materials and Maintenance," presented by Michael Beltran of Beltran Technologies

The first day concluded with an offsite dinner at the McCormick Ranch Golf Club where guests continued to mingle and network over the meal. After dinner, guests were treated with fresh cigars, hand-rolled on site, as well as a selection of accompanying port and whiskey cordials.

The next morning the conference continued with the following full day of presentations:

—"Polishing Filters: An Answer to the Increasing Need for Cleaner Sulfur," presented by Jeroen Bouwan of Twin Filter

—"Sulfuric Acid Plant Hydrogen Explosion from an Unusual Source," presented by Leonard Friedman, Acid Engineering & Consulting Inc.

—Panel Discussion: Safety Issues and Incident Reviews with presentations by George Wang of Solvay-Houston; and Amy Blanton and Patrick Geoghegan of DuPont

—"Stack Mist Acid Reduction and Reduction in Turnaround Maintenance Costs," presented by Kirk Bailey and Randeep Malhan of DuPont/MECS

—Panel Discussion: Acid Towers (packing/mist elimination/distributors/pressure drop/mist carryover/replacement) with presentations by Egan Godfredsen of Border Chemical, Dean Sutherin of Langeloth and Martin Dube of Xstrata-Fonderie Horne

—"VK-701 Update," presented by Patrick Polk of Haldor Topsøe

—Panel Discussion: Converter (replacement/maintenance/catalyst screening and disposal) with presentation by Jared Skinner of Agrium-Redwater

—"Understanding Spray Technology to Optimize Sulfur Burning," presented by Chuck Munro and Dan Vidusek of Spraying Systems Co.

—"Achieving a Gas Tight Seal in FRP Flanged Piping Systems," presented by John Czerwinski of W.L. Gore

—"Continuous Measurement of $SO_3$ in Off-Gas from Smelter Process," presented by Carl Kamme of Opsis and John Connell of CleanAir Engineering

At the conclusion of their second full day, participants relaxed over a traditional southwestern barbeque featuring cowboy steaks, ribs and chicken. After dinner, guests let their hair down during the mechanical bull riding contest where would-be cowboys and cowgirls vied for longest ride. For those preferring more of a mental challenge, guests competed at the casino tables to test their wits in a game of poker, black jack, roulette or craps. The evening wrapped up with door prizes where lucky attendees from acid producing companies won a variety of gifts donated by co-sponsors.

The producing plant attendees volunteered to chair sulfuric acid panel discussions. Chairing the acid tower panel, are, from left, Ron Eickelman of Solvay, Randy Sarrazin of Chemtrade and Egan Godfredsen of Border Chemical.

The following morning the conference continued with the final round of presentations:

—"Project Manager? Not Again! or Project Manager? Why Sure!" presented by Rick Davis of Davis and Associates Consulting

—Panel Discussion: On-line Condition Monitoring/On-line Corrosion Monitoring/Online Gas Leak Repairs, presented by Josh Every of Mosaic-Riverview

—Panel Discussion: Flow Control (valves/dampers/expansion joints/gauges)

—Panel Discussion: Pumps (vertical/horizontal/sulfur/corrosion/maintenance), presented by Ken Rodgers of Tesoro Refining

The conference concluded with a question and answer period as well as an awards presentation for co-sponsors, whose contributions made the event possible.

The co-sponsor companies participating in this year's event included: Acid Engineering Consulting Inc., Acid Piping Technology, Beltran Technologies, Blasch Precision Ceramics, Central Maintenance & Welding, Chattanooga Boiler & Tank Co., ClearAir Engineering, Conco Industrial Services, Chemetics, Davis & Associates Consulting Inc., Drake Specialities, DuPont/MECS Inc., El Dorad Metals, Flexim Americas Corp., Frisch Engineered Products, Feryl Inc., H.A. Tenney, Haldor Topsøe Inc., George Locke Enterprises, Kimre Inc, Koch-Knight LLC, NORAM Engineering & Constructors, OP & Associates – $H_2SO_4$ Consultants, OPSIS, Outotec, Ramco Manufacturing Co., Spraying Systems Co., Siemens Energy Inc., Tenova Minerals, The Roberts Co./Professional Project Services, Twin Filter, Weir Mineral Lewis Pumps, W.L. Gore Sealants, and VIP International.

Throughout the conference, co-sponsors also staffed information booths where producers could learn about the latest technologies available in the industry.

The next Sulfuric Acid Roundtable will be held in 2015 and initial plans are already underway. Please check the event's website at www.acidroundtable.com for updates. ❑

Throughout the conference, co-sponsors also staffed information booths where producers could learn about the latest technologies available in the industry. Stephanie Zingel visits with Patrick Polk, left, and Sam Chidester at the Haldor Topsøe display.

The roundtable consisted of several insightful co-sponsor presentations. Kevin Bryan of the Roberts Co. shared information about sulfuric plant materials of construction.

# AIChE Clearwater Conference celebrates 37th year

The Sheraton Sand Key Resort in Clearwater, Fla., was once again host to the AIChE Clearwater Conference, held June 7-8, 2013. The 37th annual event attracted over 300 professionals from the fertilizer, mining and spent-acid regeneration industries.

The always-popular conference kicked off on Friday with the 16th Annual Sulfuric Acid Workshop. Chaired by Rick Davis of Davis & Associates and Jim Dougherty of Mosaic Fertilizer, the workshop provided attendees with the opportunity to learn from others in the industry in a more relaxed setting. This year's topic was acid towers, and presenters covered a broad range of subjects, including the benefits of brick lining vs. alloy, installation, packing types and support, mist eliminators, materials of construction and maintenance. Delving into these topics and answering attendees questions were Guy Cooper of NORAM Engineering and Constructors Ltd., who spoke about the design of brick-lined towers; Rachel Grimes Braun of DuPont/MECS Inc., discussing the design of alloy towers; Matthias Walschburger of Koch Knight LLC, who focused on ceramics and bricks; and David Bailey of Central Maintenance & Welding, covering alloy tower maintenance.

On Saturday, attendees chose between two concurrent technical sessions. One session focused on sulfuric acid production and maintenance, while the other was geared toward the phosphoric acid industry. Papers presented to the sulfuric acid attendees included:

—"MECS SolvR™ Regenerative Sulfur Dioxide Technology," presented by Steve Puricelli of MECS Inc.

—"Mosaic Fertilizer Simultaneously Meets New $SO_2$ Emission Regulations and High Performance of its Single Absorption Sulfuric Acid Plant by Using Cansolv's Regenerable Technology," presented by John McIlwain of Mosaic Fertilizer and Philippe Micone of Cansolv Technologies

—"Main Blower Solutions and Controls for the Challenges in Sulfuric Acid Plants," presented by Jacque Shultz of Siemens Energy Inc.

—"Boosting Sulfuric Acid Production While Lowering $NO_x$ Emissions," presented by Naresh Suchak of Linde Gases Division

—"Proven Low Emissions from Sulfuric Acid Plants with Alkali or Peroxide Systems," presented by Leonard Friedman of Acid Engineering & Consulting

—"Modern Trough Distributer Improves Operation and Maintenance," presented by Tyler Caviglia of Chemetics

—"Update on Commissioning of the Ambatovy Acid Plants," presented by Werner Vorster of Tenova Mining & Minerals

—"The Development of Solid Sulphur Burner as an Alternative for the Production of $SO_2$ for Use in a Sulfuric Acid Plant," presented by Werner Vorster of Tenova Mining & Minerals

Another mainstay of the Clearwater convention is always the plentiful hospitality and networking opportunities—this year was no exception. Attendees and their families enjoyed popular hospitality suites each night, giving them the opportunity to reconnect with friends and colleagues while enjoying the hotel's beautiful location. In addition to the traditional hospitality events, a science party was held for the children and grandchildren of attendees. Hosted by the Museum of Science and Industry in Tampa, the kids got to try out some wacky experiments and enjoy cool door prizes.

*Planning is already underway for the 38th annual meeting, to be held June 6-7, 2014, at the Sheraton Sand Key. Please visit www.aiche-cf.org for further details.* ❑

**Guy Cooper of NORAM Engineering and Constructors, center, visits with Rick and Charlotte Davis of Davis & Associates during NORAM's hospitality suite.**

**The MECS Inc. crew enjoyed the karaoke at their company's hospitality suite. Pictured, from left, are Rachel Braun, Steve Puricelli, Sarah Douglas, Sarah Richardson, John Horne and Doug Azwell.**

**Kimre hosted a hospitality suite at the annual AIChE Clearwater Conference. Enjoying the evening, from left, are Janet Matos, Ed Fowler, Daniel Buehring, Frances Accurslo, Fred Mueller, Mary Keenan and Stephanie Gornail.**

# SYMPHOS 2013 — innovating for the future of phosphate

In only its second go around, the SYMPHOS conference has already become the central hub pulling together like-minded professionals from the phosphate industry. Attracting over 1,000 researchers, manufacturers and suppliers, this year's SYMPHOS 2013 was the premier venue to exchange ideas about phosphate and share the latest innovations in that chemical's sustainable development.

The Office Cherifen des Phosphates (OCP Group), one of the world's leading phosphate producers, organized and hosted the event, held from May 4-10 in Adgair, Morocco. By the start of the conference, the guest list had expanded by some 200 participants beyond the head-count of the original SYMPHOS, held in 2011.

This year's event offered an extensive technical program allowing industry specialists from around the world to collectively consider the future of the phosphate industry. The program addressed pressing and sometimes contradictory demands such as how to deal with the rising global demand for food, how to preserve phosphate deposits, how to operate efficiently and sustainably, and how to maintain safety and the environment.

Attendees considered these questions in a variety of formats, from lecture style to interactive workshops to scheduled meetings. All together, the program consisted of nine technical courses, 16 plenary lectures, 145 oral presentations, 10 thematic workshops and more than 100 exhibits. In addition, guests were offered the opportunity to pre-book working meetings with customers, suppliers and any other party having shared interests. By the start of the conference, there were 3,000 of these meetings scheduled.

Participants interested in the arena of sulfuric acid could attend the sulfuric acid workshop. Chaired by Kathy Hayward, publisher of *Sulfuric Acid Today*, and co-chaired by Ahmed Hanine, director of chemical study and development at OCP, the workshop provided the following presentations and a subsequent question and answer period:

—"Spray Injectors within Large Capacity Molten Sulfur Combustion Spray Efficacy: Fluid-Structure Interaction Study," by Kathleen Brown, Wojciech Kalata and Rudolf Schick of Spraying Systems Co., U.S.

Ahmed Hanine, director of chemical study and development at OCP, co-chaired the sulfuric acid workshop during SYMPHOS 2013.

Amar Drissi, executive vice president at OCP, welcomes over 1,000 participants to the second edition of the international symposium on innovation and technology for the phosphate industry.

—"Modeling and development of computer code for the simulation of $SO_2/SO_3$ converters," by Belkacem Abdous, Lhachmi Khamar and Omari Lhoussaine of OCP SA, Morocco.

—"$H_2S$ Emission Control by Converting to NaHS," by Safaa IbnGhazala, Salaheddine Albustami, Allal Khoudir and Abdessamad Nasri of JESA, Morocco.

—"Optimization of $SO_2$ Scrubber using CFD Modeling," by Rudolf Schick, Kathleen Brown and Wojciech Kalata, Spraying Systems Co., U.S.

—"Polishing Filters: the answer to the increasing need for cleaner sulphur," by Jeroen Bouwman of Twin Filter, The Netherlands.

—"Design, realization and commissioning of a 'DUCT VALVE' in a Morocco Pakistan Phosphorus sulfuric plant," by Ouadie Senhajie of OCP SA, Morocco.

—"Cleaning and neutralization of sulfuric acid storage tanks with an automatic spray system," by EL Bahraoui Abdellah and Arhnaje Elmostafa of KIMIA, Morocco.

Besides the sulfuric acid presentations, nine other workshops explored topics relating to innovation in the mining industry, sustainable mines, smart mines and automation, desalination technologies, geology, the environment, phosphoric acid, materials and corrosion, energy and water, and fertilizer manufacturing.

Visiting the exhibition area of SYMPHOS 2013, are, from left, Paul Kucera, Chris Dye and Vance Singletary of Mosaic Fertilizer.

Kathy Hayward, publisher of *Sulfuric Acid Today*, visits with, from left, Nitzan Moshe, Naveh Assaf and Kahalon Yakov of Rotem Amfert Negev Ltd, during the conference's gala dinner.

New to this year's conference were "novelty shows," during which companies shared their technologies with audience capacities of up to 300 participants. Both DuPont Sustainable Solutions and MECS hosted their own novelty shows. The DuPont Sustainable Solutions show was titled, "Alloy Equipment in Sulfuric Acid Production—Solution for Efficient, Reliable and Safe Operations." MECs presented its show called, "$SO_2$ Emissions: MECS Innovations for Sulfuric Acid Plants with Clean Technologies."

In keeping with an event of this stature, the conference closed with a gala dinner. On the final evening, guests dined on cuisine of the local culture and enjoyed the entertainment of a traditional Moroccan band, singers and dancers.

*For more information and for updates on the next symposium in 2015, see the event's website, www.symphos.com.* ❑

# The Roberts Company provides engineering, fabrication and installation services

Founded in 1977, The Roberts Company (TRC) has grown from a small mechanical contractor to a large multi-faceted company that offers turn-key engineering, fabrication and installation services to its customers. Though headquartered in Raleigh, N.C., TRC extends its practical and innovative solutions across the globe, from Idaho to Australia, and numerous locations in between.

With over 35 years of experience under its belt, TRC now handles projects of various sizes in a host of industries, including chemical, specialty chemical, mining, power, light industrial, pharmaceutical and manufacturing.

Current and recently completed projects on the company's resume include:

—A large engineering, procurement and construction project that will allow the client to unload, store and distribute bulk chemicals on the east coast.

—Fabrication of MECS ZeCor-Z® Acid Coolers that will eliminate the need for anodic protection.

—Design for the replacement of two plate and frame heat exchangers with a ZeCor-Z® acid cooler. The effort also included a cost analysis of the ZeCor-Z® acid cooler versus an anodically protected acid cooler, as well as the fabrication and installation of the acid cooler with new piping.

—Fabrication and installation of a ZeCor-Z® drying tower for a plant in Louisiana.

—Fabrication and installation of a converter and new ductwork for a plant in Alabama. The project also included demolition of the old converter.

TRC's broad-based expertise is provided by its fully integrated divisions specializing in engineering, fabrication

The Roberts Company fabricated this ZeCor-Z® drying tower and will complete site erection in Louisiana in December.

**The Roberts Company fabricated this 304L converter and completed installation with new ductwork during an October outage in Alabama.**

and field service.

The Roberts Company Engineering Division in Raleigh, N.C., has extensive capabilities to meet any engineering need. The Engineering Division is a full-service project solutions group that provides turn-key engineering, procurement, and construction (EPC) services, front end engineering and design (FEED) and design/build services for grass roots projects or plant upgrades.

The Roberts Company Fabrication Services Division in Winterville can meet any process equipment needs, including pressure vessels, heat exchangers (fabrication and rebuilds), towers and columns. The Fabrication Services Division offers unlimited steel and alloy plate fabrication services specializing in stainless steel and exotic alloy custom complex ASME code pressure vessels and heat exchangers. The company also manufactures to international standards as required and delivers alloy fabrications by truck, rail or ship anywhere in the world. If an item is too large to ship whole, the Fabrication Services Division field erects shop fabricated components wherever the customer is located.

The Fabrication Services Division recently added personnel and equipment to produce up to 200 tons of piping fabrication per month. The company can fabricate sulfuric acid piping in materials such as ZeCor-Z® and ZeCor-310M®.

The Roberts Company Field Services Division, with offices throughout the southeastern United States, can meet any construction, project, maintenance and turnaround needs. The Field Services Division can provide experienced craftsmen for projects involving civil, concrete, structural, equipment installation, rigging, electrical, instrumentation, piping and tanks.

*For more information, contact The Roberts Company at (252) 355-9353 or visit www.robertscompany.com.* ❑

# Faces & Places

Participants from Border Chemical enjoyed the 2013 Sulfuric Acid Roundtable western dinner held in Scottsdale, Ariz. Pictured, from left, are Steve Vasko, Greg Zahayko and Egan Godfredsen.

Dorian Sugar of DuPont, left, event organizer for the the STRATCO® Alkylation Workshop and the MECS® Sulfuric Acid Regeneration (SAR) Workshop, visits with Rama Venkatachalam of Lucite International, Kirk Bailey of MECS and Michael Bridgers of DuPont at the Claxton Farms offsite dinner near Asheville, N.C.

Kim Nikolajsen of NORAM, left, networks with Werner Vorster of Tenova Minerals during the welcome Cajun dinner at the 2013 Sulfuric Acid Roundtable in Scottsdale, Ariz.

Thierry Marin of DuPont Sustainable Solutions, left, and Pascal Du Bois d'Enghien of DuPont MECS Inc., center, visits with participants in DuPont's exhibition area at the SYMPHOS 2013 conference in Agadir, Morocco.

Catching up at the 2013 Sulfuric Acid Roundtable in Scottsdale, Ariz., are, from left, Skip Unger of Acid Piping Technology, Tina and Ed Knoll of Acid Piping Technology and Becky and Jack Harris of VIP International.

Hoss Maddry of VIP International stirs a pot of crawfish étouffée cooked on-site for the Cajun welcome dinner.

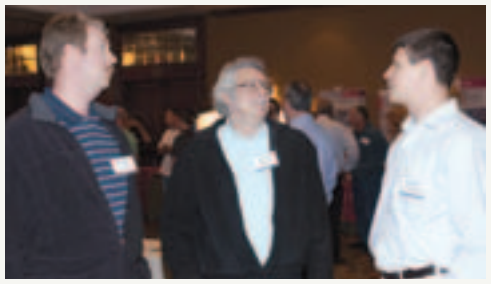
Orlando Perez of OP & Associates–$H_2SO_4$ Consultants catches up with Marie Vognsen of Haldor Topsøe A/S at the welcome Cajun dinner at the 2013 Sulfuric Acid Roundtable in Scottsdale, Ariz.

Nelson Clark of Clark-Koch, left, visits with his long time friend, Bob Fell, who recently retired from MECS Inc., at the AIChE Clearwater Conference in Florida.

Don Harcus of J.R. Simplot, center, was the lucky recipient of the Benelli shotgun door prize donated Jeff Primm, left, and William McNabb of El Dorado Metals at the 2013 Sulfuric Acid Roundtable in Scottsdale, Ariz.


Michael Fenton of Chemetics mans the company's booth during the SYMPHOS 2013 conference and exhibition in Agadir, Morocco.

Visiting at the McCormick Ranch Golf Club dinner, held in conjunction with the 2013 Sulfuric Acid Roundtable, are, from left, Randeep Malhan of DuPont MECS Inc., Doug Holm of Cornerstone Chemical Co. and Rick Bywater of Cornerstone Chemcial Co.



David Popowitch of Flexim, right, visits with Jon Meyer of PotashCorp-Aurora, left, and Feryl Masters of Feryl Inc., in Flexim's display area during the 2013 Sulfuric Acid Roundtable in Scottsdale, Ariz.

Josh Every, left, and Ricky Carlson of Mosaic Fertilizer relax during the welcome Cajun dinner at the 2013 Sulfuric Acid Roundtable in Scottsdale, Ariz.

Michael Kemmerich of Outotec, left, shares the benefits of his company's sulfuric acid technology with participants of SYMPHOS 2013 in Agadir, Morocco.

The 2013 Sulfuric Acid Roundtable kicked off with a friendly golf tournament consisting of 14 teams at the beautiful McCormick Ranch golf course. Pictured are, from left, Timothy Christian and Ron Eickelman of Solvay and Ken Black and Mick Cooke of Weir Minerals Lewis Pumps.

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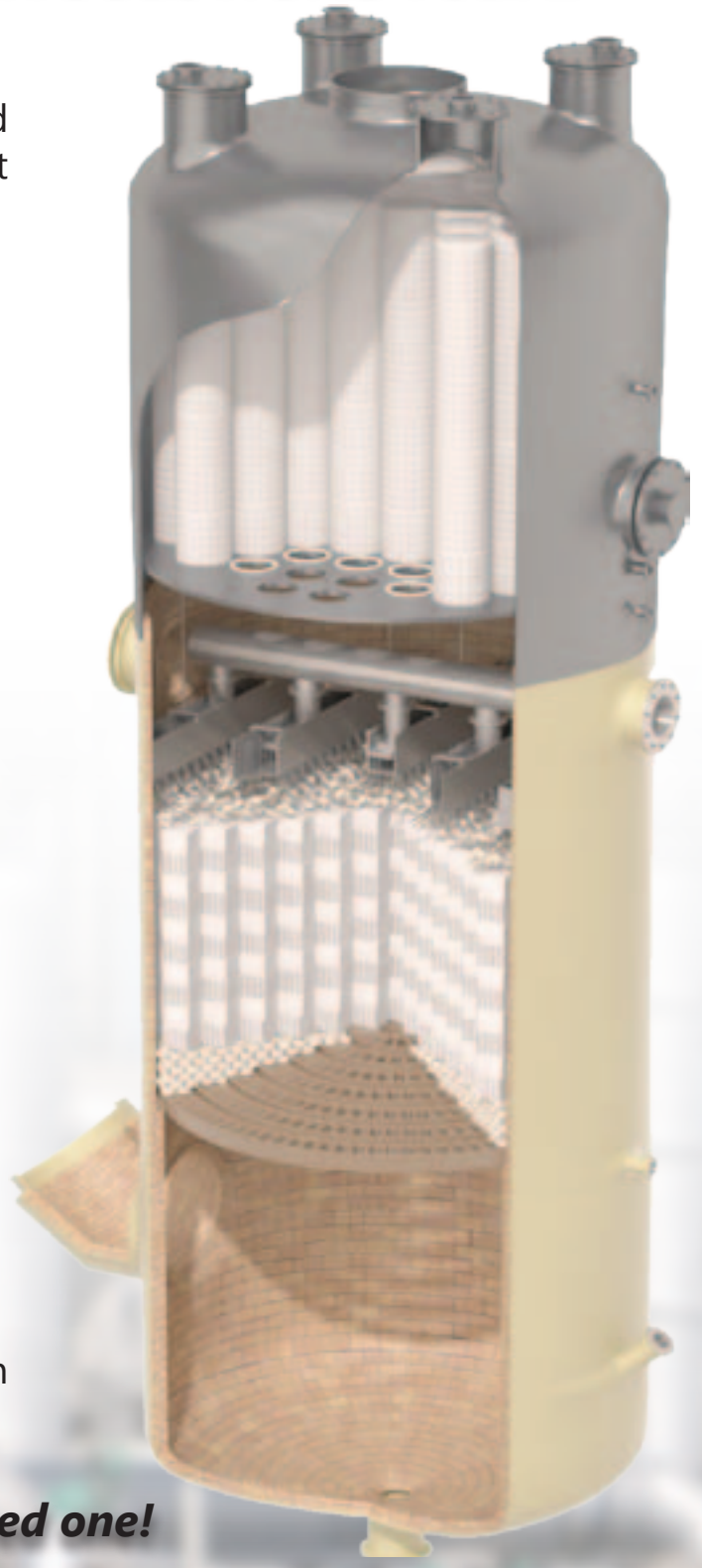

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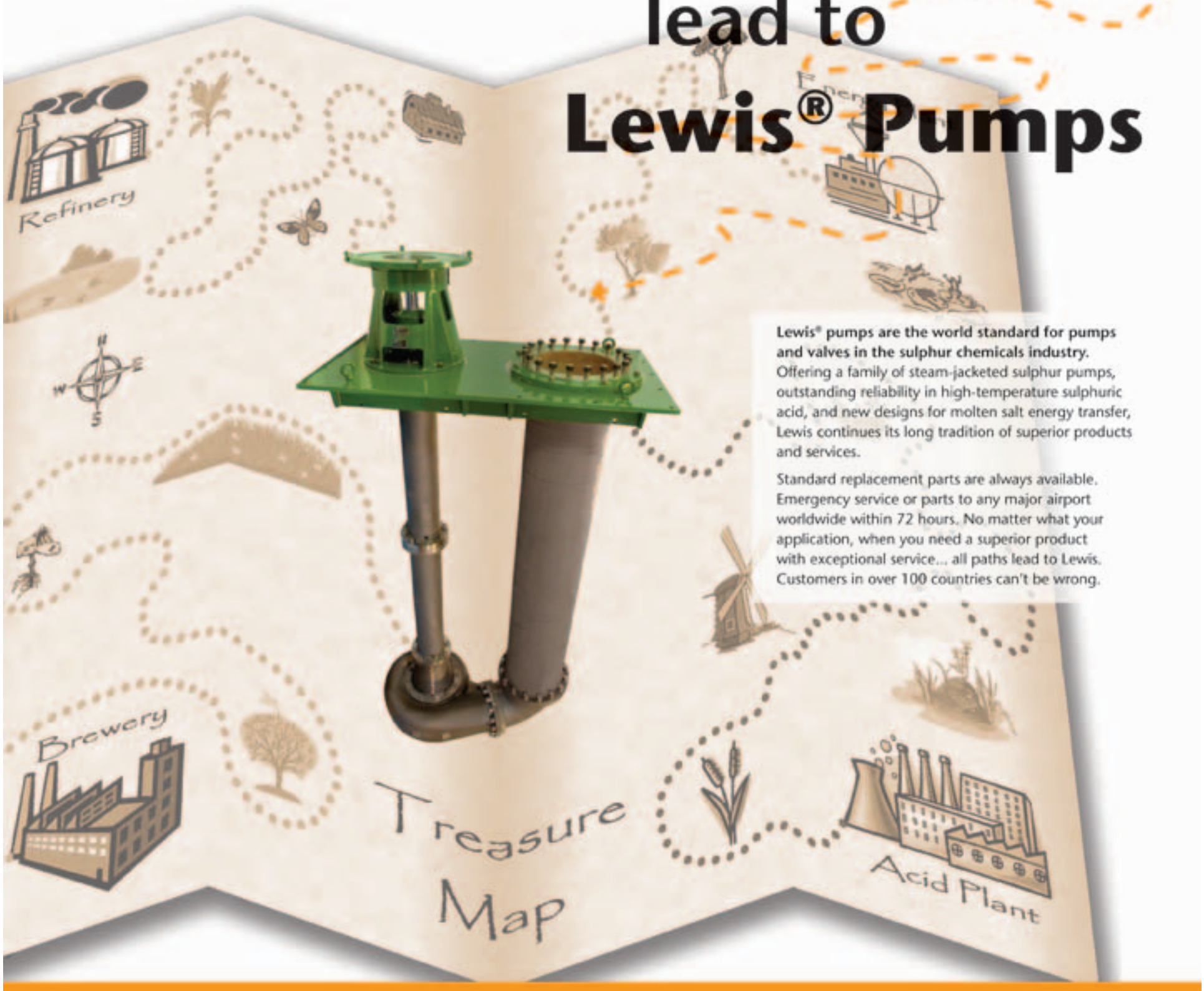


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