COVERING BEST PRACTICES FOR THE INDUSTRY

Sulfuric Acid TODAY

www.H_2SO_4Today.com

Fall/Winter 2017

ASARCO's copper plant investment yields two-for-one: cleaner air and longer life

Page 7

IN THIS ISSUE >>>>

ASARCO's copper plant investment yields two-for-one: *cleaner air and longer life*

By: April Smith

Replacing Hayden's five existing converters with three larger capacity versions will reduce SO_2 emissions at the smelter.

ASARCO's Hayden, Ariz., copper smelter has been undergoing a major upgrade that will enable the operation to capture nearly all its SO_2 emissions by the end of 2018. The company is investing approximately $180 million into its Hayden plant to fund improvements that both satisfy a consent decree reached with the EPA and secure Hayden's operation for the future.

One of only three major copper operations in the United States, the Hayden smelter processes up to 693,500 short tons of copper concentrate annually. In 2016, the concentrate from the facility produced over 275 million pounds of copper anodes.

Copper is a key component in electrical products, electronic equipment, and the routing of electricity into homes. With continued growth predicted in the electronics industry, ASARCO planners wanted to ensure future production at Hayden kept up with demand. But smelting copper at high temperatures releases sulfur dioxide, and the plant's emissions control system needed to be updated to comply with newer, more stringent government regulations. So through a consent decree reached with the U.S. Environmental Protection Agency, ASARCO began a major upgrade to mitigate SO_2 emissions at the smelter.

"We will be meeting the new standards in the U.S. for emissions control," said Joe Wilhelm, General Manager for Hayden Operations. "And what we get out of the deal is the ability to operate for the next generation, including throughout the life of our mines."

About ASARCO

ASARCO was established in 1899 as American Smelting and Refining Company and was a consolidation of several lead-silver smelting companies. The facility at Hayden has been in production since 1912, when it began processing copper ore from the adjacent Ray mine, which feeds the Hayden smelter to this day. In 1983, the facility received a major upgrade, including the installation of its present sulfuric acid plant. Further modernizations to the Hayden smelter and concentrator occurred in 1989, 1996, 1998, and 2012. In 1999, Grupo Mexico purchased ASARCO and the company now operates as a wholly-owned subsidiary.

Today ASARCO is an integrated copper mining, smelting, and refining operation with approximately 2,300 employees companywide, and about 560 at Hayden. In addition to the Hayden complex, ASARCO's Arizona operations include three mines, two of them with solvent extraction/electrowinning plants. The company also runs the Amarillo Copper Refinery in Texas, which refines anodes from Hayden to copper cathode, then to rod and cake for sale to customers.

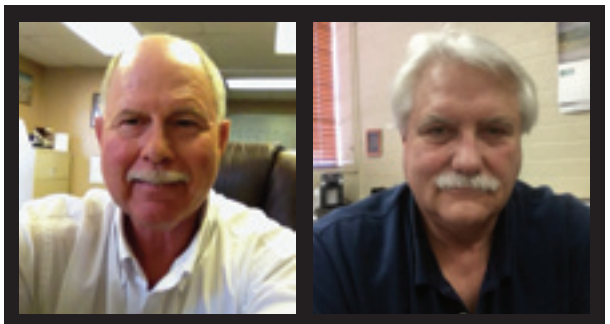
Hayden's operations today include a 24,000 ton/day concentrator, an oxygen flash furnace, converters, anode casting, oxygen plant, sulfuric acid plant, and associated maintenance, warehouse, and administrative facilities. The acid plant produces about 575,000 short tons of sulfuric acid annually which is used in the ASARCO leaching operations or is sold on the open market.

Over decades of production at Hayden, the copper industry as a whole has had its downturns, shuttering multiple copper producing plants across the nation. But given so few large producers now in the United States, the predicted longevity of the Ray mine (until roughly 2040), and copper's continuous use in the growing electronics industry, the plan for Hayden was clear: upgrade and keep the copper flowing.

Capturing emissions during conversion

The plant upgrade is currently 50 percent complete, with the whole project expected to finish by the end of 2018.

Sulfuric acid plant upgrades are underway and will be completed by the end of 2018.



Joe Wilhelm, left, general manager for Hayden Operations Steven Gasser, right, Hayden-operations smelter manager.

One of three new larger converters installed at Hayden's copper smelter, giving the plant greater control of emissions.

Hayden's acid plant produces about 575,000 short tons of sulfuric acid annually, which is used in the ASARCO leaching operations or is sold on the open market.

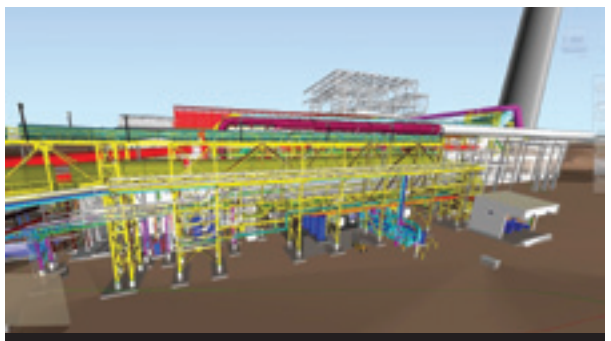
The new wet gas cleaning system at Hayden's acid plant improves particulate capture and eliminates a 1970s-era system that was a source of SO_2 emissions.

David Valdez, Hayden-support manager.

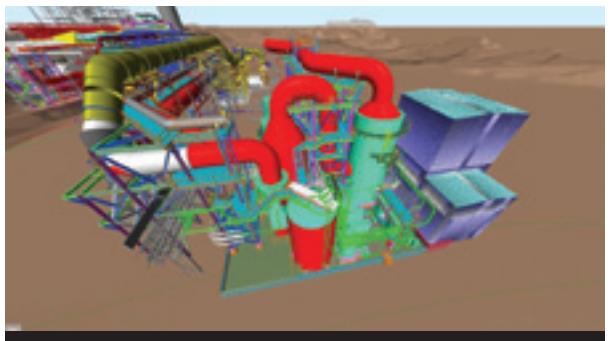
It's been a multi-year endeavor, which included securing initial engineering contractor Gas Cleaning Technologies in 2011 and finalizing consent decree negotiations for emissions abatement with the EPA in 2015. Under the EPA agreement, the plant will improve its SO_2 emissions capture from 95 percent to 99+ percent.

The primary mechanism for reaching this goal is to replace the smelter's converters, where molten copper is heated at very high temperatures to separate out iron and other impurities. The existing five 13-ft. diameter converters will be replaced with three 15-ft. diameter converters, each with about 1.5 times the capacity of the originals. Greater capacity affords the plant the flexibility to run only a single converter at a time, rather than the two converters it had been concurrently operating. Fewer converters running mean fewer rollouts for skimming and recharge, which in turn translates to fewer opportunities for fugitive gas emissions. Additionally, larger ladles, 280 cubic feet instead of 200 cubic feet, will be installed to reduce the number of hot metal transfers.

Aside from the converters themselves, a major feature of the upgrade is a new ventilation system to be constructed above the converters to capture fugitive emissions. The system consists of brand new ducting and hooding including primary, secondary, and tertiary off-gas capture systems. The new converters will also be fitted with an electrostatic precipitator (ESP) to remove solids from the converters' off-gas. The off-gas collected at the converters is then ducted to the facility's sulfuric acid plant where the contained SO_2 is used in the production of sulfuric acid.



Rendering of new converter upgrade at ASARCO's Hayden, Ariz., copper smelter.



Modeling of new wet gas cleaning system at Hayden's sulfuric acid plant.

Wet gas handling at the acid plant

Achieving greater than 99 percent SO_2 capture also required upgrades to the facility's 2,000 STPD sulfuric acid plant. "The consent decree sets a combined emissions limit throughout all stages of the process, including the acid plant," said David Valdez, Hayden-support manager. "The combined emissions have to meet one limit at the stack exit."

The double-contact, double-absorption, 3+1 technology plant provides all the sulfuric acid used in copper leaching at ASARCO facilities, with any extra acid produced sold externally. The acid plant can process up to 120,000 standard cubic feet per minute (SCFM) smelter gas at a strength of up to 12 percent SO_2 (dry basis). The upgrades underway at the facility will retain the same gas-handling capacity, but more efficiently increase the SO_2 concentration in the gas stream.

A key aspect of the upgrade involves replacing the 1970s-era gas cleaning section of the acid plant with a new scrubbing system that improves particulate capture from off-gas streams. The particulates from the scrubbing process are valuable because they contain copper and can be reprocessed for further metal extraction. "We make byproducts from all that scrubbing water," explained Valdez, "because it is high in copper."

But the procedure for separating the water from particulate was time consuming and represented another source of emissions. "We used to pump the used scrubber water to solar drying beds out in the open. It took forever to get the material ready for reuse or sale," Valdez said.

The equipment for the system includes a new scrubber, packed gas cooling tower, thickener, filter press, and dryer. The scrubber is coupled with a disengagement (separator) vessel to facilitate gas and blowdown liquid streams. Blowdown from the scrubber and the rest of the scrubbing system is pumped continuously to the new thickener to thicken solids from 1.4 percent to approximately 25 percent by weight. The underflow from the thickener is pumped to a 55 cubic foot capacity filter press to remove the majority of the liquid. "We get the solids to 10 percent moisture content, ready to be put back in the mix to process again or sell to another metals extraction facility," Valdez said.

The 2,000 STPD double-contact, double-absorption, 3+1 technology plant provides all the sulfuric acid used in copper leaching at ASARCO facilities.

Improving acid contact side

To tamp down on another part of the process that generates fugitive emissions, the plant will also install a new, larger capacity preheater. Historically, regulating processing temperatures and reheating during startup in particular have been responsible for most of the SO_2 emissions at the acid plant. "Our old process involved starting up one bed at a time, with each bed heating up the next," explained Steven Gasser, Hayden-operations smelter manager. "But this method took too long, releasing too much SO_2 to be compliant with the new rules. With the new consent decree, we can't do that anymore. We have to preheat all the beds at the same time."

So early next year, the team will install a NORAM Engineering and Constructors Ltd.-designed preheater capable of delivering preheated gas to each converter bed independently. The design will enable operators to heat all the beds concurrently, which reduces startup time and thus fugitive emissions. The larger preheater is designed to operate at full-flow capacity and high process gas temperatures.

Improvements to towers: Drying, Final, and Cooling

Other enhancements to the acid plant operation included upgrades in the drying tower, final absorption tower, and the

VIP International replaced the inlet gas elbow to the drying tower with a NORAM-designed brick lined mild steel elbow.

cooling tower that cools water used in acid heat exchangers. Some of the changes addressed issues with leaks and distortion, which are not surprising considering how long the plant has been running. "We've gotten 34 years of service out of this plant," said Gasser. "You've got to keep up with the maintenance to continue to run efficiently and in compliance," he said.

The drying tower received a new MECS® distribution system along with demist pads at the tower's exit. "Our old system was from 1998 and we were having issues with mist carryover," Valdez explained. The team also replaced the old lead inlet gas elbow with a NORAM-designed brick lined elbow.

The team also installed a new EvapTech-designed cooling tower to cool the interpass and final tower acid streams. The two-cell design with variable speed fans offers better temperature control and the inline pH and conductivity meters provides better monitoring.

Like the drying tower, the final tower internals were replaced to address mist carryover. MECS® Inc.-designed equipment was used, including a ZeCor®-Z Uniflo® distribution system, replacement tubesheet, and 52 new mist eliminator candles.

Other maintenance ongoing over the last few years included piping, which the team has replaced in all three towers, and shoring up the four-pass converter, installed in 1983.

Challenges

Not surprisingly, a project of this scope provided the Hayden team with its fair share of hurdles. The first of these was identifying the goals and measures to achieving EPA compliance.

"We couldn't do anything until we had an agreement with the Department of Justice and the EPA," said Wilhelm. "We worked for four years, from 2011 to 2015, negotiating with the government to get a consent decree agreement. It took a long time, but we're pleased with the outcome."

Another huge challenge has involved scheduling the construction. The team had to determine which aspects of the retrofit required shutdown and which could be performed while operating. Then the team had to work out exactly how to perform the retrofit while operating. "It's like putting together a jigsaw puzzle," said Valdez. "Scheduling the transition to new converters from the old converters has been difficult. Also, we're temporarily running the new scrubbing system with part of the old cyclones until the new ESP operation begins."

The Hayden complex as a whole employs about 560 people, with 360 working at the smelter. Since 2015 when construction began, there have been roughly 400 contractors working at the facility, and this trend is expected to continue for the next 6 to 12 months. Throughout all the construction, however, project safety has been exemplary. "The contractors and our plant personnel have been extremely successful with safety," Wilhelm said. "All of our contractors and Hayden employees are outstanding."

Future at Hayden

Per the consent decree timeline, the completion date for the project is year-end 2018. In terms of the upgrade's impact going forward, the team anticipates a slight uptick in costs. "We'll need more electricity to drive the new ventilation for the converters," Wilhelm explained. "However, employment will remain about the same," he said, "and we will produce 4 percent more sulfuric acid."

And then there's the impact to the people operating the plant. "I think it will be an easier plant to run," said Gasser, "because we'll be running at the same production level as today but with only one converter at a time rather than operating two converters concurrently nearly all the time. And we'll have fewer crane movements for transfer of metals."

Wilhelm speaks of the sense of security employees have been feeling because an investment in the plant mirrors an investment in their future, too. "Of course, everyone loves the shiny new equipment," he said. "But people seem happy in a deeper sense; that the changes we're making reflect greater job security."

The changes, in fact, put the facility in good standing to continue running through 2040, the present projected life of the Ray mine, and likely much longer. Plus, operating at nearly 100 percent SO_2 capture ranks Hayden among the big leaguers. "How much better can you get than 99+ percent recovery?" Wilhelm said. "That's what the best smelters in the world do and that's what we'll be doing too." ❑

The acid plant's new EvapTech-designed cooling tower provides better temperature control and monitoring.

VIP International installs new MECS®-designed tubesheet in the acid plant's final tower.

Vacuuming old ceramic packing, VIP International prepares for loading new 3" ceramic saddles from APT in the acid plant's drying tower.

Hayden's upgrades

Wet gas cleaning

- New MikroPul-design Venturi scrubber, GEA-design packed gas cooling tower, WesTech Engineering thickener, Ascension Industries Durco filter press, and Met-Chem dryer.
- Venturi scrubber improves particulate capture from off-gas streams. It is coupled with disengagement (separator) vessel to facilitate gas and blowdown liquid streams. Vessel has "venturi throat" where gas passes through and throat blades actuate to a damper position to control with a pressure drop set point.
- Centrifugal recirculation pumps recirculate scrubbing water which quenches and cleans incoming off-gas.
- Packed gas cooling tower cools gas to desired set point before entering wet electrostatic mist precipitators.
- Gas flows countercurrent to a recirculating weak acid stream which is pumped via recirculation pumps through a trough-style liquid distributor. Recirculating weak acid is cooled in a set of plate heat exchangers with cooling tower water.
- Blowdown from scrubbing system is pumped continuously to the new thickener to thicken solids from 1.4% to about 25% by weight.
- Underflow from thickener pumped to 1,000 mm side-bar electro/hydraulic Ascension Industries Filter Press with 48 chambers and 55 cu. ft. capacity to remove majority of liquid with discharge filter cake of 15-25 percent moisture.

Preheating

- NORAM-design preheater will replace old undersized unit.
- Improves preheat based on full flow (120,000 standard cubic feet per minute (SCFM)) capacity and higher process gas temperature.
- Distributes preheat gas independently to all converter beds.
- Helps with system temperatures especially during startup.

Tower improvements

Drying Tower

- VIP International replaced inlet gas elbow w/NORAM-designed brick lined mild steel elbow.
- VIP International replaced distribution system with MECS® ZeCor®-Z Uniflo® Distribution System w/4,500 gallons per minute (gpm) design.
- VIP International replaced MECS® SS Mesh Demist Pads at tower exit.
- VIP International unloaded 5,500 cubic feet of ceramic packing, inspected Aludar® beams and grid blocks. Loaded 5,500 cubic feet of new 3" saddle ceramic packing from Acid Piping Technology (APT).

Final Tower

- VIP International replaced distribution system w/MECS® ZeCor®-Z Uniflo® Distribution System @ 2,500 gpm.
- VIP International replaced tubesheet w/MECS® design 316 SS replacement tubesheet.
- VIP International replaced 52 "candles" w/MECS® design mist eliminator elements.

Cooling Tower

- New Crossflow EvapTech design cooling tower w/21,000 gpm water flow provides cooling for interpass and final tower absorbing acid streams.
- Two-cell design with variable speed fans to control on water temperature set point.
- Inline pH and conductivity meters for better control.