

# Innovative heat exchanger repair

Fouled tubes in a cold pass heat exchanger are bad enough, but when tubes actually fail, the problem goes from serious to critical. In the past the only solution was to plug leaking tubes until so many tubes were plugged the equipment must be replaced.

However, when cross flow issues in Minara Resources' cold interpass heat exchanger started significantly reducing the company's sulfuric acid production, Minara partnered with VIP International of Baton Rouge, La., to develop an innovative solution. Minara, based in Perth, Western Australia, relies on sulfuric acid in its nickel and cobalt mining and refining operation located in the northern goldfields region between the towns of Leonora and Laverton.

Minara was well aware of the issues with its cold interpass HX-19 heat exchanger and had a new heat exchanger on order. But because Minara's equipment is so large, the lead-time on replacing it was well over 12 months. A repair needed to be executed that could last at least 18 months.

"We have one of the largest exchangers of its type," Wayne Ashworth, general manager at Minara explained, "with roughly 3,762 tubes of about 10 meters each." And the problem was that a significant portion of the tubes ruptured and became fouled with sulfates.

"What happened was that a ruptured steam jacket on the sulfur guns went unnoticed and breached the tubes of the cold heat exchanger," John Hall, Minara manager, utilities maintenance said. This event then caused the bypass that affected the company's production rates. Minara couldn't wait for a replacement exchanger; they needed an immediate intermediary solution.

At this point, the company consulted with VIP International. VIP first inspected the exchanger and found many tubes

plugged with hard sulfates. "There was a video inspection of the inside of the tubes to verify where the corrosion was," said Ashworth. "As expected, the tubes had failed close to the bottom of the exchanger, about three to four inches from the bottom tube sheet."

VIP then proposed a three-part repair strategy:

Step 1. Clear all the plugged tubes and open partially plugged tubes via mechanical tube cleaning equipment. VIP International has an arsenal of equipment and techniques to clean fouled tubes. Pluggage can range in consistency from peanut butter to concrete and the condition cannot be predicted. "We used drills with custom bits on the hardest material," Bubba Miller, Director of VIP International said. "After a pilot hole is opened we can use more conventional tools."

Step 2. Prepare the tube ID with tungsten carbide cutter for a close tolerance fit with the tube sleeves. Since the tolerance in a sleeving operation is critical, proper dressing of the tube and sizing of the sleeve is essential.

Step 3. Install stainless steel sleeves about 20 inches long into the tubes. Material selection and implementing the strategy took careful planning. "We had approximately four months in trials," Hall said. "We trialed and tested different insertion methods and ultimately decided on the compression insertion and in-situ rolling," he explained. "VIP was involved in the pre-installation trials on the rolling of the tubes," Hall continued. VIP fashioned models and experimented with different methods in Baton Rouge while results were verified in Australia.

"It was a team effort," Miller explained. "Communication and co operation was excellent every step of the way."

The company also had their share of backup plans. "We had many contingencies in place," Ashworth said. "We went in



**Minara's gas-to-gas exchanger is one of the largest of its type in the world with approximately 3,762 tubes and over 30 feet in length.**



**Proper PPE, specialized equipment, VIP International's experience and a joint venture attitude was attributed to the success of the repair.**

with the idea that some tubes might be worse than others, so when we did hit hard spots we had a plan B, a plan C, and a plan D."

With all the trials and backup plans, the work was completed within the budgeted time frame. The installation itself took only eight days. Most importantly, the plant is up and running.

"This solution is allowing us to run at maximum rates and we have been up and running ever since the installation," Ashworth said. The plant is currently running at approximately 60 tons per hour burn rate at 4,400 tons per day.

"This process is buying us time until we can get a replacement exchanger," Ashworth said. And both he and Hall are very pleased with results. □