

## **Life of Ten Heat Exchangers Tripled (Savings: \$600,000 every month)**

Imagine a slurry (30% mineral-suspended solids, 475°F, 650 psi, pH <1) flowing through a titanium shell-and-tube cooler at 6 ft/s; how long do you think this unit will last?

The leach plant of our metallurgical client operated 10 coolers, under the above conditions, with an average life of 20 days. The maintenance and operations losses from these failures were \$12 million/yr.

When leaching became the production bottleneck, a cross-functional team of 6 employees, led by Tony Rodriguez of Pemmax Consultants, was given the challenge of doubling the average operating life of these units. Using PROACT Root Cause Analysis (RCA) methodology, the team analyzed the problem for two weeks and made many recommendations, mostly related to changes in operations and maintenance procedures; these recommendations were implemented immediately, raising the average life of the coolers to 25 days.

The team also identified several hypotheses, suspected to be the main causes of the failures. During the next six months, every failure was analyzed against these hypotheses and it was discovered that the main failure modes were:

- 1. Weld perforations at the inlet of the first-pass tubes.**
- 2. Tube-wall perforations of the first-pass tubes, approximately 12" from the inlet**

Failure mode 1 was caused by partial obstruction of tube inlets. A very ingenious crusher and screen combination was incorporated inside the cooler's feed-head; this increased the average life to about 50 days.

Failure mode 2 was caused by turbulence that originated at the inlet of the tubes. Cones were installed at the inlet of the tubes to streamline the flow and this failure mode was eliminated; this increased the average life to about 70 days.

At this point, the target life was raised to 90 days (full production campaign). To achieve this, the filters were made more efficient and robust; currently the coolers last 70 to 90 days and we continue improving inspections and overhaul procedures to ensure that all the units last a full production campaign.

Before this analysis, the short life of the coolers was mostly attributed to high acidity and flow rates. After eliminating about 30 root causes, the life of the units has more than tripled, even though the adverse process conditions remain the same.

**Additionally to the economic benefits for production and maintenance, increasing the life of the coolers reduced the work demands on many hourly and supervisory personnel. These benefits raised enthusiasm among all the personnel to solve other major problems. This and other similar successes created the proactive-work environment that is presently allowing the company to raise production and reliability standards.**

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