

Minimizing Collateral Damage From An Acid Cooler Leak

Good shell and tube acid cooler design practice dictates that the acid pressure should be higher than the water pressure during normal operation, in order to provide a rapid method of leak detection. Although this is highly recommended, some situations preclude this. The information DOES NOT APPLY to systems where the water pressure is higher than that of the acid.

Conductivity and pH in cooling water systems are very sensitive to the presence of H₂SO₄. To put the pH and conductivity measurements into perspective, 0.05 wt% H₂SO₄ (~0.01N) has a pH of 2 or a conductivity increase of ~5,800 micro-mhos/cm² and 0.5 wt% (~0.1N) H₂SO₄ has a pH of 1 or a conductivity increase of ~24,000 micro-mhos/cm². All pH excursions below 6 must be taken seriously and the problem diagnosed. If the pH drops much below 6, it will be difficult to differentiate the source of the leak by pH change across the acid cooler.

To identify a problem, most coolers have a pH or conductivity meter on the cooling water return, located near the cooler. Any indicated drop in the pH or increase in conductivity of the cooling water must be regarded as a potential leak, requiring field verification with pH paper. Do not dismiss a drop in pH or an increase in conductivity as an instrument problem.

The best way to screen for acid leaks, especially in systems with multiple coolers on the same cooling water circuit, is to test the cooling water inlet pH against the cooling water outlet pH using pH paper. Taking samples to a laboratory pH meter is also acceptable, provided there is no delay in reporting the outcome.

Once a leak starts in an acid cooler, the problem will rapidly escalate. If the local conditions produce 80% acid at 100C, the corrosion rate will be 100,000 mils/yr or about 10 mils/hr for 304 SS. Even higher corrosion rates are possible at lower acid concentrations at the point of the leak. A plant shutdown must be initiated in minutes to avert major damage to acid cooler and other connected equipment.

For every leak event, there are unique piping layout considerations that affect how the water and acid will mix when circulation is stopped. Keep in mind that water added to acid will cause violent dilution and steam formation. Therefore, the consequences of shutting down must be thought through.

- For a small leak, it may be prudent to simultaneously stop the circulation of the water and acid and proceed immediately to draining both the acid and water, recognizing that some mixing of water and acid will occur due to hydrostatic head.
- If the leak has become sizeable, the best approach may be to stop the cooling water circulation first, drain the water side of the cooler, then stop acid circulation. Acid leaking into the water may be a lesser evil.

Remember that isolating headers may confine pressure generated by the heat of dilution. Cooling water isolation will also slow down the draining of the water because air cannot easily displace the draining water.

Finally, don't forget that the heat exchanger represents a large surface for corrosion and hydrogen generation. If weak acid is trapped in the cooler, be sure to properly ventilate equipment prior to commencing any work.