NEOTISS
HIGH PERFORMANCE TUBE

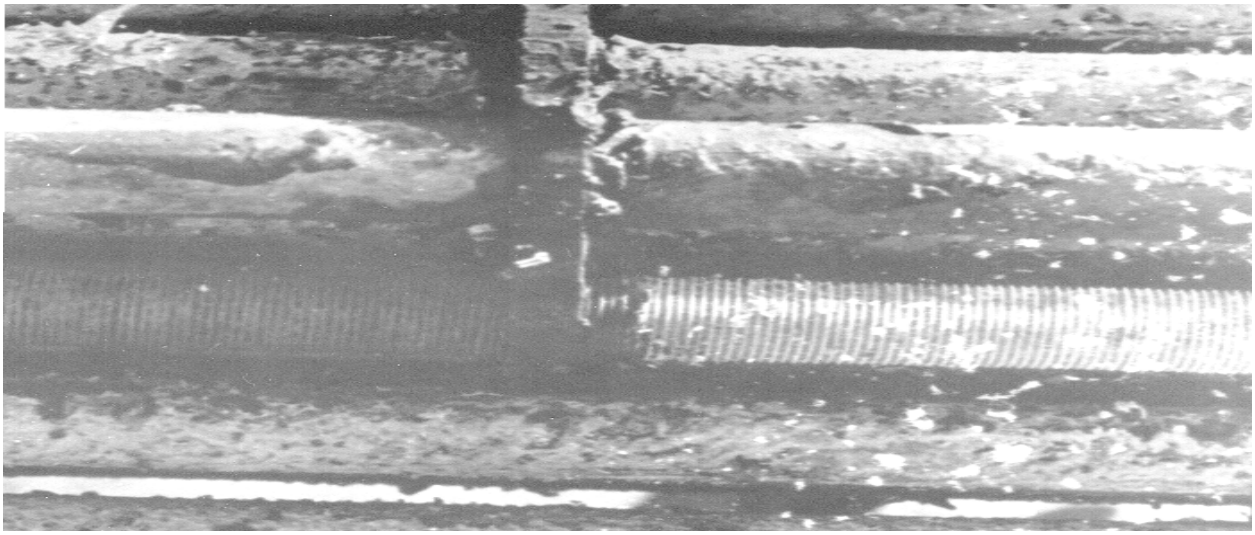
Technical Bulletin No. 1 January 22, 2023

Are fin tubes more likely to foul than smooth tubes?

Be careful how you answer…

Below is a photo of a reboiler bundle pulled for cleaning that shows the smooth tubes completely covered in scale and other deposits while the single fin tube remains relatively clean. This is the opposite of what most engineers would predict. How do we explain this?

A Reboiler Test Case



In reboilers where crystallization fouling is common and tends to form a hard scale on the tube surface, it has been shown that for the same heat duty a low-fin surface will foul less than a smooth surface. The reasons for this are twofold.

The primary factor is the metal surface temperature. In the case of the fin tube, the same heat energy from the tube side is transferring to the shell side through 250% more surface area as compared to the smooth tube. Therefore, the fin tube is operating at a lower heat flux compared to the smooth tube. The resulting skin temperature of the fin tube will be lower than the smooth tube and therefore less prone to scale formation. The higher the tube wall temperature the more likely that minerals in the boiling fluid will come out of solution to form a scale deposit on the tube surface.

A secondary factor, besides temperature, could be that the mechanics of the scale formation. Some have theorized that there may be a breaking away or sluffing off effect in normal operation as scale attempts to form a continues structure but then breaks off and falls away. This may be more likely to happen on a finned surface as compared to smooth.

What about other Services?

In overhead condensers and light-ends coolers, low fin tube has been used throughout the refining industry since the 1950's with a high degree of success. One major end client using HPT fin tubes since 1975 has reported excellent results in services such as: Catalytic Cracking Unit Fractionator OHC, Catalytic Light Ends Splitter OHC, Pipestill Vacuum OHC, Power Former Reactor Effluent Cooler, Naptha Debutanizer OHC, Alkylization Unit Deisobutanizer Condenser, Fuel Gas MEA Regenerator OH, Lube Oil Cooler. In some heavier saltine fouling services, fin tubes have been used with an online water wash system as a way to keep them clean and extend run time and ensure the full heat transfer benefit between planned maintenance cycles.

Low-fin tube has also been used in very heavy / dirty services. One operator replaced bare tube with low fin tube in an asphalt cooler (7% API asphaltic residual shell side) as part of a debottlenecking project. They found that the fin surface was effective and maintained a higher average heat duty then the bare tube within their 18-month cleaning cycle.

What about cleaning?

This would depend on the type of fouling but in the above referenced asphalt cooler case, the fin tube bundles cleaned by hydro blasting in less time than the original smooth bundles. The same was observed by another operator with cracked gas coolers. One explanation for this may be the larger cleaning lane in the bundle given the smaller root diameter of the fin tubes.

So how do I know when a service is safe for low-fin tube?

Each case must be evaluated on its own merits because there are many types of fouling and not all services are appropriate for fin tube. Ask for and check references on experience. If there is a removable bundle that is already on a planned cleaning cycle, even if the fin tube fouls over time, it may still deliver a higher average heat duty over the same mean time between cleaning as compared to smooth tube. A pragmatic problem-solving approach is always better than a blind policy approach. The main point here is not to rule out low-fin tube just based on a general policy that it can only be used in very clean, not fouling environments. You might even be able to solve a fouling problem using fin tube as shown in the reboiler case photo above.