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PROCESS EQUIPMENT CORP.
FINNED TANK COILS

LONGITUDINAL VS. HELICAL FINTUBES

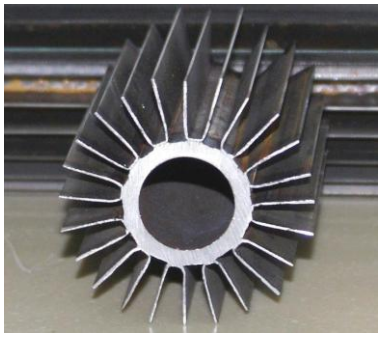
What is the difference between longitudinal and helical fin tubes? How are they used? More importantly, how are they misapplied?

The selection and application of finned tubes is arguably the most important contributor to the success or failure of a viscous product heating system. Properly applied fins allow for significantly greater heating surface per linear foot, which provides a number of benefits:

- Finned tank bundles are cost-effective vs. field runs of significantly more feet of bare pipe plus the accompanying fittings.
- Fewer linear feet means fewer welds, especially field welds, which must be considered a major potential failure mode of an in-tank heating system.
- In hot oil systems, it allows for a lower pressure drop, which reduces pump horsepower operating cost. In steam systems, finned bundles allow for more parallel flow heat transfer, greatly improving the utilization of condensing steam.
- It allows for better tank floor inspection per API-653. The more pipe that covers the tank floor, the less effective inspections and scans which, over time, makes maintenance of the tank floor less effective.

The key factor to remember is that extended surface is designed to balance the excellent heat transfer coefficients of the steam or hot oil and the carbon steel pipe versus the poor heat transfer coefficient of the viscous product. When you consider that the steam or hot oil gives up heat very easily to the pipe that is carrying it, that pipe gets hot fast and is ready to transfer heat to the viscous product, which is the overall goal of the system. Here is the limiting factor, because the viscous product has a relatively poor ability to accept the heat. This allows the heat to build up in the pipe, increasing the surface temperature of the pipe. Extended surface on the outside of the pipe allows that heat to be driven up the fin based on the integral contact between the fin and the tube, making the heat transfer surface of the fin very effective. This allows for lower peak metal temperatures, as the heat is driven out into the viscous product rather than being retained in the metal pipe.

Consider the two configurations of finned pipe available:



LONGITUDINAL

HELICAL

It is easy to see that these two examples show the fin in opposite orientation relative to the pipe. It must be realized then that in order to be properly applied, these two types of finned pipe will need to be used in opposite applications. In ALL cases, the fin must be in the direction of the flow of the fluid that is being heated. In forced convection applications the direction of the fluid flow is evident, but what is the direction of flow in natural circulation? The answer is vertical. As the product is heated it becomes less dense. That causes the product that comes in contact with the finned surface to rise. As it rises it is replaced low in the tank by more dense material from around the tank perimeter, which has sunk to the bottom of the floor as it has naturally been cooled by giving up its heat through the tank wall to the environment.

So, therefore, longitudinal fins belong in the vertical position in natural convection systems, such as atmospheric tanks. What happens if longitudinal fins are applied in a horizontal orientation, such as a tank heating coil? The answer is that the viscous product is trapped in and between the longitudinal fins, and in particular the lower 180° of circumference. Trapped product becomes disastrous to the heat transfer surface, not only blocking access of the cooler product to the heat transfer surface, but also "baking" the product that remains in contact with the hot surface over time. This quickly leads to failure of the longitudinally finned tank coil. Even the finned surface in the upper half of the circumference becomes ineffective, as the flow pattern of the colder product is blocked from integral contact with the heat transfer surface.

Consider, though how this process has a very different result with helical fins. In a horizontal application, such as a tank heating coil, the helical fin is vertical – in the direction of the flow of the naturally circulating viscous product as it is heating. The product flows easily around the pipe, coming in integral contact with the hot finned surface and freely travels upward, allowing colder, more dense product to take its place and continuing the process of effective heating.

Now, there are still other considerations to a successful finned system. Most importantly, the hot finned pipe MUST always be in the product and not allowed to run "dry". That would kill any system. And, naturally, the equipment needs to be designed properly from the outset,

allowing the proper spacing between fins to support the variability of products from lube oils to asphalts. But we can say with no doubt that the best heating system for viscous product is a properly designed and operated finned coil system.