How to Select a Tank Heater

By Adam Heiligenstein, Chromalox

The two main methods of tank heating -- direct and indirect -- have their advantages and disadvantages.

Direct Tank Heating. Direct heating places the heater in direct contact with the heated medium. The heating element is immersed in the process fluid utilizing various mounting styles. The advantage of heating directly is that the heaters are nearly 100 percent efficient with this method. This is because all heat that is generated is absorbed directly by the process. This helps to speed heatup and eliminate thermal lag. There is no intermediate heat transfer medium that could result in heat losses.

The disadvantages of direct heating include the element surface limitation of the heater to deliver the energy. Large surface areas require more space for the heater. If the tank is small, there may not be room for a properly sized heater. Additionally, consideration of the heater material must be made to ensure that the element is compatible and will not degrade due to corrosion or pitting from the process. Because of the efficient heat transfer with directly immersed heaters, the relative watt density is typically high in these applications. Therefore, the heater must be designed so that it is not exposed to air while operating which could lead to heater failure due to high element temperatures. Finally, the element must be protected from sludge buildup in the tank that could limit the elements ability to transfer the heat.

Indirect Tank Heating. Indirect heating uses a heat transfer medium to transfer the heat to the tank. Indirect methods can vary from external heating of the tank using the tank wall as the heating medium to utilizing a heat transfer medium to carry the heat to the tank. In addition, pipe-insert heaters have been included in this category because they use an air space between the element and the process to convey the heat. There are various advantages to indirect heating. The biggest advantage is that the heater typically can be serviced without draining the tank. Second, indirect heating often allows watt density exposed to the process fluid to be lowered by spreading the heat over a larger surface. Finally, overheat conditions can be limited in many instances by simply limiting the temperature of the heat transfer medium.

There are a few minor disadvantages to indirect heating that may be critical to your process. The primary disadvantage is the thermal lag caused by using a heat transfer medium to carry the heat. The delay is caused by the fact that the heater must first heat the heat transfer medium before the heat transfer medium can heat the process. If there is a large mass of heat transfer medium, larger heating capacities will be required to raise temperatures.

How to Checklist

The first step in any application is to gather information:

Determine tank characteristics and the nature of the material contained in the tank

- Bulk, liquid or other compound, etc. * Acid or alkaline
- Specific heat * Specific gravity or density * Viscosity

Tank size

- Diameter * Height * Capacity (gal)
- Length and width (rectangular tanks)
- Determine tank surface area, side and roof (ft^2)
- Determine tank bottom area in contact with ground (ft^2)

- Note any heat sinks on the tank such as ladders, manways or nozzles

Temperature

- Tank temperature contents to be heated from and to, or maintained (^{o}F)
- Worst-case ambient temperature tank surface is exposed to (^{o}F)
- Worst-case ambient temperature of ground under tank (^{o}F)

Heatup or temperature recovery times

Process

- Additions to tank * Volume * Incoming temperatures

Insulation type, thickness and K factors

Environmental conditions

- Wind velocity * Location classification * Indoors/outdoors

Code requirements