HEATING THINGS UP

Chelsey Kemper, Omega Thermo Products LLC, USA, looks at methods to heat storage tanks with viscous products.

Storage tanks with viscous product can be a costly challenge to heat when it becomes time to extract product from the tank.

Large amounts of energy and several heat exchangers are needed to achieve this process. The result is high operating costs for the end customer. In addition to the high operating costs, there are also higher initial costs to buy and install the equipment needed to maintain pumping temperatures and empty or extract product from the tank. This is especially true if the tanks are uninsulated in a cold environment or if the storage tanks are located in the ground.

Solution

A solution to this challenge would be to use a heat exchanger that is inserted in the tank through a manway and only heat it as needed for removing product from the tank. This type of heat exchanger goes by many different names, such as suction heater, bayonet heater or stab in heater. However, all of these names are performing the same function when it comes to heating the product in the storage tank.

How does it work?

A suction heater is a heat exchanger that is mounted in the existing manway of a tank. Heat exchanger plates are mounted on the blind flange and piped with a common inlet and outlet manifold to feed steam, thermal oil, or hot water though the plates and generate a heat source (Figure 1). Around the plates is an outer skin that forces viscous product to go between the heat exchanger plates and quickly heat up, reducing the viscosity of the product to an easily pumped temperature. On the outlet mounted

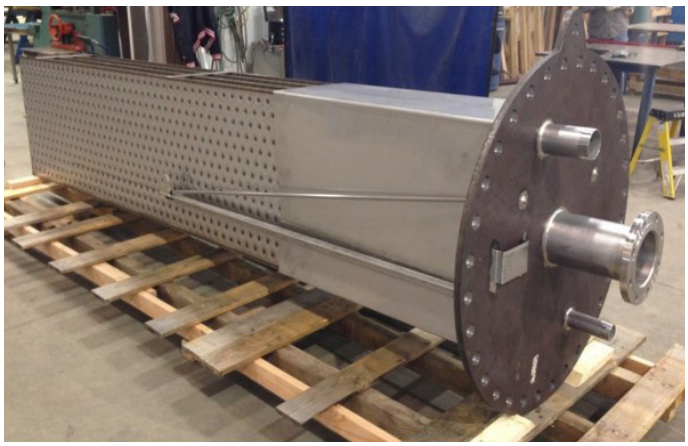

Figure 1. Plate suction heater with shroud and blind flange.

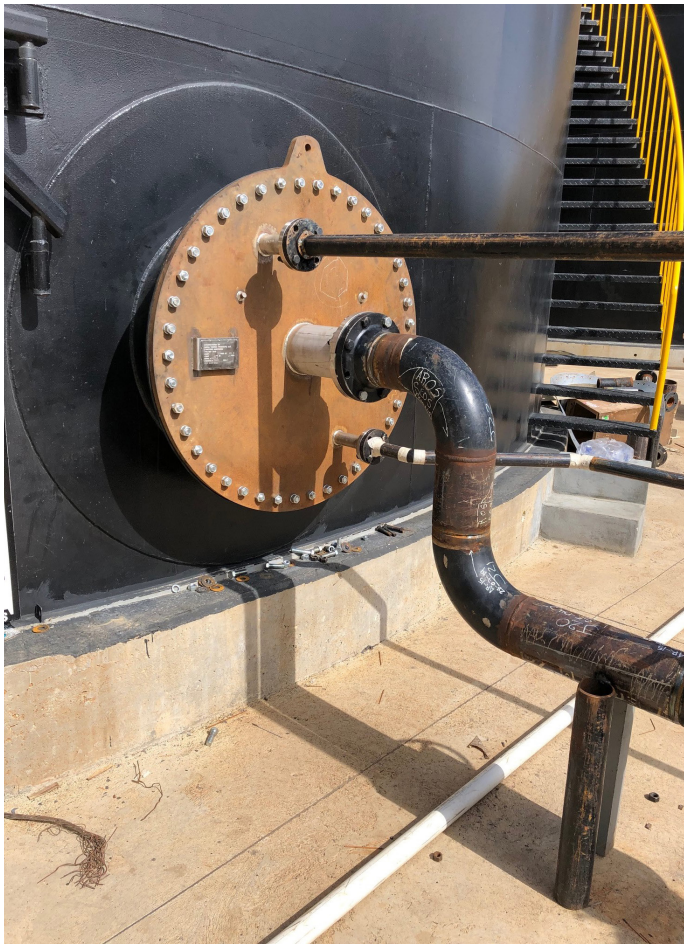

Figure 2. Suction heater installed in a heavy crude oil storage tank. The heating medium is steam with a centre outlet for pumping out warm heavy crude.

to the blind flange, hot product can be sucked out and pumped to the next process (Figure 2).

The advantage of using plate heat exchangers over tubes or fins is that the plates are easier to clean because there are larger gaps between the plates. There is also less fouling because the product is continuously moving across the plates without the addition of an agitator. Another advantage is the pillowed shape of the plates, which creates turbulent flow of the heating medium inside, resulting in higher rates of heat transfer at lower volumes compared to the laminar flow seen in tubes (Figure 3).

Any viscous fluid would be a candidate for this type of heat exchanger fuel oil, heavy fuel oil, crude oil, heavy crude oil, asphalt, bitumen, etc. This article focuses on viscous fluids but this process can be used in any type of storage tank where energy can be saved by keeping the product at ambient temperatures instead of maintaining an elevated temperature for the duration of the product being held in the tank.

Different scenarios

Table 1 shows a cost comparison of a 250 000 gal. storage tank of heavy fuel oil sitting outside in the winter. For comparison purposes, the table shows three scenarios for heating the tank. The first puts external plates on the outside of the tank to heat from ambient to 208°F when needed. The second puts external plates on the outside of the tank that maintain 208°F for one month once the product is up to temperature. The third uses a suction heater that is turned on as needed to heat up product as it is being pumped out of the tank.

High pressure steam is used as the heating medium. However, the tank may not need to be drained. It may only need increments of product to be pumped out at a time, depending on the process, which would save more energy than what is shown in Table 1. The total load for heating up the tank with external heat exchangers is similar to using a suction heater. The time required and Btu load shown for the suction heater is to empty the entire tank. The advantage then comes from being able to remove product in desired increments instead of heating the full capacity of the tank. The real savings come when only portions of the product are needed at a time, as extra energy is then not wasted on heating the full volume of the tank. The concept is similar to an on demand water heater vs a traditional tank water heater. This can also be very helpful if continuous heating or prolonged heating to pumping temperatures will affect the composition or structure of the viscous product.

The cost of the suction heater will be 10% of the cost of the external plates required to cover the sidewall of the tank. Using the suction heater also only requires one inlet and one outlet to be piped for the heat exchanger. The external option would require 64 individual inlets and outlets with 128 piping runs. This example is only looking at one tank but all of these numbers need to be multiplied by the number of storage tanks per site.

The result is an on demand process that can be turned on and off as needed to save energy and operating costs when it is not necessary for the product in the storage tank to be maintained at temperatures that reduce the viscosity of the fluid for flow purposes. The initial heat up on the external option has a similar total Btu load required but the entire tank needs to be heated and if the storage tank is not being fully drained this creates a significant amount of wasted heat. If only 10 000 gal. at a time need to be

released from the tank, then the suction heater is the better option, because only the product that will be used is heated, compared to heating the entire tank every time product needs to be drained.

This comparison required the entire sidewall of the tank be covered, which in this case results in 64 panels that need to be bought, installed and individually piped. The suction heater is only one piece of equipment with one inlet and outlet that needs to be piped. The cost to buy panels for covering the sidewall of the tank is 10 times the cost to buy one suction heater in this example. That is not including the labour and additional material to install 64 external heat exchanger plates compared to one suction heater. Multiplying this by 10 storage tanks really starts to add up as major savings to the end user.

Conclusion

When looking at how to heat a storage tank, the required process needs to be weighed with the cost and energy consumption. Finding cost-effective solutions will always be a challenge in any industry but using a suction heater is one option to try and balance performance with return on investment for storage tanks of viscous liquids. T&T

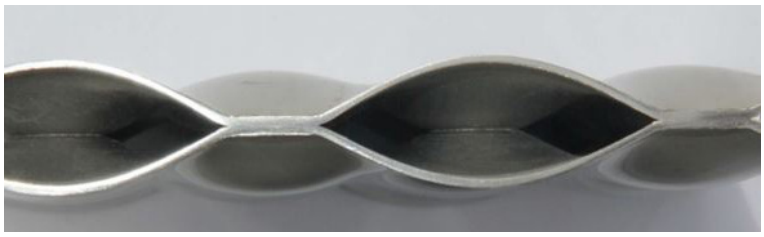

Figure 3. Cross-section of the plate, laser welded and hydrostatically inflated.

Table 1. Cost comparison of a 250 000 gal. storage tank of heavy fuel oil sitting outside in the winter[1]

	Heating from ambient to 208°F	Maintaining 208°F for one month	Heating 105 GPM from ambient to 208°F
Type of heat exchanger	External	External	Internal (suction heater)
Steam consumption (lb/hr)	15 062	2260	4205
Total steam consumption (lb)	10 844 640	1 627 200	168 200
Time required (hr)	12	720	40
Load (Btu/hr)	13 118 646	1 968 346	3 662 435
Total load (Btu)	157 423 752	1 417 209 120	146 497 400

[1]Heavy fuel oil starting temperature is 55°F, heavy fuel oil ending temperature is 208°F, and steam pressure is 120 psi