Advantages

The advantages of an off line cooling system are a stable cooling and filtration performance irrespective of variations in flow and duty cycle of the main hydraulic circuit. This allows the cooler to be sized to fit the heat load and not the maximum return flow of the main circuit. A further advantage is that the offline cooler is completely isolated from surge pressures in the return line that can potentially damage the cooler. Also, maintenance can be performed on the filters without having to shut down the main system.

Selection Requirements

The following parameters need to be known to correctly size a cooler:

- How much heat needs to be removed from the system?
- What is the desired oil temperature?
- What is the supplied water temperature and ambient air temperature?
- What is the flow required?
- What is the desired oil to water flow ratio?
- What is the viscosity of the oil?

1. Required Flow

As a rule of thumb, the pump should be sized so that it circulates approximately 25 to 30% of the reservoir's capacity.

Note: Before sizing the heat exchanger, the flow rate needs to be known.

2. Heat Removed

The main function of the cooler is to transfer heat from the oil into the water or air. Heat load is generally described in units of HP, kW, or BTU's/Hr being removed. When designing a new system, a good rule of thumb is a cooler should be sized to remove approximately 25 to 30% of the input HP or kW.

In an existing system with a heat problem and the heat load is not known, a heat load test needs to be performed. The test is performed by measuring the temperature rise of the oil over a certain period of time. Take this temperature rise and time in minutes and use it in the following formula to determine the kW heat load.

$$\textbf{Heat Load Pv} = \frac{\textbf{Temperature rise (°C) x Specific Heat (1.88 KJ/Kgk) x Density of oil (0.951 Kg/l) x Volume (l)}}{\textbf{Operating time (Minutes) X 60}}$$

HP = kW x 1.341

See example of heat load calculation below.

3. Oil/Water Temperatures

The inlet oil temperature is the desired temperature of the oil in the reservoir. The inlet water temperature is the water temperature entering the cooler unit.

4. Flow Ratio

Maximum capacity of a cooler is achieved when the oil to water ratio is 1:1. This is desirable where the water supply is plentiful, as this will be the smallest, least expensive cooler. As the ratio increases, the cooling capacity decreases and a larger cooler will be required. This option costs more initially, but will save on water usage.

Heat Load Calculation Example

Pv *(Heat Load)*	=	kW
ΔT *(Temperature Rise)*	=	34.4°C (93.9°F)
SH *(Specific Heat of oil)*	=	1.88 KJ/Kgk
SG *(Specific Gravity of oil)*	=	0.915 Kg/l
V *(Tank Volume)*	=	380 l (100 Gal)
t *(Time in Minutes)*	=	45 min.

$$Pv = \frac{\Delta T \times SHoil \times SGoil \times V}{t \times 60} = kW$$

$$Pv = \frac{34.4 \times 1.88 \times 0.915 \times 380}{45 \times 60} = 8.32\ kW$$

HP = 8.32 x 1.341 = 11.16

Heat to be removed = 11.16 HP