**“Old school” formulae for calculating process heat load and chiller size**

**Start with material specific heat, ΔT and ΔH**

To calculate a process load, start by quantifying the heat inputs required for processing material according to:

* the specific heat of the material being used;
* the pounds of material being processed per hour;
* “sensible” temperature change of the material during the process, or the “delta T” (ΔT).  ΔT is determined by subtracting the temperature of the material entering the process from the temperature as it leaves the process;
* “latent” heat (ΔH) that must be removed as the plastic changes phase from liquid to solid. During this phase change, the temperature of the material does not change (there is no ΔT), but heat must still be removed from the material.

Often ΔH can be accounted for by including a “safety factor” in the calculations. If you don’t want to quantify heat generated mechanically (by hydraulic motors, feed throats, etc.), either by itemizing the equipment used and adding in the appropriate values, you can include these loads in the safety factor as well.

Usually that involves adding 10 to 20% to the result of your calculations, as shown below:

1. Multiply to calculate BTUs per hour:
**Pounds/hour  X  specific heat  X ΔT = BTUs per hour**
2. Convert BTUs to tons:
**BTUs per hour / 12,000 = Tons per hour.**
3. Add a safety factor of 10% to 20%:
**Tons per hour  x 1.2 (safety factor) = Chiller size in tons**

**Calculate a simplified MCΔT**

This method is ideal for measuring the actual load of a process.  To calculate a result, you need to:

* Measure the flow rate of process coolant (gallons per minute or GPM),
* Determine the ΔT of the process coolant,
* Plug your numbers into a formula to calculate a result,

***Measure flow rate.***

Flow rate can be measured by placing a flow meter on the cooling output line or, if that is unavailable, by measuring the time it takes for the outlet to fill a five-gallon bucket and computing the equivalent flow in GPM.

*Example:* 25 GPM

***Determine ΔT of the process coolant.***

Subtract the Leaving Water Temperature (LWT), the temperature of the water leaving the chiller and moving to the process, from the Entering Water Temperature (EWT), the temperature of the coolant that is re-entering the chiller carrying process heat.

*Example:*  97°F EWT minus 60°F LWT = 37°F ΔT

***Plug results into formula.***

Use the formula **Q = M X C X ΔT where:**

**Q** = heat load in British Thermal Units per Hour (BTUH)

**M** = flow in Gallons per Hour (GPM)

**C** = specific heat of the fluid.

(For water, 1 BTU per pound times 8.34 pounds per gallon times sixty minutes per hour or 500 BTU per gallon per hour)

**ΔT** = temperature difference in degrees Fahrenheit

*Example:*  If process coolant flows at 40 GPM and the ΔT (EWT-LWT) is 12°F then:

**Q =** 500 BTU per gallon per hour X 40 GPM x 12 ΔT = 240,000 BTU per hour

**Convert result into tons of chiller capacity.**

Divide Q (BTUs per hour) by 12,000 (the number of BTUs in one ton of cooling capacity).  This yields the chiller capacity required to handle the process heat load in tons per hour:

*Example:* 240,000/12,000= **20 tons/hr.**

**Correct chiller tonnage for leaving water temp (LWT), if LWT is other than 50°F:**

Calculations for chiller tonnage in the plastics industry are based on a coolant temperature of 50°F (LWT), with sufficient capacity to handle a 10°F-temperature rise in coolant from the process load.  So, if the LWT you need is above or below 50°F, you’ll need to correct your chiller tonnage calculation accordingly.

As a rule, one degree of cooling above or below 50°F equates to about 2% of chiller tonnage. So, to correct your calculation:

* ADD 2% (approximately) to the required nominal tonnage for every F degree below 50°F, or
* SUBTRACT 2% (approximately) to the required nominal tonnage for every F degree above 50°F.

***Example:*** If you need an LWT of 40°F, specify a chiller that has 20% (10 X 2%) more capacity than if your LWT was 50°F. Likewise, if your LWT is higher, say 60°F, you could specify a chiller with 20% less capacity.

**One Last Thing**

And finally, one last rule of thumb:  Because your chiller is likely to see a range of heat loads and cooling temperatures, be sure to *size it for the highest heat load and lowest temperatures* you need it to handle.