

37.63 A chiller plant producing a low chilled water supply temperature of $40^\circ F$ uses a glycol/water mixture of 30% glycol by volume. At $40^\circ F$, glycol has a specific heat capacity of $0.56 \frac{Btu}{lb_m \cdot ^\circ F}$ and a specific gravity of 1.15. What is the specific heat capacity of the mixture?

- A. $0.86 \frac{Btu}{lb_m \cdot ^\circ F}$
- B. $0.87 \frac{Btu}{lb_m \cdot ^\circ F}$
- C. $0.88 \frac{Btu}{lb_m \cdot ^\circ F}$
- D. $0.89 \frac{Btu}{lb_m \cdot ^\circ F}$

The glycol/water mixture is defined as being 30% glycol by volume, but the specific heat capacity of the mixture will be a function of the relative *mass* of glycol and water, not the volume.

Assume an arbitrary volume of $100ft^3$ of the mixture, comprised of $30ft^3$ of glycol and $70ft^3$ of water.

Find the mass of water:

$$m_{water} = \rho_{water} V_{water} = \left(62.4 \frac{lb_m}{ft^3} \right) (70ft^3) = 4368lb_m$$

Find the mass of glycol, by first determining the density of glycol using the **Specific Gravity**.

$$SG = \frac{\rho}{\rho_{water}} \rightarrow \rho_{glycol} = \rho_{water} SG_{glycol} = \left(62.4 \frac{lb_m}{ft^3} \right) (1.15) = 71.76 \frac{lb_m}{ft^3}$$

$$m_{glycol} = \rho_{glycol} V_{glycol} = \left(71.76 \frac{lb_m}{ft^3} \right) (30ft^3) = 2153lb_m$$

Perform a mixing calculation for the specific heat capacity as a function of the relative mass of glycol and water.

$$c_{p,mixture} = \frac{c_{p,glycol} m_{glycol} + c_{p,water} m_{water}}{m_{glycol} + m_{water}}$$

$$c_{p,mixture} = \frac{\left(.56 \frac{Btu}{lb_m \cdot ^\circ F} \right) (2153lb_m) + \left(1 \frac{Btu}{lb_m \cdot ^\circ F} \right) (4368lb_m)}{2153lb_m + 4368lb_m} = .855 \frac{Btu}{lb_m \cdot ^\circ F}$$

Answer A