# SFE Questions/Answers

1. Using the *Peng-Robinson EOS* determine the $\rho$ of the supercritical $CO_2$ when T = 60°C, P = 90 bar, R = 8.31451 x $10^{-2}$ L*bar/K*mol and $\omega$ = 0.225.

$$K_i = 0.37464 + 1.54226(\omega) - 0.26993(\omega^2) = 0.7079838$$

$$T_r = \frac{T}{T_c} = \frac{(60 + 273.15)}{(30.0 + 273.15)} = 1.0959$$

$$b = 0.0778\left(\frac{R * T_c}{P_c}\right) = 0.0778\left(\frac{0.0831451L * \frac{bar}{K} * mol * 304\,K}{73.8\,bar}\right) = 0.02665047$$

$$a = 0.45724\frac{(R^2)(T_c^2)}{P_c}[1 + K_i(1 - \sqrt{T_r})]^2 = 3.70178$$

$$B = \frac{b * P}{R * T} = \frac{(0.02665047)(90\,bar)}{(0.0831451)(60 + 273.15)} = 0.086591$$

$$A = \frac{a * P}{R^2 * T^2} = 0.43421$$

$$Z^3 - (1 - B)Z^2 + (1 - 3B^2 - 21B)Z - (AB - B^2 - B^3) = 0$$

$$Z^3 - 0.913409Z^2 - 0.840905Z - .0294514 = 0$$

Using a cubic equation calculator, Z=1.49074

$$\rho = \frac{MP}{ZRT} = \frac{\left(44\frac{g}{mol}\right)(90\,bar)}{1.49074\left(0.0831451\frac{L * bar}{K * mol}\right)(60 + 273.15K)} = 95.947\;{}^g/_L = 96\;{}^g/_L$$

2. When P is above $P_c$ and constant. How does increasing T (T is already higher than $T_c$) affect density, velocity, solubility, and diffusivity?

*Density is decreased*

*Velocity does increase with increased temperature, but viscosity decreases because it is more dependent on density and density decreases with increased temperatures.*

*Solubility can either increase or decrease depending on what the pressure is.  There is an increase in solubility at both low and high pressures (see Supercritical Fluid Extraction (SFE)-An Overview about "cross-over pressure")*

*Diffusivity increases*

3. Name one aspect about SFE that is BOTH an advantage and disadvantage.

*Several possible.  Use of $CO_2$ as mobile phase (as it is non-polar and needs additives to remove the more polar molecules, but it is non-toxic and cheap), all three parameters can change (gives more flexibility for optimizing results, but also gives too many choices for it at the same time), etc.*

4. Which characteristics of SFE are similar to liquids and which are similar to gases?

*Density and solvent power similar to liquids, viscosity and diffusivity is similar to gases.*