



Green Engineering

(458.701)

Midterm

OPEN TEXTBOOK ONLY

1. [30point] Your company has used CFC-113 [CAS:76-13-1] as a defluxing solvent. However, due to the high ozone depletion potential of CFC-113, you are asked to replace this defluxing solvent with a new cleaning process or a suitable replacement solvent. You has identified the following solvents as suitable for formulation of the cleaning agent which can be used at 38°C. Considering both hazard and exposure potential, which of these solvents would you recommend to your colleague for the cleaning agent? To solve this problem, use the vapor pressure as a surrogate for the magnitude of worker exposure to the solvent vapors and the OSHA Permissible Exposure Limit as a surrogate for relative hazard.

solvent	OSHA PEL, ppm
acetone	1000
cyclohexane	300
Isopropyl alcohol	400
methyl ethyl ketone	200

2. [30point] Compare and contrast the Inherently Safer Design concepts with the Pollution Prevention concepts. Note in particular that design methods for improving process safety are focused on preventing catastrophic releases, while pollution prevention design methods are primarily concerned with reducing chronic emissions.

3. [40점] During pesticide application, 1 kg of hexachlorobenzene [118-74-1] is accidentally applied to a 10^8 liter pond. Estimate the amount of hexachlorobenzene that would be ingested if a person were to eat a 0.5 kg fish from the pond. Assume that the pond is well mixed and that the organic sediment content is 10 ppm and the total fish loading is 100 g per 100 m^3 .

$K_{oc} = 3,388 \text{ L water/kg organic carbon}$

$BCF = 5,152 \text{ L water / kg fish}$

