ABE – 201 Fall 2016

Homework 6
Due Monday 9/26 at beginning of class

1. Methanol is synthesized from carbon monoxide and hydrogen in a catalytic reactor. The fresh feed to the process contains 32.0 mole% CO, 64% H_2, and 4.0% N_2. This stream is mixed with a recycle stream in a ratio of 5 mol recycle / 1 mol fresh feed to produce the feed to the reactor, which contains 13.0 mole% N2. A low **single-pass** conversion is attained in the reactor, thus the need for recycle. The reactor effluent goes to a condenser from which two streams emerge: a liquid product stream containing all of the methanol formed in the reactor, and a gas stream containing all of the CO, H_2, and N_2 leaving the reactor. The gas stream is split into two fractions: one is removed from the process as a purge stream, and the other is the recycle stream that combines with the fresh feed to the reactor.
   a) (8 pts) For a basis of 100 mol fresh feed/hr, calculate the production rate of methanol (mol/hr), the molar flow rate and composition of the purge gas, and the overall and single-pass conversion yields.
   b) (2 pts) Briefly explain in your own words the reasons for including the recycle stream and the purge stream.

2. (10 pts) A steady-state, continuous flow fermenter uses the yeast *Saccharomyces cerevisiae* to produce ethanol through reaction 1. The yeast also produces propenoic acid by reaction 2.

$$1: \quad C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$$

$$2: \quad C_6H_{12}O_6 \rightarrow 2C_2H_3CO_2H + 2H_2O$$

   Fermentation broth enters the reactor at a rate of 3500 kg/hr having 12% (by weight) glucose. Leaving the reactor is 90 kg of unreacted glucose and 120 kg of carbon dioxide per hour. Assume that none of the glucose is assimilated by the yeast to produce more cells. How many kg of ethanol and kg of propenoic acid leave the fermenter per hour?