UNIVERSITY OF GHANA

FACULTY OF ENGINEERING SCIENCES

DEPARTMENT OF FOOD PROCESS ENGINEERING

B.Sc FIRST SEMESTER FINAL EXAMINATION, 2012/2013

FPEN 201: INTRODUCTION TO FOOD PROCESS ENGINEERING

<u>**ANSWER FOUR (4) QUESTIONS**</u>   <u>**TIME: 2 HRS**</u>

1. (a) Show with the aid of separate flowsheet diagrams, recycling, bypassing and purging. Explain with <u>one</u> sentence each, the purpose of each process.

   (b) A cereal product containing 55% water is made at the rate of 500 kg/hr. You need to dry the product so that it contains only 30% water. How much water has to be extracted per hour?

2. (a) Pure carbon is burned in oxygen. The flue gas analysis is:

   CO_2 :   65 mol %

   CO   :   19 mol %

   O_2 :   16 mol%

   What was the percent excess oxygen used?

   (b) A gaseous mixture containing 90% and C_2H_6 and 10% O_2 is burned in an engine with 300% excess air. Ninety percent of the ethane goes to CO_2, 5% goes to CO and 5% remained unchanged. What is the amount of the excess air per 100 moles of the gas?

3. A drier takes in wet timber (20.1% water) and reduces the water content to 8.6% water. You want to determine the kg of water removed per kg of timber that enters the process.

   (a)   Draw a picture of the process, and put the data on the figure

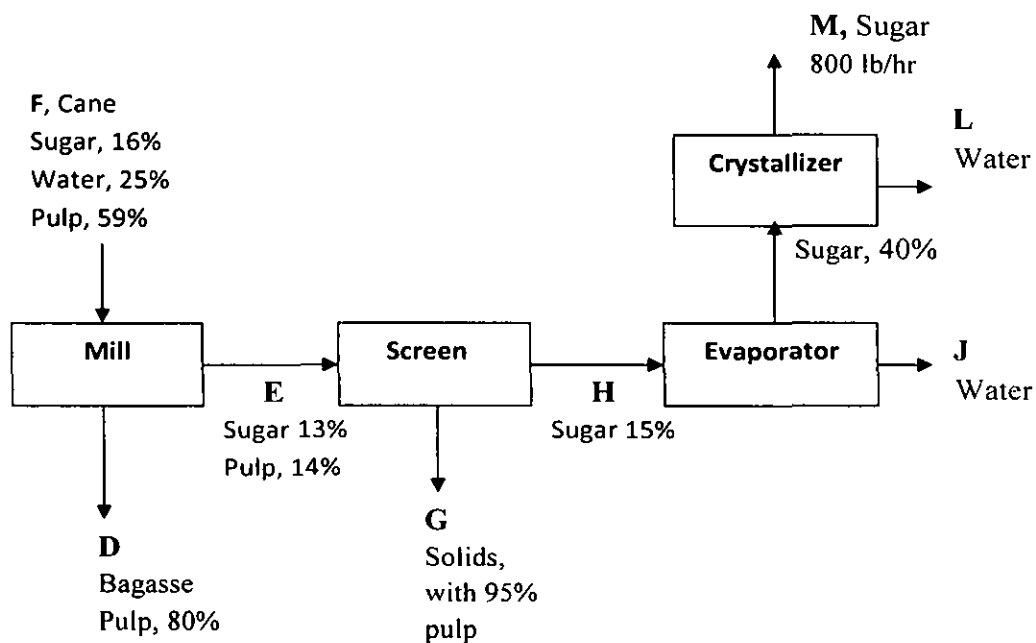   (b)   Determine the number of variables whose values are unknown

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(c)   Determine the number of independent equations that can be written for the process.

(d)   Is a unique solution possible? Find it.

4. A water solution containing 15% acetic acid is added to a water solution containing 30% acetic acid flowing at the rate 25 kg/min. The product P of the combination leaves at the rate of 100 kg/min. For this process

   a) Determine how many independent balances can be written
   b) List the names of the balances
   c) Determine how many unknown variables can be solved for and state them
   d) Determine the composition of P using the Gauss Elimination method

5. A simplified flowsheet for the manufacture of sugar is shown below. Sugarcane is fed to a mill where syrup is squeezed out, and the resulting 'bagasse' contains 80% pulp. The syrup (E) containing finely divided pieces of pulp, is fed to a screen which removes all the pulp and produces a clear syrup (H) containing 15% sugar and 85% water. The evaporator makes a 'heavy' syrup and the crystallizer produces 800 lb/hr of sugar crystals

   a) Find the water removed in the evaporator, lb/hr
   b) Find the mass fractions of the components in the waste stream G
   c) Find the rate of feed of cane to the unit, lb/hr
   d) Of the sugar fed in the cane, what percentage is lost with the 'bagasse'?

M, Sugar
800 lb/hr

F, Cane
Sugar, 16%
Water, 25%
Pulp, 59%

L
Water

Crystallizer

Sugar, 40%

Mill   Screen   Evaporator   J
         E   H   Water
    Sugar 13%   Sugar 15%
    Pulp, 14%

D
Bagasse
Pulp, 80%

G
Solids,
with 95%
pulp

b) It is proposed to install a reverse osmosis system to remove some moisture from the egg whites prior to dehydration to increase the drying capacity. If the reverse osmosis system changes the moisture content of the egg whites prior to drying to 80% moisture, and the same inlet and outlet air humidity are used on the drier, calculate the new production rate for the dried egg whites.