

Intro to Engineering – Material Balance

Show work and Draw flow diagrams

NAME _____ Date _____

- 1) In a tannery, mangrove bark is extracted by treating the finely ground wood with hot water. The original bark contains 4% moisture, 37% tannin, and 23% soluble non-tannin material. The residue, (spent bark) removed from the extraction tanks contains 62% moisture, 2.8% tannin, and 0.9% soluble non-tannin material. What percentage of the tannin in the original bark remains unextracted in the residue?
- 2) A paint mixture containing 25% of a pigment and the balance water sells for \$6.00/kg, and a mixture containing 10% pigment sells for \$3.50/kg. If a paint retainer produces a blend containing 15% pigment, from blending the other two, for how much should he sell it in \$/kg, to make a 10% profit?
- 3) A natural gas blender combines gas samples from three sources
Sample A contains 85 mol% CH₄, 10 mol% C₂H₆, and 5 mol% C₂H₄
Sample B contains 0 mol% CH₄, 11 mol% C₂H₆, and 89 mol% C₂H₄
Sample C contains 6 mol% CH₄, 94 mol% C₂H₆, and 0 mol% C₂H₄
How many moles of each blend produces 100 moles containing equal parts CH₄, C₂H₆, and C₂H₄ ?
- 4) An evaporator is fed continuously with 25 tons/hr of a solution containing 10 wt% NaCl and 80 wt% H₂O. during evaporation water is boiled away from the solution, NaCl crystallizes and is filtered out of the remaining liquid. The concentrated remaining liquid leaving the evaporator contains 50% NaOH, 2% NaCl and 48% H₂O. Calculate the flow rates in lbs/hr of water, precipitated salt and remaining liquid per hour.
- 5) Eggs are sorted into two sizes, large and extra large, at the Cheerful Chicken Dairy. Unfortunately, business has not been so good lately, and since the Cheerful Chicken's 40 year old egg sorting machine finally gave up the ghost there isn't any money to replace it. To fill in, Old Fred, a veteran egg sorter with a sharp eye, has been equipped with a "large" stamp for his right hand and an "extra large" stamp for his left. Eggs from the hen house pass by at a rate of 120/ minute on a conveyor belt and are sorted into bins downstream. The scheme works fairly well even though Fred's heavy hand breaks about 30% that pass. A check downstream reveals that extra large eggs arrive at the rate of 70 eggs/min, of which 25 eggs/min are broken.
 - Draw the flow plan for sorting the eggs
 - Write and solve the "egg balance" around Fred to show total and broken eggs
 - How many "large" eggs make it to the bins for shipping per minute
 - What fraction of the large eggs are broken?
 - Is old Fred right or left handed? Justify your answer