University of Melbourne

Department of Chemical Engineering

CHEN20010 MATERIAL AND ENERGY BALANCES

NUMERICAL ANSWERS TO EXERCISE SHEET C

This material is copyright, University of Melbourne. Posting this material to an external website, including file-sharing sites, is not permitted under any circumstances.

Note the number of significant figures to which each answer is given. Giving an answer to too many figures suggests an accuracy that is not usually warranted. Also note that the units of the answer should be specified.

1 – 4. There are no numerical answers for these four questions.

5. Upper stream: F = 747.8 kg/h; 16.5 % $^{w}/_{w}$ A, 40.9 % $^{w}/_{w}$ B, 19.2 % $^{w}/_{w}$ C and 23.4 % $^{w}/_{w}$ D

Lower stream: F = 236.2 kg/h; 6.1 % $^{w}/_{w}$ A, 20.9 % $^{w}/_{w}$ B, 37.6 % $^{w}/_{w}$ C and 35.4 % $^{w}/_{w}$ D

6. 1.77 kg of cream and 0.23 kg of skim milk.

7. Production rate of the dried solid is 2534 kg/h and the water removal rate is 990 kg/h.

8. Spent acid: 606.4 kg; conc. sulphuric acid: 153.0 kg; conc. nitric acid: 240.6 kg.

9. 19.6 % solids, 80.4 % water.

10. Distillate = 2426 kg/h; Residue = 16474 kh/h; 24.3 mol % iso-butane, 51.9 mol % n-butane, 21.8 mol % iso-pentane and 2.0 mol % iso-hexane.

11. F_3 = 223.3 kg/h; 29.6 % toluene, 2.0 % benzene and 68.4 % xylene.

12. a) 1096 kg/h

b) 96.1 %

c) 6.5 kg/h

d) Upper layer: F = 1070 kg/h Lower layer: F = 110 kg/h.

13. cream: 2094 L/h; milk: 19627 L/h.

14. a) A → B; B → C

b) F_3 = 7.16 kg/min; F_4 = 0.36 kg/min; F_5 = 21.48 kg/min.

15. Oil produced: 490 kg/h Meal: 371.9 kg/h Hexane: 1720 kg/h

16. a) 1720 lb/h

b) 413 lb/h

c) 587 lb/h

17. F_1 = 2852 kg/h F_2 = 3477 kg/h F_3 = 4900 kg/h F_4 = 1429 kg/h

F_5 = 2940 kg/h F_6 = 929 kg/h F_7 = 1960 kg/h F_8 = 560 kg/h

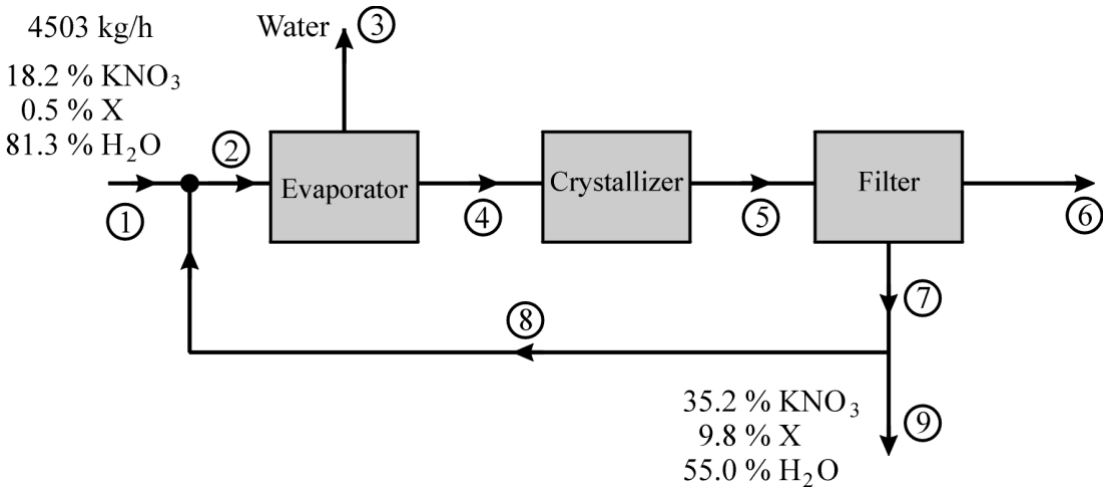
This material is copyright, University of Melbourne. Unauthorised distribution of this material is not permitted.

18. a) 0.994 kg/kg

b) 0.104 kg/kg

c) 0.76 % protein, 0.46 % fat, and 6.8 % total solids.

19. a)



b) 98.1 % KNO_3, 0.28 % X and 1.6 % H_2O.

c) 273 kg/h.

d) 8.9 %

e) 3911 kg/h.

M20. a) Stream ②: F_2 = 837.3 mol/min

42.5 mol % A, 9.9 mol % B, 26.6 mol % C and 21.1 mol % D

Stream ③: F_3 = 867.7 mol/min

41.8 mol % A, 12.7 mol % B, 18.6 mol % C and 27.0 mol % D

b) 79.6°C

M21. a) 1024 kg/m^3 b) 1027 kg/m^3 c) 1029 kg/m^3