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國立臺北科技大學 110 學年度碩士班招生考試

系所組別：3510 化學工程與生物科技系化學工程碩士班甲組

第一節　單元操作與輸送現象　試題

注意事項：

1. 本試題共 6 題，1~4 題,每題 20 分; 5~6 題,每題 10 分，共 100 分。
2. 不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

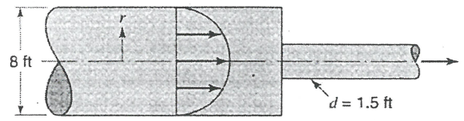
1. Describe and explain the following briefly
   ① To write down the define of hydraulic radius and equivalent diameter D_{eq}, and what is the hydraulic radius for annulus between two concentric pipes? (4%)
   ② What are the wet-bulb temperature and dry-bulb temperature, and the relative volatility? (4%)
   ③ Please interpret the dropwise and film type condensation? (4%)
   ④ Why use the extended-surface equipment in heat exchanger, and descript the kinds and its advantage. (4%)
   ⑤ Define the reflux and the used reason in the operation, what are the minimum reflux ratio and optimum reflux ratio? (4%)

2. A cylinder (cross-sectional diameter of 0.01128 m) containing chloropicrin (CCl_3NO_2) is placed in a hood. The hood has a blower system that continually circulates dry air at a constant temperature 25°C and 1 atm pressure. Originally, the liquid surface is 0.0388 m from the top of the cylinder. After one day the liquid level is 0.0412 m below the top. The vapor pressure and density of CCl_3NO_2 are 3178.3 N/m^2 and 1650 kg/m^3, estimate the substances diffusivity in air. Molecular weight of CCl_3NO_2 is 164.39. (20%)

3. A continuous fractionating column is to be designed to separate 30000 lb/h of a mixture of 40% benzene and 60% toluene into an overhead product containing 97% benzene and a bottom product containing 98% toluene. These percentages are by weight. A reflux ratio of 3.5 moles to 1 mole of product is to be used. The molal latent heats of benzene and toluene are 7360 and 7960 cal/gmol, respectively. If the feed is liquid and at its boiling point.
   ① Calculate the moles of overhead product and bottom product per hour. (6%)
   ② The molal latent heats of steam is 939 cal/gmol and used for heating, how much steam is required per hour for the above cases, neglecting heat losses and assuming the reflux is a saturated liquid? (7%)
   ③ If cooling water enters the condenser at 80°F and leaves at 150°F, how much cooling water is required? (7%)

4. A fan sends static air into a 45 m long; rectangular pipe of 200 mm × 300 mm. The air entering the pipe is 15 °C and 750 mmHg absolute pressure, and the flow rate is 0.6 m^3/s. What is the theoretical power required? For a smooth tube, f = 16/Re in laminar flow; f = $0.046Re^{-0.2}$ in turbulent flow; Re is the Reynolds number. (20%)

5. What is flowing through a large circular conduit with a velocity profile given by the equation $v = 9(1-r^2/16)$ fps. What is the average water velocity in the 1.5-ft pipe? (10%)



6. A standard schedule 40, 2-in steel pipe (inside diameter 2.067 in and wall thickness 0.154 in) carrying steam is insulated with 2-in of 85% magnesia covered in turn with 2-in of cork. Estimate the heat loss per hour per foot of pipe if the inner surface of the pipe is at 250°F and the outer surface of the cork is at 90°F. The thermal conductivities (in Btu/hr · ft · °F) of the substances concerned are: steel, 26.1; 85% magnesia, 0.04; cork, 0.03. (10%)