

มหาวิทยาลัยสงขลานครินทร์
คณะวิศวกรรมศาสตร์

การสอบกลางภาค ประจำปีการศึกษาที่ 2

ปีการศึกษา 2550

สอบวันที่ 5 มกราคม 2550

เวลา 09:00-12:00 น

วิชา 220-524 Waste Geotechnics

ห้องสอบ R 300

ชื่อ..... รหัส.....

คำชี้แจง

1. ข้อสอบมี 4 ข้อ 100 คะแนน พร้อมกระดาษกราฟ 2 แผ่น ให้ทำทุกข้อ
2. อนุญาตให้นักศึกษานำเครื่องคิดเลข และ กระดาษ Note ขนาด A4 เขียนด้านเดียว เข้าห้องสอบ

ผศ.ดร. ธนิต เฉลิมยานนท์

ผู้ออกข้อสอบ

25 ธันวาคม 50

Problem 1: Short Answers (20 points)

- a. Explain the process of how contaminants from waste containment may affect the people?
- b. Explain the theory of diffuse double layer, why does it affect the hydraulic conductivity of clay?
- c. Explain the use of landfill and its main components. Also describe the function of each component.
- d. What is isomorphous substitution and how does it affect the efficiency of clay used as a landfill liner?
- e. What is the easiest way to determine the type of clay mineral and how?
- f. Explain the effects of D, R on a breakthrough curve.

Problem 2: Transport-Based Liner Design (30 points)

A composite liner consists of a 0.6 m compacted clay ($K = 1e-7$ cm/s) overlain by a 1.5-m-thick HDPE geomembrane with a maximum depth of leachate of 0.3 m. Leachate of concentration contains a variety of metals, but zinc and copper are the primary contaminants. The concentrations of zinc and copper in the leachate are 500 and 250 mg/l. Partition coefficients for zinc and copper

from batch tests were 0.261 and 0.435 l/kg, respectively. The diffusion coefficients for zinc and copper were 4×10^{-6} and 2.5×10^{-6} cm^2/s . The porosity of clay was 0.32, whereas, the density and water content were 2.21 g/cc and 20% respectively. Determine mass flux (kg/ha-yr) of both metals at 10 years and the time required for getting maximum mass flux for both metals. Assume that size of hole = 5 mm and 10 holes/ha

Problem 3: A transport parameter (30 points)

A column test was conducted using Songkhla clay ($n = 0.35$) to determine diffusion coefficient of toluene. The toluene having concentration of 200 mg/L was placed on top of a geomembrane which was underlined by a 5-cm thick compacted Songkhla clay. Observed mass fluxes with respect to time at the bottom of the column are shown in the table below. Estimate the diffusion coefficient (cm^2/s) of the toluene. Assume that there is no adsorption between toluene and the clay.

Time (yrs)	Observed mass flux mg/($\text{cm}^2 \cdot \text{yr}$)
0.5	4.20E-07
1	3.10E-04
1.5	3.31E-03
2	8.75E-03

Problem 4: Adsorption (20 points)

Batch adsorption tests were conducted on a sample of moderately to highly plastic clay that is being considered as a lining material for a pond used to contain process water containing copper chloride. The batch tests were conducted by adding 5 g of dry clay to 40 ml of solution prepared with deionized water and copper chloride, CuCl_2 (atomic weight of Cu = 63.546 g, atomic weight of Cl = 35.453 g). Four flasks were prepared. The concentrations of copper were measured before the soil was added (C_o) and after tumbling the flasks for 48 hours (C_f).

Sample	C_o (mg/l)	C_f (mg/l)
1	3792	2849
2	3355	2413
3	2401	1716
4	1401	1004

Plot the isotherm. Estimate the partitioning coefficient (K_p) for copper with the soil. Estimate CEC (meq/100 g) of this soil.

