UNIVERSITI SAINS MALAYSIA

Second Semester Examination
2011/2012 Academic Session

June 2012

KIE 358 – Current Topics in Industrial Chemistry
[Tajuk Semasa Kimia Industri]

Duration : 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of SIX pages of printed material before you begin the examination.

Instructions:

Answer any **FIVE** (5) questions. If a candidate answers more than five questions only the first five questions in the answer sheet will be graded.

Answer each question on a new page.

You may answer the questions either in Bahasa Malaysia or in English.

In the event of any discrepancies, the English version shall be used.

Answer any **FIVE** (5) questions

1. (a) What are the differences between anodic and cathodic corrosion protection?
Briefly explain with the aid of a sketch diagram, how the anodic protection can be achieved.

(10 marks)

(b) In a polarization experiment of steel in sea water it is found that thevalue of Tafel constants, β_a and β_c, are 0.129 V decade^{-1} and 0.144 V decade^{-1}, respectively. If the measured polarization resistance (R_p) is 3.57 Ohm, calculate the corrosion current and the corrosion rate (in mil per year) of steel. The molar mass and the density of steel are 55.86 g mol^{-1} and 7.8 g cm^{-3}, respectively.

(10 marks)

2. (a) What are intergranular corrosion and stress corrosion? Describe briefly under which conditions these corrosions occur.

(6 marks)

(b) Plot schematically the polarization curve for the corrosion of divalent metal M that has the following electrochemical parameters:

Corrosion potential (E_{corr})	= -0.500 V vs SCE
Passivity potential (E_{pass})	= -0.450 V vs SCE
Pitting potential (E_{pit})	= 0.950 V vs SCE
Protection potential (E_{pro})	= -0.150 V vs SCE
Corrosion current (i_{corr})	= 2.5 x 10^{-3} A cm^{-2}

Assuming that the value of Tafel constant, β_a and β_c, for the polarization curve are 0.130 V decade^{-1} and 0.145 V decade^{-1}, respectively, calculate the corrosion rate (in mil per year) for the metal M. The equivalent weight and density of the metal M are 27.95 g eq.$^{-1}$ and 7.60 g cm^{-3}, respectively.

(14 marks)

3. (a) Several types of paints are used to protect structural steel from corrosion in atmospheric environment. Briefly discuss the types and the roles of each paint that provide protection against corrosion.

(10 marks)

(b) What are meant by anodic and cathodic inhibitors? Briefly explain by using a potentiodynamic polarization curve the effects of anodic and cathodic inhibitors on the corrosion potential and the corrosion current density.

(10 marks)

4. (a) Briefly describe the advantages and disadvantages of electrochemical impedance spectroscopy (EIS) as compared to potentiodynamic polarization in corrosion study.

Determine the highest inhibition efficiency, (% IE) of the inhibitor (INH) from the following EIS data. C_{dl} and R_{ct} are double layer capacitance and charge transfer resistance of the corrosion of steel in 1 M solution, respectively.

Concentration Inhibitor (% w/v)	C_{dl} (Farads)	R_{ct} (Ohms)
1.00 M HCl	1.92×10^{-4}	19.62
0.01 % INH	1.56×10^{-4}	72.31
0.05 % INH	1.30×10^{-4}	168.91
0.50 % INH	6.50×10^{-5}	315.53
1.00 % INH	4.30×10^{-5}	296.10

(10 marks)

(b) Differentiate and elaborate on the following delivery systems;
(i) Sustained release.
(ii) Controlled release.
(iii) Triggered release.

(10 marks)

5. Describe briefly the FOUR principal advantages of controlled release delivery system. Explain the methods used in achieving such system.

(20 marks)

6. Write the THREE types of release rate and sketch their profile.

Choose one example each from the agricultural and pharmaceutical applications and discuss their release behaviour. Justify which of the profiles above best suit your chosen applications.

(20 marks)

7. Polymer capsules are used as triggered release drug delivery device. Name TWO such polymers. Discuss the various ways of triggering the release from the polymer capsules.

(20 marks)

TERJEMAHAN

Sila pastikan bahawa kertas peperiksaan ini mengandungi ENAM halaman bahan bercetak.

Arahan:

Jawab **LIMA** (5) soalan . Jika calon menjawab lebih daripada lima soalan hanya lima soalan pertama mengikut susunan dalam skrip jawapan akan diberi markah.

Jawab setiap soalan pada muka surat yang baru.

Anda dibenarkan menjawab soalan ini sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.

Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunapakai.

Jawab **LIMA** (5) soalan

1. (a) Apakah perbezaan antara pencegahan kakisan secara anodik dan katodik? Terangkan dengan ringkas dengan bantuan lakaran rajah, bagaimana pencegahan dengan anod korban dapat dilakukan.

(10 markah)

(b) Dalam eksperimen pengutuban keluli di dalam air laut didapati bahawa nilai pemalar Tafel, β_a dan β_c ialah masing-masing 0.129 V decade^{-1} dan 0.144 V decade^{-1}. Jika kerintangan pengutuban (R_p) ialah 3.57 Ohm, hitunglah arus kakisan dan kadar kakisan (dalam mil per tahun) keluli tersebut. Jisim molar dan ketumpatan keluli ialah masing-masing 55.86 g mol^{-1} dan 7.8 g cm^{-3}.

(10 markah)

2. (a) Apakah kakisan intergranular dan kakisan strees? Jelaskan dengan ringkas keadaan yang menyebabkan kakisan tersebut berlaku.

(6 markah)

(b) Lakarkan lekuk pengutuban bagi kakisan logam dwivalen M yang mempunyai parameter elektrokimia seperti berikut:

Keupayaan kakisan (E_{corr})	= -0.500 V vs SCE
Keupayaan pempasifan (E_{pass})	= -0.450 V vs SCE
Keupayaan liang (E_{pit})	= 0.950 V vs SCE
Keupayaan pencegahan (E_{pro})	= -0.150 V vs SCE
Arus kakisan (i_{corr})	= 2.5 x 10^{-3} A cm^{-2}

Andaikan bahawa nilai pemalar Tafel, β_a dan β_c, bagi pengutuban ialah masing-masing 0.130 V decade^{-1} and 0.145 V decade^{-1}, hitunglah kadar kakisan (dalam mil per tahun) bagi logam M. Berat setara dan ketumpatan logam M ialah masing-masing 27.95 g eq.$^{-1}$ dan 7.60 g cm^{-3}.

(14 markah)

3. (a) Pelbagai jenis cat digunakan untuk melindungi struktur keluli daripada kakisan dalam persekitaran atmosfera. Bincangkan dengan ringkas jenis dan fungsi setiap cat yang memberi perlindungan terhadap kakisan.

(10 markah)

(b) Apakah yang dimaksudkan dengan perencat anodik dan katodik? Terangkan dengan ringkas menggunakan keluk pengutuban potensiodinamik kesan perencat anodik dan katodik kepada keupayaan kakisan dan ketumpatan arus kakisan.

(10 markah)

4. (a) Jelaskan dengan ringkas kelebihan dan kekurangan spektroskopi elektrokimia impedan berbanding dengan pengutubatan potensiodinamik dalam kajian kakisan.

Tentukan kecekapan perencatan tertinggi, (% IE) untuk perencat (INH) daripada data EIS dibawah ini. C_{dl} dan R_{ct} ialah masing-masing kapasitan lapisan berganda dan rintangan hantaran cas bagi kakisan keluli di dalam larutan 1 M HCl.

Concentration Inhibitor (% w/v)	C_{dl} (Farads)	R_{ct} (Ohms)
1.00 M HCl	1.92×10^{-4}	19.62
0.01 % INH	1.56×10^{-4}	72.31
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1.00 % INH	4.30×10^{-5}	296.10

(10 markah)

(b) Beza dan huraikan sistem penghantaran berikut;
(i) Pelepasan terlestari.
(ii) Pelepasan terkawal.
(iii) Pelepasan tercetus.

(10 markah)

5. Terangkan secara ringkas EMPAT kebaikan utama sistem penghantaran pelepasan terkawal. Huraikan kaedah-kaedah yang digunakan bagi mendapatkan sistem tersebut.

(20 markah)

6. Tuliskan TIGA jenis kadar pelepasan dan lakarkan profilnya.

Pilih satu contoh setiapnya daripada aplikasi pertanian dan farmasutik dan bincangkan perlakuan pelepasnya. Berikan justifikasi profil manakah di atas yang lebih sesuai bagi setiap aplikasi pilihan anda.

(20 markah)

7. Kapsul polimer digunakan sebagai alat penghantaran ubat pelepasan tercetus. Namakan DUA polimer tersebut. Bincangkan beberapa cara bagi mencetus pelepasan dari kapsul polimer.

(20 markah)

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