UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Kedua
Sidang Akademik 2005/2006

April/Mei 2006

EBP 324/3 - Degradasi Polimer & Alam Sekitar

Masa : 3 jam

Sila pastikan bahawa kertas peperiksaan ini mengandungi TUJUH muka surat yang bercetak sebelum anda memulakan peperiksaan.

Kertas soalan ini mengandungi TUJUH soalan.

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

Mulakan jawapan anda untuk setiap soalan pada muka surat yang baru.

Semua soalan mesti dijawab dalam Bahasa Malaysia.

...2/-

[c] Rajah 1 menunjukkan proses pengitaran semula botol PET yang dilakukan oleh Dow Chemical.

1.	Pengasingan botol yang kotor-diasingkan kepada warna dan jenis yang berbeza	
2.	Pengranulasi	
3.	Pengklasifikasi Udara	label ↑
4.	Pengapungan Air	PET + label ↑
5.	Pengapungan dalam 1,1,1 - trikloroetana	PET + label ↑ (larutan melarutkan adhesif)
6.	Pengapungan dalam 1,1,1 - trikloroetana + perkloroetilena	PET + Aluminium ↓
7.	Penyingkiran larutan/perolehan semula PET	Pelarut ↑
8.	Pengeringan Hasil: Cebisan Kecil PET dengan ketulenan tinggi	

Rajah 1 - Sistem Pengitaran Semula PET Menggunakan Pelarut/Pengapungan

Jelaskan perbezaan kaedah di atas dengan kaedah Metanolisis, Hidrolisis dan Glikolisis bagi mengitar semula PET.

(70 markah)

...4/-

[b] Tuliskan nota ringkas mengenai pencuacaan semulajadi dan pencuacaan terpecut.

(25 markah)

[c] Berpandukan gambarajah kekuatan tensil melawan masa pendedahan, jelaskan kesan degradasi seperti yang berikut terhadap kekuatan tensil bagi polimer:

(i) sambung-silang degradatif
(ii) pengguntingan rantai
(iii) pengguntingan sambung-silang

(25 markah)

5. [a] Tuliskan nota ringkas bagi perkara-perkara berikut:

(i) peranan mikroorganisme, substrat dan persekitaran dalam biodegradasi

(30 markah)

(ii) rukun pusat bagi biodegradasi

(20 markah)

[b] Pelbagai ujian biodegradasi telah digunakan untuk menganalisis sifat biodegradasi bagi polimer.

(i) Berikan LIMA jenis ujian biodegradasi
(ii) Berikan kebaikan dan keburukan bagi LIMA jenis ujian biodegradasi tersebut.

(25 markah)

[c] Tuliskan mekanisme bagi penyahpolimeran enzimatik bagi poli(vinil alkohol).

(25 markah)

...6/-

7. [a] Huraikan tindakbalas Norrish jenis I dan Norrish jenis II dengan memberikan contoh yang sesuai.

(20 markah)

[b] Tuliskan mekanisme bagi foto-pengoksidaan polimer.

(20 markah)

[c] Poli(etilena) telah diproseskan pada tiga suhu yang berlainan, iaitu 150°C, 165°C dan 175°C. Huraikan kesan suhu pemprosesan terhadap kepekatan hidroperoksida bagi poli(etilena) dengan berpandukan gambarajah yang sesuai.

(30 markah)

[d] Poli(etilena) telah diproseskan pada suhu 150°C dengan tiga keadaan yang berbeza, iaitu (i) kebuk terbuka, (ii) kebuk tertutup dan (iii) kebuk yang mengandungi argon. Bincangkan kesan pemprosesan terma terhadap indeks karbonil bagi poli(etilena) tersebut. Jawapan perlu disokong dengan gambarajah yang sesuai.

(30 markah)

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TRANSLATION

UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session of 2005/2006

April/May 2006

EBP 324/3 - Polymer Degradation & Environment

Time : 3 hours

Please ensure that this paper consists of SEVEN printed pages before you proceed with the examination.

This paper contains SEVEN questions.

Answer any FIVE questions. If a candidate answers more than five questions, only the first five answered will be examined and awarded marks.

Answer to any question must start on a new page.

All questions must be answered in Bahasa Malaysia.

...2/-

[c] Figure 1 shows the recycling process of PET bottles done by Dow Chemical.

1.	Separation of dirty bottles - separated into different colour and type	
2.	Granulation	
3.	Air Classification	label ↑
4.	Water Floating	PET + label ↑
5.	Floating in 1,1,1 - trichloroethane	PET + label ↑ (adhesive dilute by solution)
6.	Floating in 1,1,1 trichloroethane + perchloroetylene	PET + Aluminium ↓
7.	Solution rejection/PET discovery	Solvent ↑
8.	Drying Yield: small pieces of PET with high purity	

Figure 1 - PET recycling system using solvent/floatation

Explain the difference between the above method with metanolysis, hydrolysis and glycolysis methods for recycling PET.

(70 marks)

3. [a] Why the recycling of PVC is important to be done?

(15 marks)

[b] Explain the various source for recycling PVC wastes.

(15 marks)

...4/-

[c] Based on the figure of tensile strength versus exposure time, explain the effects of the respective degradation on the tensile strength of a polymer:

(i) Degradative cross-linking

(ii) Chain scissions

(iii) Scissions of cross-linking

(25 marks)

5. [a] Write brief notes on the following:

(i) the role of microorganism, substrate and environment in biodegradation.

(30 marks)

(ii) the central dogma of biodegradation.

(20 marks)

[b] Several biodegradation tests has been used to analyze the biodegradation properties of polymers.

(i) Give FIVE types of biodegradation assessments.

(ii) Give the advantages and disadvantages of the FIVE types of biodegradation tests as you mentioned.

(25 marks)

[c] Write the mechanism of enzymatic depolymerization for poly(vinyl alcohol).

(25 marks)

...6/-

7. [a] Describe Norrish type I and Norrish type II reaction by suitable example.

(20 marks)

[b] Write the mechanism of photo-oxidation for polymer.

(20 marks)

[c] Poly(ethylene) samples were processed under three different temperature, i.e. 150°C, 165°C and 175°C. Discuss the effects of processing temperature on the hydroperoxide concentration for the poly(ethylene). Discussion should accompanied by figure.

(30 marks)

[d] Poly(ethylene) samples were processed under temperature of 150°C in three different processing condition, i.e. (i) opened chamber, (ii) closed chamber and (iii) chamber with argon gas. Discuss the effects of thermal processing on the carbonyl index of the poly(ethylene). Discussion should be supported by figure.

(30 marks)

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