UNIVERSITI SAINS MALAYSIA

Second Semester Examination
2012/2013 Academic Session

June 2013

EBP 324/3 – Polymer Degradation and Environment
[Degradasi Polimer & Alam Sekitar]

Duration : 3 hours
[Masa : 3 jam]

Please ensure that this examination paper contains SEVEN printed pages before you begin the examination.
[Sila pastikan bahawa kertas peperiksaan ini mengandungi TUJUH muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]

This paper consists of SEVEN questions. THREE questions in PART A and FOUR questions in PART B.
[Kertas soalan ini mengandungi TUJUH soalan. TIGA soalan di BAHAGIAN A dan EMPAT soalan di BAHAGIAN B.]

Instruction: Answer **FIVE** questions. Answer **ALL** questions from PART A and **TWO** questions from PART B. If a candidate answers more than five questions only the first five questions answered in the answer script would be examined.
*[**Arahan**: Jawab **LIMA** soalan. Jawab **SEMUA** soalan dari BAHAGIAN A dan **DUA** soalan dari BAHAGIAN B. Jika calon menjawab lebih daripada lima soalan hanya lima soalan pertama mengikut susunan dalam skrip jawapan akan diberi markah.]*

The answers to all questions must start on a new page.
[Mulakan jawapan anda untuk semua soalan pada muka surat yang baru.]

You may answer a question either in Bahasa Malaysia or in English.
[Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]

In the event of any discrepancies, the English version shall be used.
[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunapakai.]

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PART A / *BAHAGIAN A*

1. [a] Discuss the Bolland Gee auto-oxidation reaction.

Bincangkan tindakbalas auto-pengoksidaan Bolland Gee.

(50 marks/*markah*)

[b] Explain the following antioxidants. The discussion should be supported by appropriate mechanism.

(i) butylated hydroxyl toluene

(ii) diphenyldisulphide

Terangkan antioksidan berikut. Perbincangan perlu disokong dengan mekanisme yang sesuai.

(i) toluena hidroksil terbutil

(ii) difenildisulfida

(50 marks/*markah*)

2. [a] Discuss briefly the feedstock or tertiary recycling by thermolysis.

Bincangkan secara ringkas pengitaran 'feedstock' atau pengitaran tertier secara termolisis

(35 marks/*markah*)

[b] What do you understand by advanced processes for utilizing Plastic Derived Fuel (PDF)?

Apakah yang anda faham dengan proses-proses termaju bagi penggunaan 'Plastic Derived Fuel (PDF)'?

(35 marks/*markah*)

[c] Explain 3 environmental benefits of expanded polystyrene (EPS).

Jelaskan 3 kepentingan persekitaran bagi polistirena terkembang (EPS).

(30 marks/*markah*)

3. [a] Discuss de-polymerization and mineralization process which are related to biodegradation of biodegradable plastics by giving suitable example.

Bincangkan proses penyahpolimeran dan pemineralan yang berkaitan dengan bioperosotan plastik terbiorosot dengan memberikan contoh yang sesuai.

(40 marks/*markah*)

[b] Explain why de-polymerization process for biodegradable polymers normally occurs outside of the micro-organisms.

Jelaskan mengapa proses penyahpolimeran untuk polimer terbiorosot biasanya berlaku diluar mikro-organisma-mikro-organisma tersebut.

(20 marks/*markah*)

[c] Molecular weight and degree of crystallinity of plastics play important roles in the biodegradation processes. Discuss the effect of the two factors on the degree of biodegradation of biodegradable plastics.

Berat molekul dan darjah penghabluran plastik memainkan peranan penting dalam proses bioperosotan. Bincangkan kesan dua faktor tersebut terhadap darjah bioperosotan plastik terbiorosot.

(20 marks/*markah*)

[d] Discuss critically the advantages and disadvantages of Accelerated Simulated Laboratory System and Field Exposure test.

Bincangkan secara kritikal kelebihan dan kekurangan ujian "Accelerated Simulated Laboratory System" dan "Field Exposure".

(20 marks/*markah*)

PART B / *BAHAGIAN B*

4. [a] Compare Norrish type I and Norrish type II reaction. The discussion should be supported by appropriate mechanism.

Bandingkan tindakbalas Norrish jenis I dan Norrish jenis II. Perbincangan perlu disokong dengan mekanisme yang sesuai.

(50 marks/*markah*)

[b] Discuss on the following photo-stabilization approaches.

(i) UV screener

(ii) UV absorber

(iii) excited-state quencher

Huraikan pendekatan bagi penstabilan-foto seperti yang berikut.

(i) penapis UV

(ii) penyerap UV

(iii) 'excited-state quencher'

(50 marks/*markah*)

5. [a] Describe the accelerated weathering test for polymer.

Huraikan ujian pencuacaan terpecut bagi polimer.

(35 marks/*markah*)

[b] Write short notes about physical recycling of polyurethanes foam.

Tuliskan nota ringkas berkenaan pengitaran fizikal busa poliuretana.

(35 marks/*markah*)

[c] Discuss briefly three (3) basic processes of agglomeration methods which are:

- compression
- agitation
- densifying discs

Bincangkan secara ringkas tiga (3) proses asas kaedah penggumpalan iaitu:

- *pemampatan*
- *pengadukan*
- *"densifying discs"*

(30 marks/*markah*)

6. [a] 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

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Rajah 1 menunjukkan proses pengitaran semula botol-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 marks/*markah*)

[b] Discuss 3 main sources for recycling engineering thermoplastics and 4 products which can be produced from various waste engineering thermoplastics.

Bincangkan 3 sumber utama untuk pengitaran semula termoplastik kejuruteraan dan 4 produk yang boleh dihasilkan daripada pelbagai sisa buangan termoplastik kejuruteraan.

(30 marks/*markah*)

7. [a] Explain two (2) mechanical size reduction techniques which can be used to reduce the various sizes of recycled plastics.

Jelaskan dua (2) teknik pengurangan saiz secara mekanikal yang boleh digunakan untuk mengurangkan saiz pelbagai plastik terkitar semula.

(40 marks/*markah*)

[b] Discuss two density-based sorting methods that usually been carried out, which are float-sink method and hydrocyclone. What are the three (3) limitations of density-based sorting methods?

Bincangkan dua kaedah pengasingan berasaskan ketumpatan yang biasa digunakan iaitu kaedah "float-sink" dan hidrosiklon. Apakah tiga (3) limitasi kaedah pengasingan berasaskan ketumpatan?

(40 marks/*markah*)

[c] Explain briefly Near-Infra-Red (NIR) Spectroscopy. What are the advantages and disadvantages of this technique?

Jelaskan secara ringkas spektroskopi "Near-Infra-Red (NIR)". Apakah kelebihan dan kekurangan teknik ini?

(20 marks/*markah*)

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