
UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2012/2013

January 2013

EBB 427/3 – Technology & Application of Engineering Polymer *[Teknologi & Penggunaan Polimer Kejuruteraan]*

Duration : 3 hours
[Masa : 3 jam]

Please ensure that this examination paper contains TEN printed pages before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi SEPULUH muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]

This paper consists of SEVEN questions. FOUR questions from PART A and THREE questions from PART B.

[Kertas soalan ini mengandungi TUJUH soalan. EMPAT soalan dari BAHAGIAN A dan TIGA soalan dari BAHAGIAN B.]

Instruction: Answer FIVE questions. Answer TWO questions from PART A, TWO questions from PART B and ONE question from any part. If candidate answers more than five questions only the first five questions answered in the answer script would be examined.

Arahan: Jawab LIMA soalan. Jawab DUA soalan dari BAHAGIAN A, DUA soalan dari BAHAGIAN B dan SATU soalan dari mana-mana bahagian. 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 diguna pakai.]

PART A / BAHAGIAN A

1. [a] Select four (4) types of commodity thermoplastics, and compare how the structure of these materials influence their properties.

Pilih empat (4) jenis termoplastik komoditi dan bandingkan bagaimana struktur bahan-bahan ini mempengaruhi sifat-sifat termoplastik tersebut.

(30 marks/markah)

- [b] Representation of the changing properties among polyacrolonitrile, polybutadiene, and polystyrene is shown in Figure 1. The property changes created by increasing the concentration of one material relative to the others are seen by moving along the sides of the triangle. Based on Figure 1, explain how toughness of High Impact Polystyrene (HIPS) and Acrylonitrile Butadiene Styrene (ABS) can be achieved.

Perwakilan sifat bagi poliakrolonitril, polibutadiena dan polistirena ditunjukkan dalam Rajah 1. Perubahan sifat yang terhasil dengan peningkatan kepekatan satu bahan relatif kepada yang lain dilihat dengan pergerakan di sepanjang sisi segi tiga. Merujuk kepada Rajah 1, terangkan bagaimana ketahanan Polistirena Berimpak Tinggi (HIP) dan Akrolonitril Butadiena Stirena (ABS) boleh dicapai.

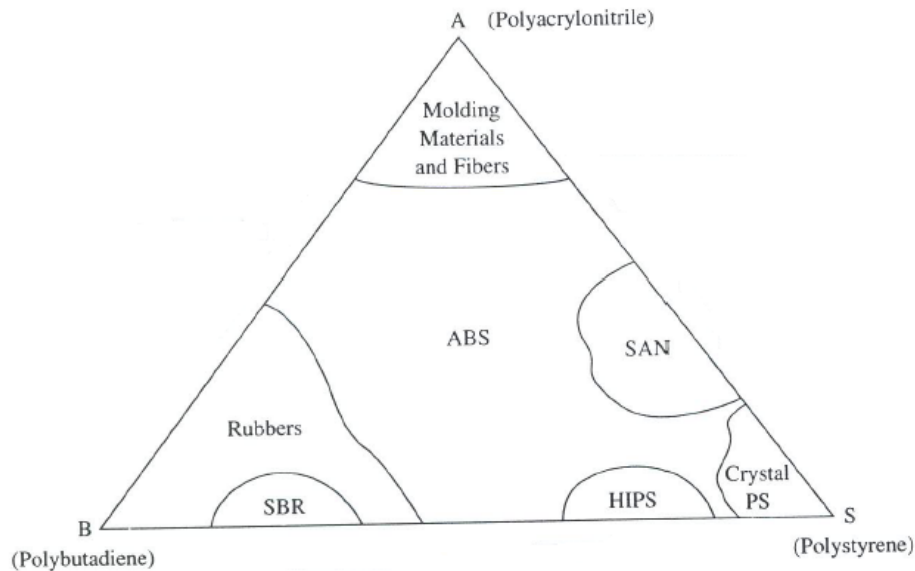


Figure 1: Relationship of polyacrolonitrile, polybutadiene, and polystyrene

Rajah 1: Hubungkait antara poliakrolonitril, polibutadiena dan polistirena

(40 marks/markah)

- [c] “Polycarbonate is non-crystalline and therefore transparent, yet it is nearly as strong as highly crystalline nylon and acetal plastics and is somewhat tougher”. Briefly discuss this statement.

“Polikarbonat adalah bahan tidak berhablur, oleh itu ianya lutsinar, namun ianya hampir sekuat bahan berhablur tinggi seperti plastik nilon dan asetal dan ianya juga liat”. Bincangkan kenyataan ini.

(30 marks/markah)

2. [a] Briefly describe two (2) different types of twin-screw extrusion process.

Perihalkan secara ringkas dua (2) jenis penyemperitan skru berkembar.

(30 marks/markah)

- [b] You are required to produce a plastic bag to package cooking oil.
Discuss the following:

- (i) Method to produce the bag.
- (ii) Relevant tests to evaluate the quality of the bag produced.

Anda diperlukan untuk menghasilkan sebeg plastik untuk membungkus minyak masak. Bincangkan perkara berikut:

- (i) *Kaedah untuk menghasilkan beg ini.*
- (ii) *Ujian yang bersesuaian untuk menentukan mutu beg yang dihasilkan.*

(40 marks/markah)

- [c] Explain why the cis form of polyisoprene is softer than the trans form.
Sketch a flow chart to process the raw rubber into a product by identifying the process and equipment involved.

Terangkan mengapa bentuk cis bagi poliisoprena lebih lembut daripada bentuk trans. Tunjukkan satu contoh carta aliran pemprosesan getah mentah menjadi satu produk dengan mengenalpasti proses dan peralatan yang terbabit.

(30 marks/markah)

3. [a] Describe why small runner is usually used in mould design and large runner is not economical to be used? Give also advantages and disadvantages of small and large runners.

Jelaskan mengapa peparit yang kecil sering digunakan dalam rekabentuk acuan dan peparit yang besar adalah tidak ekonomik untuk digunakan? Berikan juga kelebihan dan kekurangan peparit kecil dan besar.

(30 marks/markah)

- [b] MJM Industries Ltd is a well known manufacturer of injection-molded products. Predict what are the factors that might influence their productivity.

MJM Industri Berhad merupakan pengeluar produk berasaskan pengacuanan suntikan. Jangkakan apakah faktor yang mungkin mempengaruhi produktiviti kilang ini.

(30 marks/markah)

- [c] As an engineer, you are required to select between single-screw and twin-screw extruders for plastic product manufacturing. Give justification on your selection.

Sebagai seorang jurutera, anda diminta untuk memilih di antara ekstruder skru tunggal dan ekstruder skru berkembar untuk pengeluaran produk plastik. Berikan justifikasi terhadap pilihan anda.

(40 marks/markah)

4. [a] State approaches that can be taken in the recycling of waste-based thermoset plastic.

Nyatakan pendekatan yang boleh diambil dalam pengitaran semula sisa plastik berasaskan termoset.

(30 marks/markah)

- [b] The use of recycled materials is not recommended in plastic compounding. Discuss.

Penggunaan bahan teredar-ulang tidak digalakkan dalam penyebatian plastik. Bincangkan.

(30 marks/markah)

- [c] The increase in the properties of a product can be done by various ways such as laminated plastic film (film products based on a few film layers of different types of plastics) or crosslinked thermoplastic. However this approach makes it difficult for the recycling effort. Criticize this statement.

Peningkatan sifat sesuatu produk boleh dilakukan dengan pelbagai cara misalnya filem plastik laminat (produk filem yang terhasil daripada beberapa lapisan filem plastik yang berlainan jenis) atau termoplastik tersambung-silang. Namun pendekatan tersebut menyukarkan usaha kitar semula. Komen kenyataan ini.

(40 marks/markah)

PART B / BAHAGIAN B

5. [a] Propose the usage of fibre reinforced polymers (FRP's) instead of concrete in constructing the pedestrian crossing. Outline and discuss the main advantages and disadvantages of using FRP's in the selected application.

Cadangkan penggunaan polimer diperkuat gentian (FRP's) bagi menggantikan konkrit di dalam pembinaan lintasan pejalan kaki. Kemukakan dan bincangkan kelebihan dan kelemahan FRPs di dalam pembinaan jambatan pejalan kaki berbanding konkrit.

(20 marks/markah)

- [b] Prapregs (Pre-impregnated sheet materials) are fibrous materials impregnated with reactive resin materials and are the ideal starting material for lightweight yet high-strength construction parts. Discuss and compare the main advantages and disadvantages of prapreg and hand lay-up technique in preparing structural composites by taking into account the aspects of cost of materials, handling of the materials, health and safety, waste generation and surface finish.

Prapreg adalah bahan gentian yang diisitepukan dengan resin reaktif dan ideal sebagai bahan pemula untuk menghasilkan komponen binaan berkekuatan tinggi. Bincang dan bandingkan kelebihan dan kekurangan utama kaedah prapreg dan hand-layup dengan mengambilkira aspek-aspek kos bahan, pengendalian bahan, keselamatan dan kesihatan dan jumlah buangan permukaan penyudah.

(40 marks/markah)

- [c] In cases where mechanical joints are not applicable, structural adhesives play an important role in joining together similar or dissimilar faces. Discuss the nature of structural adhesives and outline the main specification of typical structural adhesives. In your discussion, please also include the various ways of improving the strength of the bond with respect to the surface preparation.

Di dalam kes-kes di mana sambungan mekanikal tidak dapat digunakan, perekat struktur memainkan peranan yang penting untuk menyambungkan dua permukaan yang sama atau berlainan. Bincangkan tabii perekat struktur dan senaraikan spesifikasi utama untuk sesuatu perekat struktur lazim. Dalam perbincangan anda, nyatakan kaedah-kaedah untuk meningkatkan kekuatan perekatan dengan menekankan kepada aspek penyediaan permukaan.

(40 marks/markah)

6. [a] Discuss the important aspects of processing thermosetting resins.

Bincangkan aspek-aspek penting dalam pemprosesan resin termoset.

(20 marks/markah)

- [b] Describe the process of manufacturing unidirectional composites using a pultrusion technique. In your description, provide the information pertaining to the resin and fibre preparations and their requirements including the resin to fibre ratio, vital additives and pulling speed in order to ensure a smooth operation.

Terangkan proses penghasilan komposit selanjur menggunakan kaedah pultrusi. Dalam penerangan anda, gariskan aspek penyediaan resin dan gentian serta keperluan seperti nisbah resin terhadap gentian, bahan tambah penting dan kelajuan penarikan untuk memastikan proses berjalan lancar.

(40 marks/markah)

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- [c] Linear unsaturated polyesters are prepared commercially by the reaction of a saturated diol with a mixture of an unsaturated dibasic acid and the corresponding anhydrides. Outline the procedure of preparing linear unsaturated polyesters commercially and recommend a typical ratio of those saturated diol and anhydride.

Poliester linear tak tepu dihasilkan secara komersil melalui tindakbalas antara campuran diol tepu dan asid dwibasik tak tepu beserta anhidrida yang sesuai. Perincikan kaedah pernghasilan poliester linear tak tepu secara komersil dan cadangkan nisbah tipikal antara asid dwibasik tak tepu dan anhidrida.

(40 marks/markah)

7. [a] Autoclave curing is always recommended when high a quality composite is required especially for aircraft and automotive components. Explain why autoclave curing is capable of producing high quality composites and compare your answer with ordinary curing methods such as compression moulding.

Pematangan autoclav adalah kaedah pilihan apabila komposit berkualiti tinggi diperlukan terutamanya untuk komponen-komponen pesawat dan automotif. Terangkan mengapa kaedah pematangan autoclav mampu menghasilkan komposit berkualiti tinggi dan bandingkan jawapan anda dengan kaedah pematangan biasa seperti acuan mampatan.

(30 marks/markah)

- [b] You are required to modify the properties of an epoxy resin without having to change the grade of the resin. Outline two (2) simple ways of modifying the resin. Consequently, present and propose the details on how you are going to perform the task and state your hypothesis and expectation clearly.

Anda diminta untuk mengubah sifat suatu resin epoksi tanpa menukar jenis resin epoksi tersebut. Cadangkan dua (2) cara mudah bagaimana sifat resin tersebut boleh diubah. Seterusnya, bentang dan cadangkan dengan terperinci bagaimana pengubahsuaian tersebut dapat dilakukan dengan jelas beserta hipotesis dan jangkaan anda.

(40 marks/markah)

- [c] Addition of a vinyl liquid monomer to an unsaturated polyester compound will not only facilitate the curing process but at the same time, reducing its viscosity without compromising the final properties of the polyester. List and describe five (5) types of available vinyl liquid monomers that are commonly used with unsaturated polyester systems.

Penambahan larutan monomer vinil ke dalam sebatian poliester tak tepu tidak hanya membantu proses pematangan tetapi juga mengurangkan kelikatan tanpa menjejaskan sifat akhir poliester. Senarai dan terangkan lima (5) jenis larutan vinil monomer yang biasa digunakan untuk sebatian poliester tak tepu.

(30 marks/markah)