
UNIVERSITI SAINS MALAYSIA

First Semester Examination
2015/2016 Academic Session

December 2015 / January 2016

EBP 308/3 – Rubber: Processing and Products [Getah: Pemprosesan dan Produk]

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. TWO questions in PART A and FIVE questions in PART B.

[Kertas soalan ini mengandungi TUJUH soalan. DUA soalan di BAHAGIAN A dan FIVE soalan di BAHAGIAN B.]

Instruction: Answer FIVE questions. Answer ALL questions from PART A and THREE 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 TIGA 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 in the examination questions, the English version shall be used.

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

PART A / BAHAGIAN A

1. [a] Explain the importance of recycling various rubber wastes. Why scrap tyre piles can create a lot of environmental problem?

Jelaskan kepentingan pengitaran semula pelbagai sisa getah. Mengapa timbunan skrap tayar boleh menyebabkan banyak masalah persekitaran?

(40 marks/markah)

- [b] Figure 1 shows the relationship between tensile strength and rubber composition of polypropylene/natural rubber (PP/NR) blends and PP/recycled rubber powder (PP/RRP) blends. Figure 2 shows the swelling percentage curves versus time of PP/NR/RRP blends using different sulphur concentration. Discuss the results obtained in Figure 1 and Figure 2.

Rajah 1 menunjukkan perbandingan perhubungan diantara kekuatan tensil dan komposisi getah bagi adunan polipropilena/getah asli (PP/NR) dan adunan PP/serbuk getah kitar semula (PP/RRP). Rajah 2 menunjukkan lengkungan peratus pembengkakan melawan masa bagi adunan PP/NR/RRP menggunakan kepekatan sulfur yang berbeza. Bincangkan keputusan yang diperolehi di dalam Rajah 1 dan Rajah 2.

(60 marks/markah)

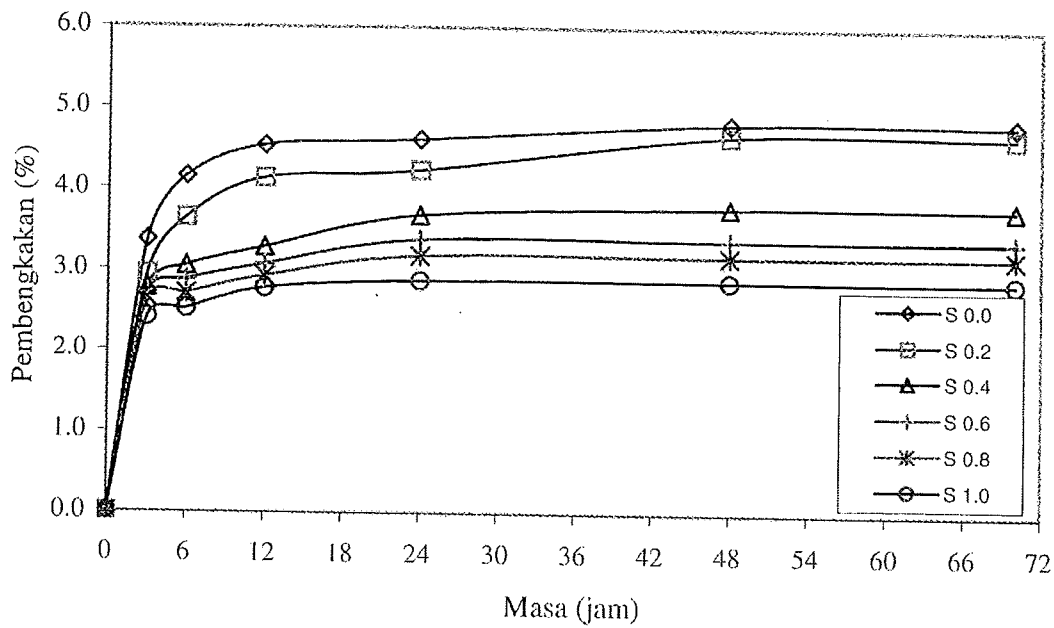


Figure 1 - Tensile strength versus rubber composition

Rajah 1 - Kekuatan tensil melawan kandungan getah

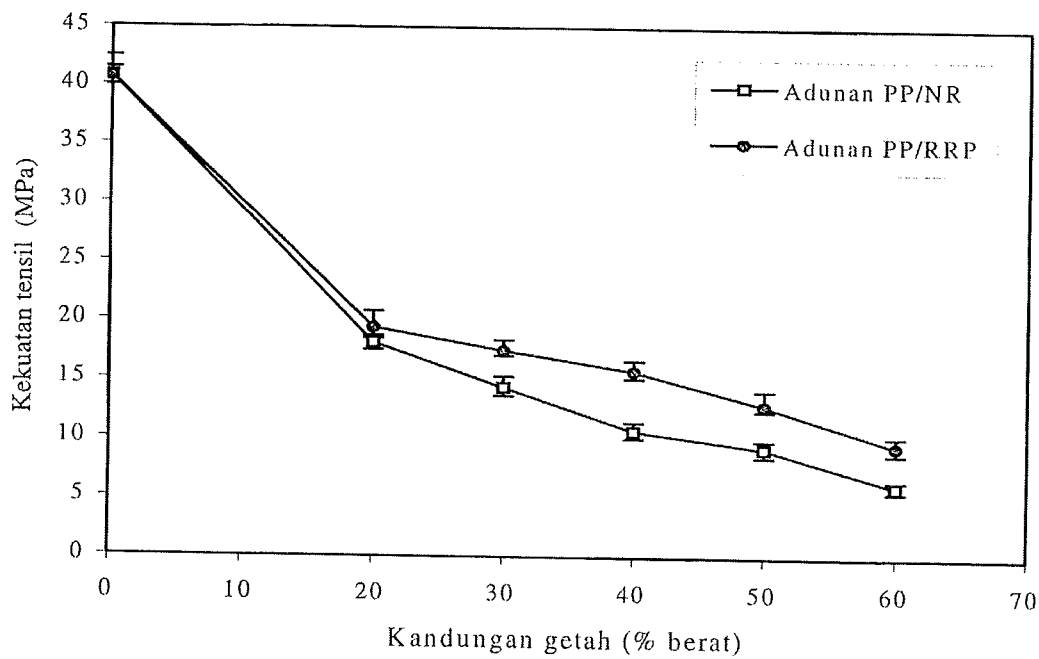


Figure 2 - Swelling percentage curve versus time of PP/NR/RRP blends with different sulphur concentration

Rajah 2 - Lengkungan peratusan pembengkakan melawan masa untuk adunan PP/NR/RRP dengan kepekatan sulfur yang berbeza

2. [a] Materials selection is one of the important steps in designing any rubber products. Based on your knowledge, discuss several consideration factors of selecting a rubber for specific application for example conveyor belt.

Pemilihan bahan merupakan salah satu langkah yang penting dalam mereka bentuk bagi sesuatu produk getah. Berdasarkan pengetahuan kamu, bincangkan beberapa faktor yang perlu dipertimbangkan bagi pemilihan getah untuk aplikasi yang spesifik sebagai contoh tali sawat.

(10 marks/markah)

- [b] List down 5 [FIVE] examples of Group M rubber for Nomenclature of Elastomers based on ISO 1629. Choose one type of Group M rubber and briefly discuss their chemical structure, compounding and vulcanizate properties.

Senaraikan 5 [LIMA] contoh getah Kumpulan M bagi Tatanama Elastomer berdasarkan ISO 1629. Pilih satu contoh bagi getah Kumpulan M ini dan bincangkan secara ringkas berkenaan struktur kimia, penyebatian dan ciri-ciri vulkanizat getah tersebut.

(30 marks/markah)

- [c] Classification of Elastomers is one of the important knowledge for materials selection for a rubber product. At service environment of 120 – 150°C, explain in details the type of rubber that suitable and what are their characteristic when exposed with mineral oils and ozone.

Pengelasan elastomer merupakan salah satu pengetahuan yang penting bagi pemilihan bahan sesuatu produk getah. Pada persekitaran servis 120 – 150°C, jelaskan secara terperinci jenis-jenis getah yang sesuai dan apakah ciri-cirinya apabila didedahkan dengan minyak mineral dan ozon.

(60 marks/markah)

PART B / BAHAGIAN B

3. [a] Explain the differences between All-Rubber Shoes and Plimsolls Shoes.

Jelaskan perbezaan di antara Kasut Semua Getah dan Kasut 'Plimsolls'.

(50 marks/markah)

- [b] PVC shoe making is a less labour intensive operation. Give your comments.

Pembuatan kasut PVC adalah operasi yang menggunakan kurang tenaga buruh. Berikan komen anda.

(50 marks/markah)

4. [a] What do you understand about thermoplastic elastomers (TPEs)? Discuss briefly THREE (3) essential characteristics of TPEs.

Apakah yang anda faham berkenaan elastomer termoplastik (TPEs)? Bincang secara ringkas TIGA (3) ciri-ciri penting TPEs.

(40 marks/markah)

- [b] Using a suitable diagram, explain the morphology of olefin based elastomeric alloys. What are the advantages of using Santoprene as a TPE?

Dengan menggunakan rajah yang sesuai, terangkan morfologi aloi olefin berasaskan elastomer? Apakah kelebihan-kelebihan menggunakan Santoprene sebagai TPE?

(30 marks/markah)

- [c] Define the term of Block Copolymer of Thermoplastic Elastomers. Discuss briefly their two commercial available products.

Berikan definisi Kopolimer Blok Elastomer Termoplastik. Bincangkan secara ringkas dua produk berkaitan yang boleh didapati secara komersial.

(30 marks/markah)

5. Write short notes about
- [a] THREE (3) main commercial products of elastomer alloy.
 - [b] FOUR (4) polymeric materials used for cable insulation.
 - [c] THREE (3) methods of recycling rubber wastes.
 - [d] TWO (2) common types of tyre construction.

Tulis nota ringkas berkaitan

- [a] *TIGA (3) produk komersial utama aloi elastomer.*
- [b] *EMPAT (4) bahan-bahan polimer yang digunakan untuk penebatan kabel.*
- [c] *TIGA (3) kaedah pengitaran sisa-sisa getah.*
- [d] *DUA (2) jenis pembinaan tayar yang umum.*

(100 marks/markah)

6. [a] Discuss 'step by step' how two rubbers can be selected to produce a suitable rubber-rubber blend in manufacturing of fireman shoes.

Bincangkan 'langkah demi langkah' bagaimana dua jenis getah boleh dipilih untuk menghasilkan adunan getah-getah yang sesuai untuk pembuatan kasut ahli bomba.

(30 marks/markah)

- [b] Figure 3 shows the comparison of Mooney scorch time versus blend composition for SMR L/CR and ENR 50/CR blends at 130°C. Figure 4 shows the comparison of modulus at 100% elongation (M100) versus blend composition for SMR L/CR and ENR 50/CR blends. Explain the results obtained in Figure 3 and Figure 4.

Rajah 3 menunjukkan perbandingan masa skorj Mooney melawan komposisi adunan untuk adunan-adunan SMR L/CR dan ENR 50/CR pada 130°C. Rajah 4 menunjukkan perbandingan modulus pada 100% pemanjangan dan M100 melawan komposisi adunan untuk adunan-adunan SMR L/CR dan ENR 50/CR. Jelaskan keputusan-keputusan yang diperolehi di dalam Rajah 3 dan Rajah 4.

(70 marks/markah)

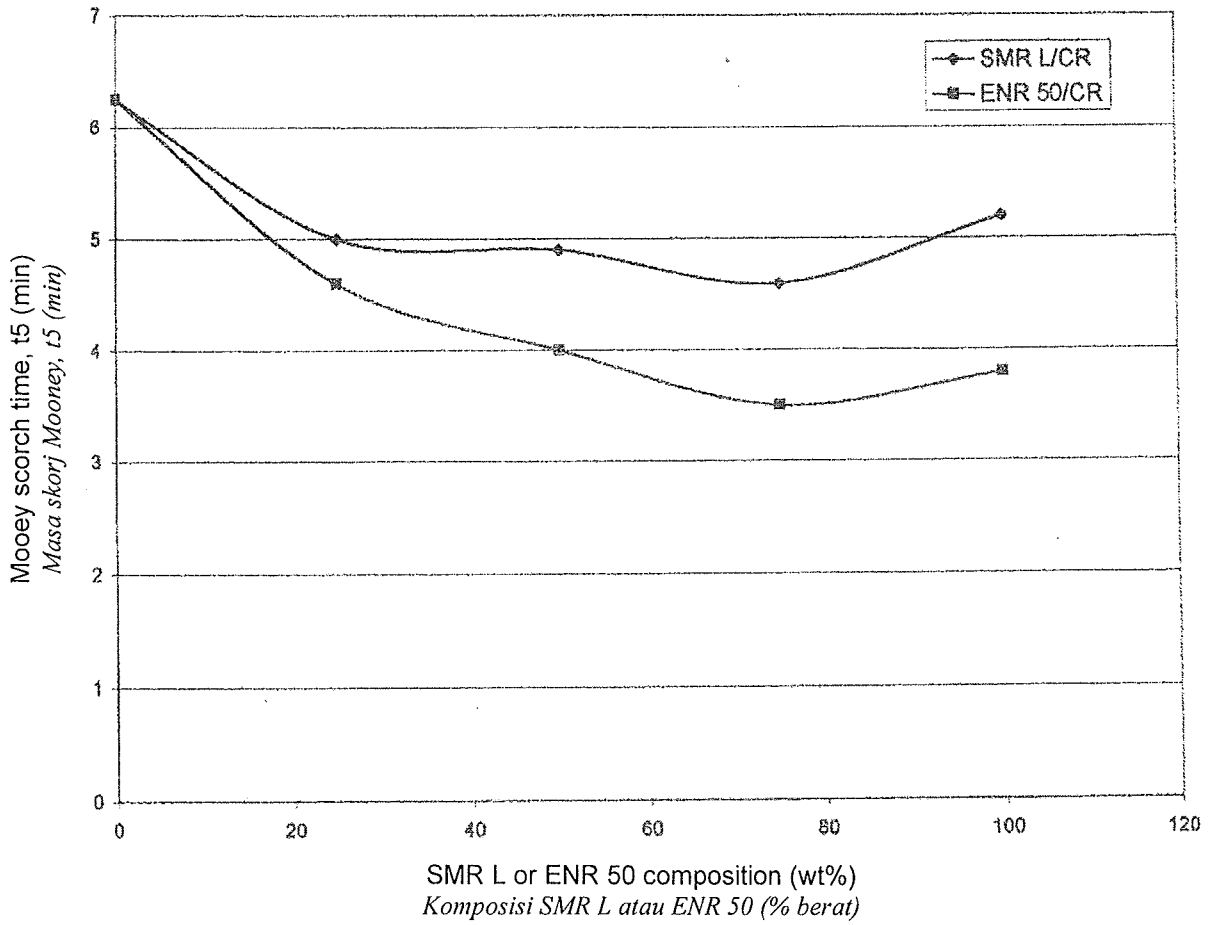


Figure 3 - The comparison of Mooney scorch time versus blend composition for SMR L/CR and ENR 50/CR blends at 130°C

Rajah 3 - Perbandingan masa skorj Mooney melawan komposisi adunan bagi adunan-adunan SMR L/CR dan ENR 50/CR pada 130°C

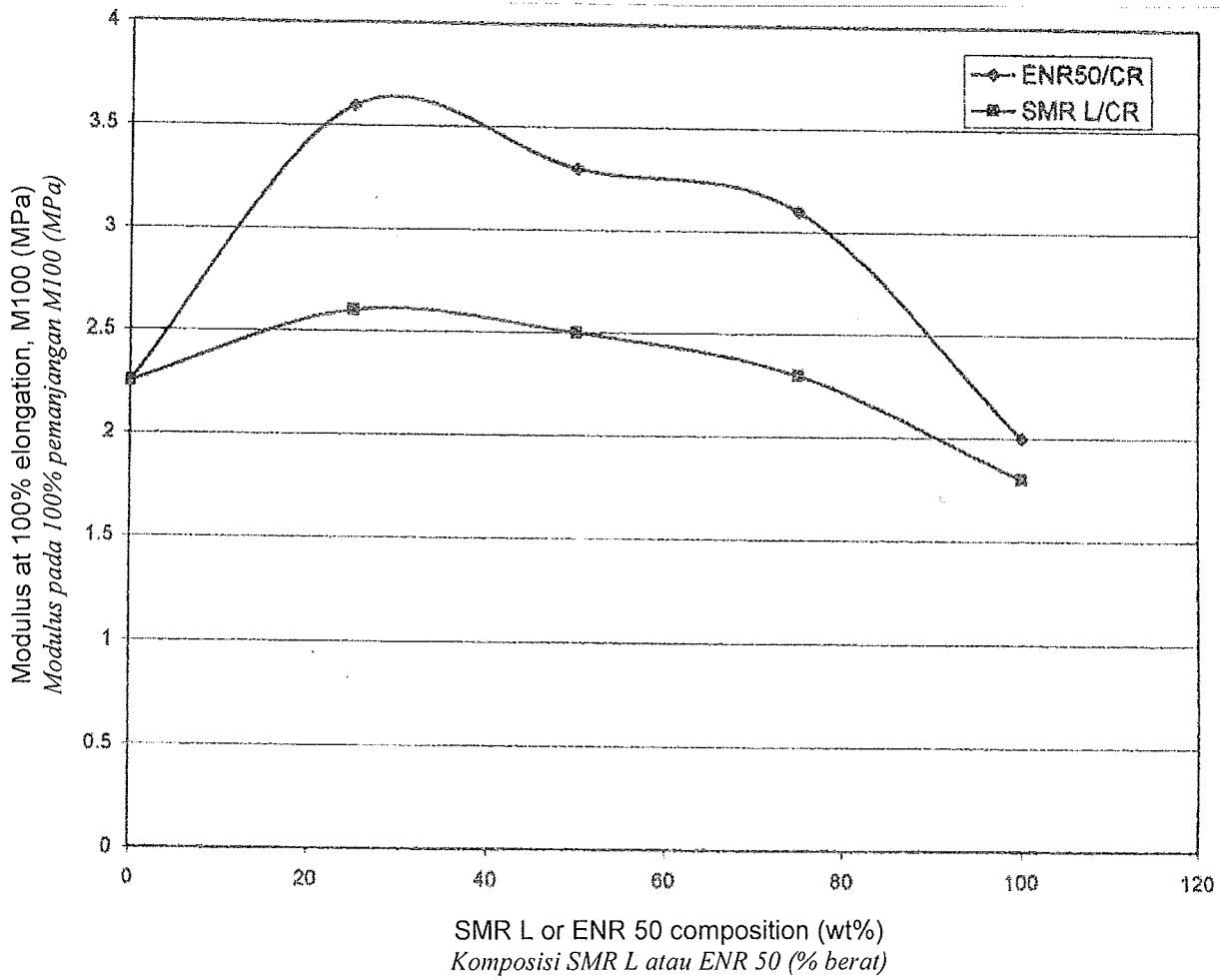


Figure 4 - The comparison of M100 versus blend composition for SMR L/CR and ENR 50/CR blends

Rajah 4 - Perbandingan M100 melawan komposisi adunan untuk adunan-adunan SMR L/CR dan ENR 50/CR

7. [a] Draw the chemical structure of Ethylene Propylene Rubbers (EPM). Describe the differences between Ethylene Propylene Rubbers (EPM) with Ethylene Propylene Diene Rubbers (EPDM) in term of chemical structure, vulcanization system and their rubber blending ability.

Lukis struktur kimia bagi getah Etilena Propilena (EPM). Jelaskan perbezaan antara getah Etilena Propilena (EPM) dengan getah Etilena Propilena Diena (EPDM) dari segi struktur kimia, sistem pemvulkanan dan keupayaan gaulan getah.

(15 marks/markah)

- [b] (i) Based on Figure 5, name FIVE (5) the car parts that made of rubber product and the types of rubber used.

Berdasarkan Rajah 5, namakan LIMA (5) bahagian-bahagian kereta yang diperbuat daripada getah dan jenis-jenis getah yang digunakan.



Figure 5

Rajah 5

(10 marks/markah)

- (ii) Explain in details a type of rubber that is suitable to be used as gasket for automotive application.

Jelaskan secara terperinci sejenis getah yang sesuai digunakan sebagai gasket bagi kegunaan otomotif.

(15 marks/markah)

- [c] For each of the following elastomers, write short notes on chemistry, compounding, vulcanizate properties and their applications:
- (i) Silicone Rubber
 - (ii) Acrylonitrile Butadiene Rubbers (NBR)
 - (iii) Polyurethane Rubbers (PU)

Untuk setiap daripada elastomer berikut, tuliskan nota ringkas berkaitan sifat kimia, penyebatian, sifat vulkanizat dan kegunaannya:

- (i) *Getah Silikon*
- (ii) *Getah Akrilonitril Butadiena (NBR)*
- (iii) *Getah Poliuretana (PU)*

(60 marks/markah)