UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2008/2009

November 2008

EBP 308/3 - Rubber: Processing and Product
[Getah: Pemprosesan dan Produk]

Duration : 3 hours
[Masa : 3 jam]

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

This paper contains SEVEN questions.
[Kertas soalan ini mengandungi TUJUH soalan.]

Instructions: Answer **FIVE** questions. If a candidate answers more than five questions only the first five questions in the answer sheet will be graded.
***[Arahan:** Jawab **LIMA** soalan. Jika calon menjawab lebih daripada lima soalan hanya lima soalan pertama mengikut susunan dalam skrip jawapan akan diberi markah.]*

Answer to any question must start on a new page.
[Mulakan jawapan anda untuk setiap 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.]

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

Apakah yang anda faham berkenaan elastomer termoplastik (TPEs)? Bincang secara ringkas 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] What do you know about Block Copolymer of Thermoplastic Elastomers? Discuss briefly their two commercial available products.

Apakah yang anda tahu berkenaan - Kopolimer Blok Elastomer Termoplastik? Bincangkan secara ringkas dua produk berkaitan yang boleh didapati secara komersial.

(30 marks/*markah*)

2. [a] Explain how elastomers can be classified into chemical saturation of the polymer chain and service performance.

Jelaskan bagaimana elastomer boleh dikelaskan kepada ketepuan kimia rantai polimer dan prestasi servis.

(50 marks/*markah*)

[b] Write the differences between ethylene propylene monomer (EPM) and ethylene propylene diene monomer (EPDM) in term of chemistry, vulcanization agents and vulcanizates properties.

Tuliskan perbezaan di antara etilena propilena monomer (EPM) and etilena propilena diena monomer (EPDM) dari segi sifat kimia, agen-agen pemvulkanan dan sifat-sifat vulkanizat.

(30 marks/*markah*)

[c] What are the main applications of chloroprene rubber (CR)?

Apakah kegunaan-kegunaan utama getah kloroprena?

(20 marks/*markah*)

3. [a] Discuss 'step by step' how two rubbers can be selected to produce a suitable rubber-rubber blend in manufacturing of fuel hoses.

Bincangkan 'langkah demi langkah' bagaimana dua jenis getah boleh dipilih untuk menghasilkan adunan getah-getah yang sesuai untuk pembuatan hos bahanapi.

(30 marks/*markah*)

[b] Figure 1 shows the comparison of Mooney scorch time versus blend composition for SMR L/CR and ENR 50/CR blends at 130°C. Figure 2 shows the comparison of modulus at 100% elongation and M100 versus blend composition for SMR L/CR and ENR 50/CR blends. Explain the results obtained in Figure 1 and Figure 2.

Rajah 1 menunjukkan perbandingan masa skorj Mooney melawan komposisi adunan untuk adunan-adunan SMR L/CR dan ENR 50/CR pada 130°C. Rajah 2 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 1 dan Rajah 2.

(70 marks/*markah*)

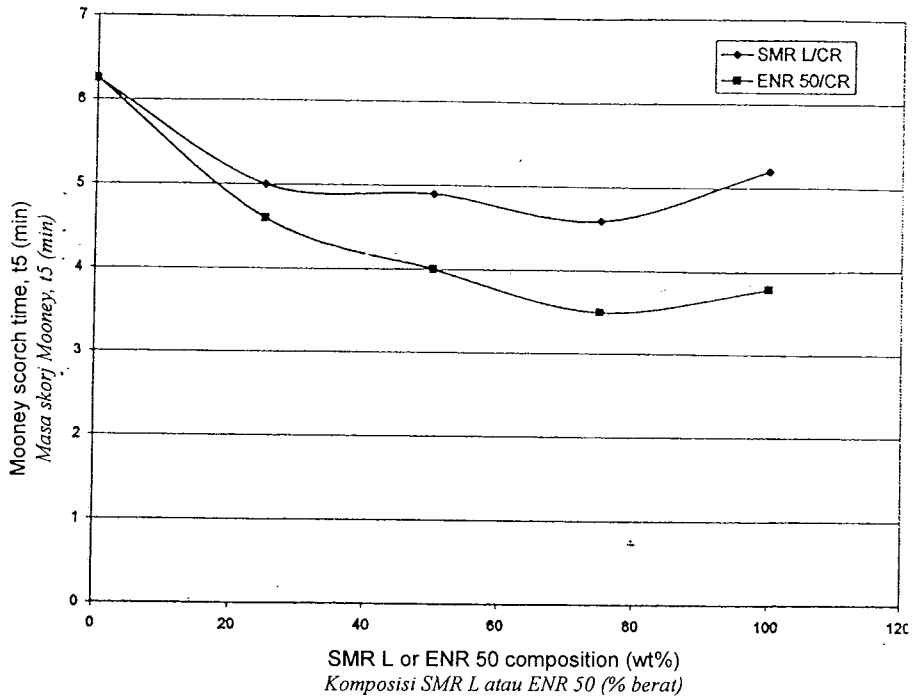

Fig. 1 - The comparison of Mooney scorch time versus blend composition for SMR L/CR and ENR 50/CR blends at 130°C

Rajah 1 - Perbandingan masa skorj Mooney melawan komposisi adunan bagi adunan-adunan SMR L/CR dan ENR 50/CR pada 130°C

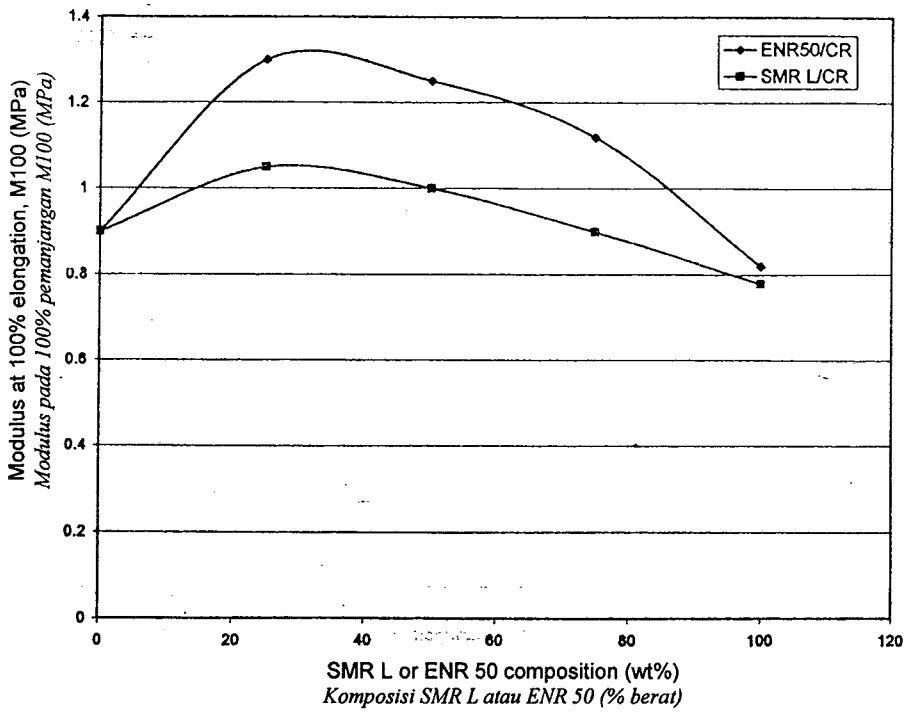

Fig. 2 - The comparison of M100 versus blend composition for SMR L/CR and ENR 50/CR blends

Rajah 2 - Perbandingan M100 melawan komposisi adunan untuk adunan-adunan SMR L/CR dan ENR 50/CR

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4. For each of the following elastomers, write short notes about:

(a) Chemistry
(b) Compounding
(c) Vulcanizate properties
(d) Application
    (i) Styrene butadiene rubber (SBR)
    (ii) Polybutadiene rubber (BR)
    (iii) Butyl rubber (IIR)

Untuk setiap elastomer berikut, tuliskan nota ringkas berkaitan dengan:

(a) Sifat kimia
(b) Penyebatian
(c) Sifat vulkanizat
(d) Kegunaannya
    (i) Getah stirena butadiena (SBR)
    (ii) Getah polibutadiena (BR)
    (iii) Getah butil (IIR)

(100 marks/markah)

5. [a] By using a suitable diagram, explain 2 types of tyre construction.

Dengan menggunakan rajah yang sesuai, jelaskan 2 jenis pembinaan tayar.

(25 marks/*markah*)

[b] What are the 2 main sources of 'tyre noise' and how to minimize it?

Apakah 2 sumber utama 'kebisingan tayar' dan bagaimana untuk meminimakannya?

(25 marks/*markah*)

[c] Explain the differences between Direct Vulcanization Process (DVP) shoes and Direct Injection Process (DIP) shoes.

Jelaskan perbezaan di antara kasut Proses Pemvulkanan Terus (DVP) dan kasut Proses Suntikan Terus (DIP).

(25 marks/*markah*)

[d] Discuss briefly the use of crosslinkable polyethylene (XLPE) as cable insulation.

Bincangkan secara ringkas penggunaan polietilena tersambungsilang sebagai penebat kabel.

(25 marks/*markah*)

6. [a] Discuss 3 methods of rubber recycling.

Bincangkan 3 kaedah pengitaran semula getah.

(40 marks/*markah*)

[b] Figure 3 shows the effect of partial replacement of NR with RRP on tensile strength of PP/NR/RRP blends. Figure 4 shows the % swelling-time curves of PP/NR/RRP blends with different blend ratio in ASTM # 3 oil. Discuss the results obtained in Figure 3 and Figure 4.

Rajah 3 menunjukkan kesan penggantian separa NR dengan RRP ke atas kekuatan tensil adunan-adunan PP/NR/RRP. Rajah 4 menunjukkan lengkungan % pembengkakan-masa bagi adunan-adunan PP/NR/RRP dengan pelbagai nisbah adunan di dalam minyak ASTM # 3. Bincangkan keputusan yang diperolehi di dalam Rajah 3 dan Rajah 4.

(60 marks/*markah*)

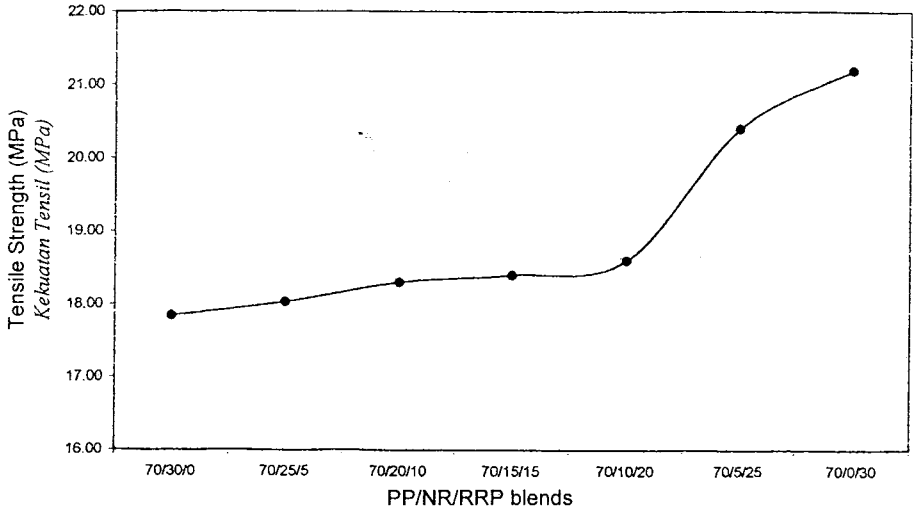

Fig. 3 - The effect of partial replacement of NR with RRP on tensile strength of PP/NR/RRP blends

Rajah 3 - Kesan penggantian separa NR dengan RRP ke atas kekuatan tensil adunan-adunan PP/NR/RRP

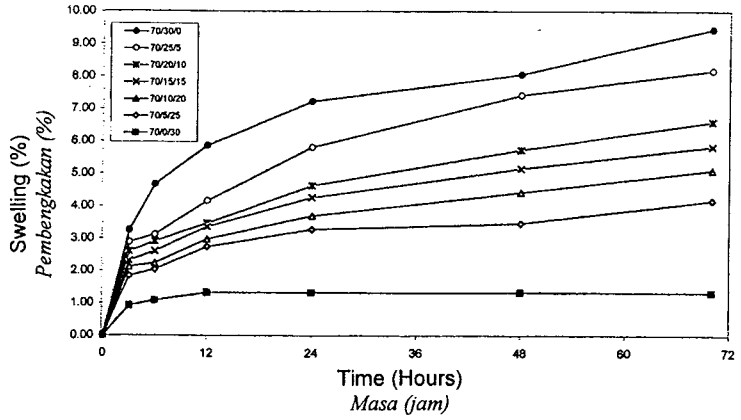

Fig. 4 - % swelling-time curves of PP/NR/RRP blends with different blend ratio in ASTM #3 oil

Rajah 4 - Lengkungan % pembengkakan-masa bagi adunan-adunan PP/NR/RRP dengan pelbagai nisbah adunan di dalam minyak ASTM #3

7. Explain briefly

(a) Main applications of acrylonitrile butadiene rubber (NBR)

(b) Curing systems of polyurethane rubber (AU/EU)

(c) Differences between chlorosulphonated polyethylene rubber (CSM) and ethylene vinyl acetate (EAM)

(d) Chemistry of silicone rubber

Jelaskan secara ringkas

(a) Kegunaan-kegunaan utama getah akrilonitril butadiena (NBR)

(b) Sistem-sistem pematangan bagi getah poliuretana (AU/EU)

(c) Perbezaan di antara getah klorosulfonat (CSM) dan etilena vinil asetat (EAM)

(d) Sifat kimia getah silikon

(100 marks/*markah*)

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