
UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2008/2009

April/Mei 2009

EBB 212/4 - Raw Materials & Structural Ceramics [Bahan Mentah & Seramik Struktur]

Duration : 3 hours
[Masa : 3 jam]

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

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

This paper contains SEVEN questions. TWO questions in PART A, TWO questions in PART B and THREE questions in PART C.

[Kertas soalan ini mengandungi TUJUH soalan. DUA soalan di BAHAGIAN A, DUA soalan di BAHAGIAN B dan TIGA soalan di BAHAGIAN C.]

Instruction: Answer FIVE questions. Answer ONE question from PART A, ONE question from PART B, ONE question from PART C and TWO questions from any sections. 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 SATU soalan dari BAHAGIAN A, SATU soalan dari BAHAGIAN B, SATU soalan dari BAHAGIAN C dan DUA 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.]

PART A**BAHAGIAN A**

1. [a] Describe 4 types of silicate structure and give an example of the clay minerals which are constructed based on such a silicate structure?

Terangkan 4 jenis struktur silikat dan beri contoh bagi mineral tanahliat yang dibina berdasarkan struktur silikat tersebut.

(30 marks/markah)

- [b] Define clay minerals and draw a flow chart to illustrate the formation of Halloysite.

Beri definisi mineral tanahliat dan lukiskan carta alir untuk menunjukkan pembentukan Halloysite.

(30 marks/markah)

- [c] Explain briefly 3 factors which influence the cation replacement in clay particles and, based on these factors, list the general order of replacement for the following ions: barium, sodium, ferum, lithium, aluminium and magnesium. Consider the information in the following table.

Terangkan dengan ringkas 3 faktor yang mempengaruhi penggantian kation dalam partikel mineral dan berdasarkan faktor tersebut senaraikan turutan umum pengantian bagi ion-ion berikut: barium, natrium, ferum, litium, aluminium dan magnesium.

Cations	Non-hydrated radius (A)	Hydrated radius (A)
Li ⁺	0.68	3.8
Na ⁺	0.95	3.6
Mg ²⁺	0.65	4.3
Ba ²⁺	1.35	-
Al ³⁺	0.5	4.8
Fe ³⁺	0.6	-

(40 marks/markah)

...3/-

2. [a] Briefly discuss 4 factors which affects the fired color of ball clay.

Bincangkan dengan ringkas 4 faktor yang mempengaruhi warna bakar tanahliat bebola.

(30 marks/markah)

- [b] State the properties and applications of steatite.

Berikan sifat-sifat dan kegunaan steatite.

(20 marks/markah)

- [c] Explain how to manipulate the plasticity of china clay to be used in a whiteware product.

Terangkan bagaimana untuk mengubahsuai sifat keplastikan tanahliat cina untuk membentuk produk tembikar putih.

(20 marks/markah)

- [d] Explain, in terms of colloidal properties, how to produce a good slip casting product made of clay?

Terangkan dari segi sifat koloidal bagaimana dapat membentuk produk penuangan slip yang diperbuat daripada tanahliat.

(30 marks/markah)

PART B

BAHAGIAN B

3. [a] Sketch a screw mixer and describe how it operates in the ceramic mixing process.

Lakar satu alat pencampur jenis skru dan perihalkan operasinya dalam proses pencampuran seramik.

(30 marks/markah)

- [b] If you are given one unknown fired ceramic sample, which characterization technique that using X-Ray source should you use to determine its phase? Justify your answer.

Jika anda diberikan hasilan seramik yang tidak diketahui jenisnya, teknik manakah yang menggunakan sumber sinar X perlu anda gunakan untuk menentukan fasa seramik tersebut. Berikan hujahan bagi jawapan anda.

(30 marks/markah)

- [c] Give FOUR (4) examples of additives and describe their function in ceramic processing.

Berikan EMPAT (4) contoh bahan tambah dan terangkan fungsi-fungsi bahan tersebut dalam pemprosesan seramik.

(40 marks/markah)

4. [a] What media is suitable for grinding high purity dielectric powders such as CCTO and give reasons for your answer.

Media apakah yang sesuai untuk mengisar serbuk dielektrik yang tinggi ketulenannya seperti CCTO dan nyatakan alasan anda.

(30 marks/markah)

- [b] Illustrate and discuss briefly the mechanism of convection, shear and diffusion of two different materials during the milling process.

Ilustrasikan bagaimana mekanisme olahan, ricihan dan resapan bagi dua bahan berbeza semasa proses pengisaran.

(50 marks/markah)

- [c] List the advantages and disadvantages of wet and dry mixing processes.

Senaraikan kebaikan dan keburukan bagi proses pencampuran kering dan basah.

(20 marks/markah)

PART C**BAHAGIAN C**

5. [a] Cite and describe on THREE (3) characteristics of the ceramic powder which are important for advanced ceramic application.

Nama dan huraikan mengenai TIGA (3) ciri-ciri serbuk seramik yang penting untuk aplikasi seramik termaju.

(30 marks/markah)

- [b] Describe, with a specific example, the synthesis of ceramic powder using solid state reaction.

Bincangkan dengan menggunakan contoh yang spesifik tentang sintesis serbuk seramik melalui kaedah tindakbalas fasa pepejal.

(20 marks/markah)

- [c] Alumina (Al_2O_3) is a major oxide ceramic material. Describe it, in terms of properties and its production methods.

Alumina (Al_2O_3) merupakan salah satu bahan seramik oksida yang utama. Huraikannya dari segi sifat-sifat, serta kaedah penghasilannya.

(50 marks/markah)

6. Describe three of following topics:

- (i) Production of ceramic powder using the Spray Drying Method
- (ii) Production of SiC using the Acheson Process
- (iii) Processing Methods for Ordinary Portland Cement (OPC)
- (iv) Concrete raw materials and their function

Huraikan tiga dari tajuk-tajuk berikut:

- (i) *Penghasilan serbuk seramik melalui kaedah Pengeringan Sembur*
- (ii) *Penghasilan SiC menggunakan Proses Acheson*
- (iii) *Kaedah-kaedah Pemprosesan Ordinary Portland Cement (OPC)*
- (iv) *Bahan mentah bagi Konkrit serta fungsi-fungsinya*

(100 marks/markah)

7. [a] Instead of natural resources, there are alternatives materials that can be utilized in cement production. Cite four (4) materials which are industrial by-products.

Di samping sumber-sumber asli, terdapat bahan-bahan alternatif yang boleh digunakan dalam penghasilan simen. Namakan empat (4) bahan dari bahan sampingan industri.

(20 marks/markah)

[b] Using an appropriate flowchart, describe the stages involved in concrete preparation.

Dengan carta alir yang sesuai, huraikan tentang tahap-tahap yang terlibat dalam penyediaan konkrit.

(30 marks/markah)

[c] Below is the chemical for a type of cement:

Berikut merupakan analisis kimia bagi salah satu jenis simen:

SiO ₂	20.5%
Al ₂ O ₃	7.10%
Fe ₂ O ₃	2.73%
TiO ₂	0.21%
MgO	1.88%
CaO	63.20%
Na ₂ O	0.34%
K ₂ O	0.52%
SO ₃	1.84%
Loss of Ignition (L.O.I) <i>Kehilangan Nyalaan (L.O.I)</i>	1.32%
Insoluble <i>Insoluble</i>	0.26%
	99.90%

By using the Bogue equation, determine the phases present. What would happen if the composition of MgO is increased to 40% from the above value.

(Atomic weights: Si = 28.09, Al = 26.98, Fe = 55.85, Ti = 47.9, Mg = 24.31, Ca = 40.08, Na = 22.99, K = 39.1, S = 32.06 and O = 16)

Dengan menggunakan persamaan Bogue, tentukan fasa-fasa yang wujud. Apakah akan berlaku sekiranya komposisi MgO ditingkatkan sebanyak 40% daripada nilai di atas.

(Berat atom: Si = 28.09, Al = 26.98, Fe = 55.85, Ti = 47.9, Mg = 24.31, Ca = 40.08, Na = 22.99, K = 39.1, S = 32.06 dan O = 16)

(50 marks/markah)