
UNIVERSITI SAINS MALAYSIA

Second Semester Examination
2010/2011 Academic Session

April/May 2011

IWK 205 – CHEMICAL ADDITIVES & PAPER PROPERTIES
[ADITIF & SIFAT KERTAS]

Duration: 3 hours
Masa: [3 jam]

Please check that this examination paper consists of SEVEN pages of printed material before you begin the examination.

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

Instructions: Answer FIVE questions. You may answer the questions either in Bahasa Malaysia or in English.

Arahan: *Jawab LIMA soalan. 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.]

1. (a) What do you understand by colloidal systems? (5 marks)
- (b) Why are colloidal particles charged in an aqueous environment? Give examples. (5 marks)
- (c) Based on the following equation, explain how it can be applied to the papermaking process that utilize retention aids?

$$k = \frac{8\pi e^2 n_0 Z_0}{DkT}$$

(10 marks)

2. There are various types of chemical additives that have been utilized to increase the dry strength of papers, one of which is the use of starches.
- (a) What is the the chemical composition of starch and draw the chemical structure of each of the stated chemical composition. (8 marks)
- (b) Explain why unmodified starches are poorly retained by papermaking fibers. (6 marks)
- (c) When cationic starches are added as dry strength additives they are normally added early during the papermaking process. Explain the reasons behind this approach. (6 marks)
3. (a) Discuss THREE advantages for papermaking at neutral/alkali pH. (5 marks)
- (b) Differentiate between an acid and a basic dye in terms of structure and mechanism of fixation. (5 marks)

- (c) Discuss the effects of wet pressing, beating and calendering on the following paper's properties:
- i) Tearing resistance
 - ii) Tensile strength
 - iii) Opacity
- (5 marks)
- (d) How do the blue dye and pigment (such as titanium oxide) give effect on paper brightness?
- (5 marks)
4. (a) Although the origin of fiber source is same, different pulping methods (chemical and mechanical) will produce pulps with different property. Describe the differences of fiber properties between the two pulps and how do these fiber properties affect the physical, mechanical and optical properties of the papers produced?
- (15 marks)
- (b) Give 2 types of paper and describe the difference between these two paper based on functional properties.
- (5 marks)
5. (a) Discuss fiber and sheet characteristics that affecting dimensional stability of paper.
- (6 marks)
- (b) Answer the following questions based on Table 1.
- i) Calculate the density of paper in the correct unit.
- (2 marks)
- ii) Which is the best pulping condition? Why?
- (12 marks)

Table 1. Properties of pulps and handsheets produced by 3 different soda pulping conditions.

Pulping	I	II	III
<u>Conditions</u>			
NaOH Charge, %	18	25	35
Cooking Temperature, °C	165	165	165
Cooking Time, min	120	120	180
<u>Analysis</u>			
Kappa number	32.1	12.2	7.5
Pulp viscosity, cP.	27.4	18.5	13.2
Freeness, ml	712	603	496
Grammage, g/m ²	63.51	57.87	66.42
Thickness, mm	0.1524	0.1153	0.1185
Tensile Strength, kN/m	1.547	1.663	1.782
Zero-span Breaking length, km	7.34	5.72	3.13
Tearing Index, mNm ² /g	9.1	9.0	6.7
ISO Brightness, %	31.2	52.3	59.8

1. (a) *Apakah yang anda fahami dengan sistem koloid?*
(5 markah)
- (b) *Kenapakah zarah-zarah koloid bercas di dalam suatu persekitaran akues ?
Berikan contoh-contoh.*
(5 markah)
- (c) *Berdasarkan persamaan berikut, huraikan bagaimana ianya boleh di
aplikasikan di dalam proses pembuatan kertas yang menggunakan pembantu
retensi?*

$$k = \frac{8\pi e^2 n_o Z_o}{DkT}$$

(10 markah)

2. *Terdapat beberapa jenis aditif kimia yang diguna untuk meningkatkan kekuatan
kering kertas, salah satunya ialah kanji.*
- (a) *Apakah komposisi kimia kanji dan lakarkan struktur molekul setiap komposisi
kimia yang dinyatakan.*
(8 markah)
- (b) *Huraikan kenapa kanji yang tidak dimodifikasikan adalah diretensikan dengan
lemah oleh gentian pembuatan kertas.*
(6 markah)
- (c) *Apabila kanji kationik ditambah sebagai aditif kekuatan kering, ianya
biasanya di tambah seawal mungkin di dalam proses pembuatan kertas.
Huraikan sebab di sebalik pendekatan ini.*
(6 markah)
3. (a) *Bincangkan TIGA kelebihan penghasilan kertas pada pH neutral/alkali.*
(5 markah)
- (b) *Bezakan di antara pencelup asid dan bes dari sudut struktur dan mekanisme
pelekatan.*
(5 markah)

- (c) *Bincangkan kesan-kesan penekanan basah, pemukulan dan pengkalenderan terhadap sifat-sifat kertas berikut:*
- i) Rintangan koyakan*
 - ii) Kekuatan tensil*
 - iii) Kelegapan*
- (5 markah)*
- (d) *Bagaimanakah pencelup biru dan pigmen (seperti titanium oksida) memberi kesan terhadap kecerahan kertas?*
- (5 markah)*
4. (a) *Walaupun sumber gentian asal adalah sama, cara pemulpaan yang berlainan(kimia dan mekanik) akan menghasilkan pulpa yang mempunyai sifat yang berbeza. Huraikan perbezaan-perbezaan sifat-sifat gentian antara dua jenis pulpa tersebut dan bagaimanakah sifat-sifat gentian tersebut mempengaruhi sifat-sifat fizikal, mekanikal dan optikal kertas yang dihasilkan?*
- (15 markah)*
- (b) *Berikan 2 jenis kertas dan terangkan berbezaan antara dua jenis tersebut berdasarkan sifat-sifat fungsian.*
- (5 markah)*
5. (a) *Bincangkan tabii gentian dan kertas yang mempengaruhi ketabilan dimensi kertas.*
- (6 markah)*
- (b) *Jawab soalan-soalan berikut berdasarkan Jadual 1.*
- i) Kirakan ketumpatan kertas dalam unit yang betul.*
- (2 markah)*
- ii) Keadaan pemulpaan yang mana satukah paling baik? Kenapa?*
- (12 markah)*

Jadual 1. Sifat-sifat pulpa dan kertas makmal yang dihasilkan daripada tiga keadaan pemulpaan yang berbeza.

<i>Pemulpaan</i>	<i>I</i>	<i>II</i>	<i>III</i>
<u><i>Keadaan</i></u>			
<i>Caj NaOH, %</i>	18	25	35
<i>Suhu pemasakan, °C</i>	165	165	165
<i>Masa pemasakan, min</i>	120	120	180
<u><i>Analisis</i></u>			
<i>Nombor Kappa</i>	32.1	12.2	7.5
<i>Kelikatan sellulosa, cP.</i>	27.4	18.5	13.2
<i>Kebebasan CSF, ml</i>	712	603	496
<i>Kegraman, g/m²</i>	63.51	57.87	66.42
<i>Ketebalan, mm</i>	0.1524	0.1153	0.1185
<i>Kekuatan tensil, kN/m</i>	1.547	1.663	1.782
<i>Panjang pemutusan jarak sifar, km</i>	7.34	5.72	3.13
<i>Indeks koyakan, mN.m²/g</i>	9.1	9.0	6.7
<i>Kecerahan ISO, %</i>	31.2	52.3	59.8