UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Kedua
Sidang Akademik 2005/2006

April/Mei 2006

IWK 103 – Pulp Production & Paper Recycling
[Penyediaan Pulpa dan Pengitaran Kertas]

Duration: 3 hours
[Masa: 3 jam]

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

Answer FIVE questions. Questions can be answered in Bahasa Malaysia OR English.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi LIMA mukasurat yang bercetak sebelum anda memulakan peperiksaan ini.[

[Jawab LIMA soalan. Soalan boleh dijawab dalam Bahasa Malaysia ATAU Bahasa Inggeris.]

1. (a) Briefly discuss the following:

(i) The differences between softwood and hardwood fibers.

(5 marks)

(ii) The differences between cellulose and hemicelluloses.

(5 marks)

(b) What are delignification and carbohydrates degradation? Describe their effects on pulping process respectively.

(10 marks)

2. (a) What is pulping process?

(4 marks)

(b) Discuss the effect of temperature on kraft pulping process.

(10 marks)

(c) What are the advantages of mechanical pulping compared to chemical pulping.

(6 marks)

3. (a) What will happen if over-sized chips are used in chemical pulping?

(10 marks)

(b) Discuss the refiner mechanical pulping process.

(10 marks)

4. (a) Discuss the differences between lignin-removing and lignin-preserving bleaching processes by using appropriate examples and chemical reactions.

(15 marks)

(b) Why are softwood kraft pulps more difficult to be bleached than hardwood sulphite pulps?

(5 marks)

5. (a) Explain the factors that drive the development of totally chlorine-free (TCF) bleaching in pulp and paper industry.

(6 marks)

(b) Answer the following questions based on Table 1:

(i) What is bleaching selectivity?
(ii) Describe the effect of the different bleaching conditions towards resultant pulps' properties and then choose the optimum bleaching condition.

(14 marks)

Table 1: Oxygen bleaching conditions and the properties of resulted pulps

	Unbleached	I	II	III	IV
Reaction Temperature, °C		95	95	95	110
Alkali Charge, %		1.5	2.0	2.2	3.0
Reaction Time, min		30	60	120	60
Analysis					
Kappa number	13.6	9.1	7.4	9.6	6.6
Reduction of K_n, %		(33.1)	(45.6)	(29.4)	(51.5)
Viscosity of dissolved cellulose, cp.	21.7	19.9	19.2	16.1	13.7
Selectivity		2.50	2.48	0.71	0.88

6. (a) The decrease of mechanical strength properties of paper is observed in every recycling loop. Why does this phenomenon happen?

(10 marks)

(b) How does recycled paper mill do in order to restore or to increase the strength properties of recycle paper?

(10 marks)

1. (a) *Bincangkankan secara ringkas perkara berikut:*

   (i) *Perbezaan antara gentian kayu lembut dan kayu keras.*

   (5 markah)

   (ii) *Perbezaan antara selulosa dan hemiselulosa.*

   (5 markah)

   (b) *Apakah pendeligninan dan degradasi karbohidrat? Jelaskan kesan masing-masing terhadap proses pemulpaan.*

   (10 markah)

2. (a) *Apakah proses pemulpaan?*

   (4 markah)

   (b) *Bincangkan kesan suhu terhadap proses pemulpaan kraft.*

   (10 markah)

   (c) *Apakan kelebihan-kelebihan pemulpaan mekanik berbanding pemulpaan kimia.*

   (6 markah)

3. (a) *Apakah akan terjadi jika serpih bersaiz besar digunakan dalam pemulpaan kimia?*

   (10 markah)

   (b) *Bincangkan proses pemulpaan penghalus mekanik.*

   (10 markah)

4. (a) *Bincangkan perbezaan antara proses pelunturan secara penyingkiran lignin dan pengekalan lignin dengan contoh-contoh dan tindak balas kimia yang sesuai.*

   (15 markah)

   (b) *Mengapakah pulpa kraft kayu lembut lebih sukar dilunturkan berbanding dengan pulpa sulfit kayu keras.*

   (5 markah)

5. (a) *Terangkan faktor-faktor yang mendorong perkembangan pelunturan tanpa klorin sepenuhnya dalam industri pulpa dan kertas.*

(6 markah)

(b) *Jawabkan soalan-soalan berikut berdasarkan Jadual 1:*

(i) *Apakah yang dimaksudkan dengan kepilihan pelunturan?*
(ii) *Huraikan kesan keadaan pelunturan yang berbeza terhadap sifat-sifat pulpa yang terhasil dan tentukan keadaan pelunturan yang optimum.*

(14 markah)

Jadual 1 : keadaan pelunturan oksigen dan sifat-sifat pulpa terluntur

	Tak Terluntur	*I*	*II*	*III*	*IV*
Suhu Tindak bala		*95*	*95*	*95*	*110*
Cas Alkali		*1.5*	*2.0*	*2.2*	*3.0*
Masa Tindak balas		*30*	*60*	*120*	*60*
Analisis					
Nombor Kappa	*13.6*	*9.1*	*7.4*	*9.6*	*6.6*
Penurunan K_n		*(33.1)*	*(45.6)*	*(29.4)*	*(51.5)*
Kelikatan selulosa terlarutkan	*21.7*	*19.9*	*19.2*	*16.1*	*13.7*
Kepilihan		*2.50*	*2.48*	*0.71*	*0.88*

6. (a) *Penurunan sifat-sifat kekuatan mekanikal kertas boleh diperhatikan pada setiap "recycling loop". Mengapakah fenomena ini berlaku?*

(10 markah)

(b) *Bagaimanakah kilang kertas terkitar memulihkan atau meningkatkan sifat-sifat kekuatan kertas terkitar?*

(10 markah)

-oooOOOooo-