UNIVERSITI SAINS MALAYSIA

First Semester Examination
2010/2011 Academic Session

November 2010

EKC 483 – Petroleum & Gas Processing Engineering
[Kejuruteraan Pemprosesan Petroleum & Gas]

Duration : 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of SIX pages of printed material and ONE page of Appendix before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi ENAM muka surat yang bercetak dan SATU muka surat Lampiran sebelum anda memulakan peperiksaan ini.]

Instruction: Answer **ALL** (4) questions.

*[**Arahan:** Jawab **SEMUA** (4) soalan.]*

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.]

Answer ALL questions.
Jawab SEMUA soalan.

1. [a] Discuss the following terms:
Bincangkan terma-terma yang berikut:

[i] Carbon residue
Sisa karbon

[ii] Asphaltene
Asfaltena

[iii] Light cycle oil
Minyak kitar ringan

[iv] Decant oil
Minyak siring

[v] Coker gas oil
Minyak gas pengekok

[5 marks/markah]

[b] Describe the characteristics of Malaysian crude oil.
Terangkan ciri-ciri minyak mentah Malaysia.

[4 marks/markah]

[c] Crude oils are separated into fractions according to boiling point through distillation process in the refinery. Discuss the reasons in which the separation is accomplished in two steps: first by fractionating the total crude oil at atmospheric pressure; then by feeding the high-boiling bottoms fraction from the atmospheric distillation column to a second fractionator operated at a high vacuum. Addition of steam is a normal practice in vacuum distillation unit. What is the purpose of this steam addition?

Minyak mentah dipisahkan kepada pecahan mengikut takat didih melalui proses penyulingan di kilang penapis petroleum. Bincangkan kenapa pemisahan dicapai melalui dua tahap: pertama dengan penyulingan keseluruhan minyak mentah pada tekanan atmosfera; kemudian pecahan bawah takat didih tinggi disuapkan dari turus penyulingan atmosfera ke unit penyulingan kedua yang beroperasi di bawah keadaan vakum tinggi. Penambahan stim merupakan suatu amalan yang umum bagi unit penyulingan vakum. Apakah tujuan penambahan stim tersebut?

[7 marks/markah]

[d] Sketch and briefly describe fluid coking process. Compare the major differences between fluid coking and flexicoking.

Lakar dan terangkan secara ringkas proses pengekokan bendalir. Bandingkan perbezaan utama antara pengekokan bendalir dan pengekokan fleksi. *[9 marks/markah]*

…3/-

2. [a] Discuss the general feed characteristics for a catalytic cracker. Give examples of the common feedstock for a catalytic cracker. How does it differ from the feed for a hydrocracker?

Bincangkan ciri-ciri umum suapan bagi pemecah bermangkin. Berikan contoh-contoh suapan biasa bagi suatu pemecah bermangkin. Bagaimanakah ia berbeza daripada suapan bagi suatu penghidropecah.

[4 marks/markah]

[b] A sample of petroleum cut was analyzed and the ASTM distillation laboratory data was as in Table Q.2.[b].

Suatu sampel pecahan petroleum telah dianalisa dan data makmal penyulingan ASTM adalah seperti dalam Jadual S.2.[b].

[i] Construct the True Boiling Point curve for the petroleum cut.
Binakan lengkungan Takat Didih Benar bagi pecahan petroleum tersebut.

[ii] Find the mid-boiling point for this cut and its common name.
Carikan takat didih tengah bagi pecahan ini dan namanya.

Table Q.2.[b]. Petroleum sample characterization data
Jadual S.2.[b]. Data pencirian sampel petroleum

Gravity, ^{o}API **ASTM distillation** ***Graviti, ^{o}API*** ***Penyulingan ASTM***	56.1	43.8
IBP, ^{o}C	42	159
10% vol, ^{o}C	70	169
30% vol, ^{o}C	77	176
50% vol, ^{o}C	88	183
70% vol, ^{o}C	106	192
90% vol, ^{o}C	139	198
FBP, ^{o}C	166	231

[7 marks/markah]

[c] What is solvent extraction? Describe the process to extract Vacuum Reduced Crude (VRC) to be used as a good quality feed for a FCC unit.

Apakah penyarian pelarut? Terangkan proses untuk menyari Minyak Mentah Terturun Vakum (VRC) supaya dapat digunakan sebagai bahan suapan berkualiti untuk unit FCC.

[8 marks/markah]

[d] What are the major objectives of the following processes? Discuss the main reactions taking place in each process.

Apakah objektif utama bagi proses yang berikut? Bincangkan tindak balas utama yang berlaku dalam setiap proses.

[i] Hydrotreating
Rawatan hidro

[ii] Catalytic reforming
Pembentukan semula bermangkin

[iii] Visbreaking
Pecahan likat

[6 marks/markah]

3. [a] Why is it important to study about phase behaviour of natural gas?
Kenapakah kajian mengenai tingkahlaku gas asli itu penting?

[4 marks/markah]

[b] Under what conditions natural gas hydrates is formed? How to prevent hydrates from forming?

Dalam keadaan apakah hidrat gas asli terbentuk? Bagaimanakah pembentukan hidrat dapat dielakkan?

[5 marks/markah]

[c] Horizontal separator is most commonly used for the separation of large volumes of gas from small volumes of liquids. List two disadvantages of this separator?

Pemisah mengufuk biasa digunakan bagi memisahkan gas berisipadu besar daripada cecair berisipadu kecil. Senaraikan dua kekurangan pemisah ini.

[4 marks/markah]

[d] Adsorption process is used to adsorb heavier hydrocarbons while letting the lighter hydrocarbons through. This is also good for gas drying (removing water).

Proses penjerapan digunakan untuk menjerap hidrokarbon yang lebih berat sementara melalukan hidrokarbon yang lebih ringan. Ini adalah baik bagi pengeringan gas (penyingkiran air).

[i] Name three commonly used adsorbents.
Namakan tiga bahan penjerap yang biasa digunakan.

[3 marks/markah]

[ii] Briefly describe the process and draw the process diagram.
Huraikan secara ringkas proses tersebut dan lukiskan gambarajah proses.

[9 marks/markah]

4. [a] Complete each of the following statements:
Lengkapkan setiap pernyataan berikut:

[i] In selecting a gas sweetening process, the acid gases to be removed are divided into the following four groups:

Dalam pemilihan proses pemanisan gas, gas-gas asid yang akan disingkirkan terbahagi kepada empat kumpulan berikut:

i. ……
ii. ……..
iii. …….
iv. …….

[2 marks/markah]

[ii] In selecting a gas sweetening process, the first step a choice is made between chemical, physical, direct conversion or dry bed process. The following points should be taken into account:

Dalam pemilihan proses pemanisan gas, langkah pertama dalam memilih antara penukaran kimia, penukaran fizikal, penukaran langsung atau penukaran proses lapisan kering. Perkara-perkara yang harus dipertimbangkan ialah:

i. ……
ii. ……..
iii. …….
iv. …….
v. …….

[2.5 marks/markah]

[iii] Natural gas storage is required for two reasons:
Penyimpanan gas asli diperlukan kerana dua sebab:

i. ……
ii. ……..

[1 marks/markah]

[iv] There are essentially three major types of pipelines along the transportation route. These are:
Terdapat tiga jenis talian paip utama yang wujud di sepanjang laluan pengangkutan iaitu:

i. ……
ii. ……..
iii. …….

[1.5 marks/markah]

…6/-

[b] Plants that use monoethanol amine (MEA) solutions for sour gas treating have a few main problems. List three of these problems and briefly explain how can be minimized.

Loji-loji yang menggunakan larutan monoetanol amina (MEA) untuk rawatan gas masam mempunyai beberapa masalah utama. Senaraikan tiga masalah tersebut dan terangkan secara ringkas bagaimana masalah-masalah itu boleh diminimakan.

[6 marks/markah]

[c] Once natural gas liquids (NGLs) are removed from the natural gas stream, they must be broken down into their base components to be useful. The process used to accomplish this task is called fractionation. Briefly describe this process and draw a process diagram.

Apabila cecair gas asli (NGL) disingkirkan daripada arus gas asli, ia mesti dipecahkan kepada komponen-komponen asas yang berguna. Proses yang digunakan untuk mencapai tujuan ini ialah pemecahan. Huraikan secara ringkas proses ini dan lukiskan gambarajah proses.

[12 marks/markah]

- ooo O ooo –

Appendix

ASTM & TBP conversion chart