CHARACTERISTICS AND EFFICIENCY OF BLEACHING CLAYS IN THE PHYSICAL REFINING OF PALM OIL

By

NG SOOK KUEN

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master

March 2006

For my wonderful papa
with love…

Abstract of thesis presented to the Senate of Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

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March 2006

Chairman : Associate Professor Thomas Choong Shean Yaw, PhD

Faculty : Engineering

The physicochemical properties of the bleaching clays used in the physical refining of palm oil were characterized. The clays evaluated were acid-activated clays (Taiko Supreme 1B, Taiko PGEO and SBE Gold), mixed clays (Pure Flo) and natural clays (attapulgites like A4 and HRL 200). Electron micrographs of attapulgites displayed a spread of needle like lath on the surface while the acid activated clays mostly showed irregular flakes on the surface.

The analysis of Freundlich isotherm was found to be more applicable than Langmuir isotherm in the adsorption isotherm data of pigments, carotene and chlorophyll on various types of bleaching clays. However, the adsorption of trace iron on the clays fitted the Langmuir model better than the Freundlich model. The results suggested that the high surface area in the acid-activated did not necessary possess better bleaching efficiency than other clays. Pure Flo, a neutral clay, is the best bleaching clay for adsorbing chlorophyll compared with other clays. This is contrary to the general belief that acid-activated clays is better in adsorbing chlorophyll.

Crude palm oil of poor quality was degummed, bleached and deodorized to evaluate the effectiveness of various bleaching clays using different dosages of 0.8% and 1.5%. The attapulgites are good in adsorbing chlorophyll but not good in adsorbing carotene. An attapulgite clay was heat-activated using different temperatures. The treated samples were tested in order to verify their capacity to bleach palm oil and were compared to the standard commercial bleaching clay. The mildly heat-treated attapulgite was superior to the other clays in adsorbing chlorophyll.

The stepwise bleaching process and the single-step bleaching process was also compared between the acid-activated clay, attapulgite and silica. Silica was able to retain more carotene in both processes compared with the other two clays. However, the acid-activated clay was found to adsorb iron better in the stepwise process.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

CIRI-CIRI DAN KEBERKESANAN PELUNTUR BUMI DALAM PEMPROSESAN FIZIKAL MINYAK KELAPA SAWIT

Oleh

NG SOOK KUEN

Mac 2006

Pengerusi : Profesor Madya Thomas Choong Shean Yaw, PhD

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Sifat kimia dan sifat fizik bagi peluntur bumi yang digunakan dalam pemprosesan minyak kelapa sawit telah diselidik.. Peluntur bumi yang dikaji merangkumi peluntur bumi berasid (Taiko Supreme 1B, Taiko PGEO and SBE Gold), peluntur bumi campuran (Pure Flo) dan peluntur bumi asli (attapulgites like A4 and HRL 200). Mikrograf elektron bagi attapulgite menunjukkan gumpalan berupa jarum pada permukaannya manakala kebanyakan peluntur bumi berasid menunjukkan kepingan pelbagai saiz pada permukaannya.

Isoterma Freundlich didapati lebih dipatuhi daripada isoterma Langmuir dalam analisis penjerapan pigmen karotena and klorofil ke atas pelbagai jenis peluntur bumi. Namun, penjerapan logam surih, besi ke atas peluntur bumi lebih mematuhi model Langmuir daripada model Freundlich. Keputusan data mencadangkan bahawa luas permukaan yang tinggi tidak semestinya berkait

rapat dengan keberkesanan peluntur bumi. Pure Flo, penjerap bumi neutral, adalah peluntur bumi yang paling berkesan untuk menjerap klorofil paling berkesan berbanding dengan bahan peluntur lain. Ini bertentangan dengan kepercayaan bahawa peluntur bumi berasid lebih berkesan menjerap klorofil.

Minyak kelapa sawit mentah yang berkualiti rendah dinyahgum, diluntur dan dinyahbaukan untuk mengkaji keberkesanan pelbagai jenis peluntur bumi dengan menggunakan jumlah dos 0.8% dan 1.5%. Keputusan data menunjukkan attapulgite adalah berkesan untuk menjerap klorofil tetapi tidak berkesan untuk menjerap karotena. Satu jenis attapulgite diaktifkan dengan memanaskannya pada suhu yang berlainan. Sampel-sampel yang telah diaktifkan tersebut telah dianalisa untuk mengetahui kebolehannya melunturkan minyak kelapa sawit berbanding dengan peluntur bumi komercial. Attapulgite yang dipanaskan secara sederhana adalah paling berkesan menjerap klorofil berbanding dengan peluntur bumi yang lain.

Proses meluntur berperingkat dan proses meluntur satu peringkat juga dibandingkan antara peluntur bumi berasid, attapulgite dan silica. Silica dapat menahan karotena daripada dimusnahkan dalam kedua-dua proses tersebut berbanding dengan proses yang hanya menggunakan silica sahaja. Namun, peluntur bumi berasid didapati lebih berkesan untuk menjerap bahan surih besi dalam proses meluntur berperingkat.

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I certify that an Examination Committee has met on 24 March 2006 to conduct the final examination of Ng Sook Kuen on her Master of Science thesis entitled "Characteristics and Efficiency of Bleaching Clays in the Physical Refining of Palm Oil" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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This thesis submitted to the Senate of Universiti Putra Malaysia has been accepted as fulfillment of the requirement for degree of Master of Science. The members of the Supervisory Committee are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

_____

NG SOOK KUEN

Date :

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A.O.C.S.	**American Oil Chemists' Society**
Al	**Aluminium**
Å	**Armstrong**
AV	**Anisidine Value**
BET	**Brunauer, Emmett, and Teller**
BJH	**Barrett, Joyner, and Halenda**

CHL	**Chlorophyll**
CPO	**Crude Palm Oil**
DOBI	**Deteriobility of Bleaching Index**
FFA	**Free fatty acid**
Fe	**Iron**
HPLC	**High Performance Liquid Chromatography**
H_2O	**water**
HRL	**Hudson Resources Limited**
Mg	**Magnesium**
MPOA	**Malaysian Palm Oil Association**
MPOB	**Malaysian Palm Oil Board**
MS	**Malaysian Standard**
Na	**Sodium**
nm	**nanometer**
PA	**Phosphatidic acid**
PC	**Phosphatidylcholine**
PE	**Phosphatidylethanolamine**
PGEO	**Pasir Gudang Edible Oil**
PHY	**Pheophytin**
PI	**Phosphatidylinositol**
POBE	**an initial given to the mixture of SBE Gold and HRL200**
ppb	**parts per billion**
ppm	**parts per million**
PV	**Peroxide value**
RBD	**Refined, Bleached and Deodorized**

SBE	**Southern Bleaching Earth**
SCOPA	**The Seed Crushers' and Oil Processors' Association**
SEM	**Scanning Electron Microscopy**
w/w	**weight per weight**