UNIVERSITI PUTRA MALAYSIA

THE EFFECT OF BLEACHING CLAY ON THE QUALITY OF REFINED AND BLEACHED PALM OIL

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Especially for my wonderful papa and mama, brother, sisters & Teik Siang

with love....

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

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Chairperson: Professor Lee Chnoong Kheng, Ph.D.

Faculty: Science and Environmental Studies

The aim of this study was to characterize the physicochemical properties of the bleaching clays used in the refining of palm oil. Acid-activated, neutral and natural clays as well as synthetic adsorbent were analysed by various techniques: scanning electron microscopy, thermal analysis (Differential Thermal Analysis and Thermogravimetric Analysis), X-ray diffraction (XRD), determination of surface area, pore-size and particle-size distribution. The effects of these physical and chemical properties of bleaching clays on the quality of refined palm oil were subsequently investigated.

The XRD patterns showed that silica (quartz) was present in all of the analyzed commercial clays. The acid activated clays - Tonsil and WAC Omega consisted mainly of montmorillonite. The TGA, DTA and XRD results showed that the commercial clay - Pure Flo was essentially attapulgite type of clay. WAC Supreme, the acid activated clay, displayed a complicated XRD pattern indicating that besides

iron magnesium aluminium silicate (montmorillonite), attapulgite and other impurities were present.

The study on the effect of degumming acid on the quality of RBD oil indicated that increased concentration of phosphoric acid facilitated the removal of iron in the RBD oil. On the other hand, the copper content in the oil was likely to be influenced by the type of clay used in the bleaching process.

Langmuir isotherm was more applicable than Freundlich isotherm in the adsorption of trace metals, copper and iron, from degummed palm oil on Pure Flo. The adsorption of phosphorus by Pure Flo, Attapulgite and WAC Supreme conformed to both Langmuir and Freundlich isotherms. On the other hand, adsorption of pigments, chlorophyll and carotene on the clay adsorbents fitted the Freundlich model better than the Langmuir model. The data showed that the acid activated clay of WAC Supreme with high surface area and large pore volume did not necessary possess better bleaching efficiency than Pure Flo and Attapulgite.

Pure Flo is the best clay adsorbent compared to WAC Supreme and Attapulgite (Hudson Resource). The degummed-bleached palm oil after bleaching with Pure Flo showed the lowest concentration of phosphorus, copper, chlorophyll and carotene pigments. Conversely, WAC Supreme is a poor adsorbent of phosphorus, iron and secondary oxidation products. High concentrations of copper and carotene were retained in the degummed-bleached palm oil after bleaching with Attapulgite (Hudson Resource).

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

KESAN PELUNTUR BUMI KEPADA KUALITI BERPROSES DAN BERLUNTUR MINYAK KELAPA SAWIT

Oleh

CHUA HOOI LING

November 2001

Pengerusi: **Profesor Lee Chnoong Kheng, Ph.D.**

Faculti: **Sains dan Pengajian Alam Sekitar**

Tujuan penyelidikan ini adalah mengkaji sifat kimia dan fizik bagi peluntur bumi yang diguna untuk pemprosesan minyak sawit. Peluntur bumi yang bersifat acid aktif, neutral, semulajadi serta penjerap sintesis dikaji dengan pelbagai teknik termasuk: analisis mikroskopi imbasan elektron, terma analisis (Perbezaan Terma Analisis dan Termagravimeter Analisis), pembelauan sinar-X (XRD), dan ujikaji luas permukaan, size ruang dan taburan size serbuk. Sifat fizikal dan kimia peluntur bumi ke atas kualiti minyak berproses turut diselidik.

Corak XRD menunjukkan kehadiran silicon dioksida dalam komersial peluntur bumi; di samping itu, Tonsil dan WAC Omega- peluntur bumi yang beracid adalah terdiri daripada montmorillonite. Keputusan yang diperolehi daripada TGA, DTA dan XRD menujukkan peluntur bumi jenis attapulgite terjumpa dalam peluntur bumi yang komersial - Pure Flo. WAC Supreme sebagai peluntur bumi bersifat asid telah

memaparkan corak XRD yang rumit dan menunjukkan kehadiran besi magnesium aluminium silicate (montmorillnite), attapulgite dan bahan asing.

Ujikaji bagi kesan acid nyahgum ke atas qualiti minyak RBD menghuraikan bahawa penambahan kepekatan asid fosforik boleh megurangkan kandungan besi dalam minyak sawit berproses. Kuprum yang dikesan dalam minyak mungkin dipengaruhi oleh jenis peluntur bumi yang digunakan.

Penjerapan besi dan kuprum secara isoterma daripada minyak sawit yang nyahgum ke atas Pure Flo lebih mematuhi kepada persamaan Langmuir berbanding dengan Freundlich. Di samping itu, penjerapn fosforus oleh Pure Flo, Attapulgite dan WAC Supreme mematuhi kepada kedua-dua isoterma Langmuir dan Freundlich. Penjerapan pigment klorofil dan carotin ke atas peluntur bumi lebih mematuhi isoterma Freundlich daripada isoterma Langmuir. Keputusan data menunjukkan bahawa WAC Supreme, peluntur bumi yang berasid dengan luas permukaan dan isipadu ruang yang besar tidak semestinya memaparkan sifat perlunturan yang berkesan berbanding dengan Pure Flo dan Attapulgite.

Pure Flo adalah penjerap yang berkesan berbanding dengan WAC Supreme dan Attapulgite (Sumber Hudson). Minyak sawit yang diluntur oleh Pure Flo mencatit kepekatan fosforus, kuprum, klorofil dan carotin yang terendah. Sebaliknya, WAC Supreme merupakan penjerap fosforus, besi dan bahan oksida kedua yang tidak efektif. Kepekatan kuprum dan carotin yang tinggi dikesan dalam minyak sawit yang diluntur oleh Attapulgite (Sumber Hudson).

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a & b	Langmuir adsorption equilibrium constants
AR	analytical grade
AV	anisidine value
Ca-Mont	calcium Montmorillonite SAz-1 from Arizona (Cheto)
CHL	chlorophyll
CPO	crude palm oil
Cu	copper
DF	Discriminant Function
DOBI	the deterioration of bleachability index
DTA	differential thermal analysis
$E^{1\%}_{233c}$	Specific extinction in ultra-violet light 233nm
$E^{1\%}_{269c}$	Specific extinction in ultra-violet light 269nm
FFA	free fatty acid
g /l	gram per litre
hr	hour
K & n	Freundlich adsorption equilibrium constants
K_A	Langmuir adsorption equilibrium constant
m	weight of adsorbent
max.	maximum
meq O_2 /kg	milliequivalents of active oxygen per kilogram
mins	minutes
m/m	mass per mass

mm Hg	millimeter in mercury
μm	micron
N	normality
Na-Mont	sodium Montmorillonite SWy-2 from Wyoming
nm	nanometer
No	number
ρ	density
P	phosphorus
PA	phosphatidic acid
PC	phosphatidylcholine
PE	phosphatidylethanolamine
PF	Pure Flo M85/20 P37 from Oil Dri Company
PI	phosphatidylinositol
PORIM	Palm Oil Research Institute of Malaysia
PV	peroxide value
ppb	parts per billion
ppm	parts per million
q_m	Langmuir adsorption equilibrium constant
r^2	square of correlation coefficient
R	constant separation factor of Langmuir equation
RAL	Attapulgite from Hudson Resource
RBD	refined, bleached and deodorised palm oil
SEM	scanning electron microscopy
Std RA	Attapulgite PFl-1 from Florida

T300	Trisyl 300 (GRACE)
TGA	thermogravimetric analysis
TO	Tonsil Optimum 215FF from Sud Chemie Company
UV	ultra-violet
VIS	visible
Vit E	vitamin E
VM	volatile matter
v/v	volume per volume
W	watt
WO1G	WAC Omega 1G from Taiko Group of Companies
WS	WAC Supreme 1B from Taiko Group of Companies
wt	weight
XRD	X-ray diffraction
X	the amounts of adsorbed components at equilibrium
Xe	the amounts of unadsorbed components at equilibrium