PALM METHYL ESTERS: SUSTAINABLE AND ENVIRONMENTALLY FRIENDLY FEEDSTOCKS FOR OLEOCHEMICAL AND BIODIESEL INDUSTRIES

Salmiah Ahmad, Wolfgang Rupilius, Hazimah Abu Hassan and Zulina Abd Maurad
CONTENTS

• Palm methyl ester and sources
• Palm methyl esters & biodiesel
• Development of oleochemicals
• Sustainability and related issues
• Diversification - biorefinery
• Conclusion
Palm Oil – rich in C16 and C18 Fatty acids

Palm Kernel Oil – rich in C12 and C14 Fatty acids
ME can be used as diesel substitute or biodiesel
## COMPOSITION IS IMPORTANT

<table>
<thead>
<tr>
<th></th>
<th>PO</th>
<th>PS</th>
<th>Tallow</th>
<th>CNO</th>
<th>PKO</th>
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<tr>
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<tr>
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<td>29.5</td>
<td>42.8</td>
<td>5.7</td>
<td>15.1</td>
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<td>C18:2</td>
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<td>2.7</td>
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<td>-</td>
<td>2.1</td>
<td></td>
<td></td>
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<tr>
<td>OTHERS</td>
<td>0.38</td>
<td>0.7</td>
<td>4.0</td>
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**EXPENSIVE**
Palm Biodiesel (Methyl Esters)

Crude / Distilled Palm Oil Methyl Esters)

- Low pour point biodiesel – pour point 0°C to -20°C
- 2005: Scaling up to 30,000 TPA
- 2006: Commercial production

RBD Palm Oil Methyl Esters
RBD Palm Olein Methyl Esters
Vitamins

CPO/CPKO

- Crude Methyl ester
  - Fractionation or crystallization

Glycerol

- Unsaturated ME
- C16 ME, C16-18 ME Saturated ME
  - Winter fuel
## CAPACITY OF BIODIESEL PLANTS IN MALAYSIA

<table>
<thead>
<tr>
<th>Biodiesel Plants</th>
<th>Capacity (TPA)</th>
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<tbody>
<tr>
<td>5 Biodiesel Plants in Operation</td>
<td>300,000</td>
</tr>
<tr>
<td>4 Biodiesel Plants in Production Trial</td>
<td>272,000</td>
</tr>
<tr>
<td>Current capacity in Malaysia</td>
<td>572,000</td>
</tr>
<tr>
<td>Addition of 11 Biodiesel</td>
<td>965,000</td>
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</tbody>
</table>
EXPORTS OF ME (VOLUME IN TONNES)

VALUE OF ME EXPORTS (PRICE / TONNE)
MAJOR DESTINATION FOR BIODIESEL (in tonnes)

<table>
<thead>
<tr>
<th></th>
<th>EU</th>
<th>H-KONG</th>
<th>JAPAN</th>
<th>TAIWAN</th>
<th>SING</th>
<th>USA</th>
<th>AUST</th>
<th>P-RICO</th>
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<td>2006</td>
<td>12598</td>
<td>21</td>
<td>960</td>
<td>0</td>
<td>0</td>
<td>34406</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>2007</td>
<td>24696</td>
<td>221</td>
<td>87</td>
<td>216</td>
<td>5665</td>
<td>51953</td>
<td>6065</td>
<td>6001</td>
<td>109</td>
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</tbody>
</table>
BIODIESEL AND PRICE STABILIZATION MECHANISM

- Diesel consumption in Malaysia – 10 million tonnes
- If 5% -10% substitution – 0.5 -1mil. tonne demand
- Reduce stock
- Increase price
- 70% of cost is feedstock cost → Decrease profitability → subsidy
BASIC AND INTERMEDIATE OLEOCHEMICALS FROM MALAYSIA
OLEOCHEMICALS: SUCCESS DUE TO

- Adequate and consistent supply of feedstock
- Complement the food industry in Malaysia
- Environmentally friendly
- Acceptable to all religions and
- Sustainable
AVERAGE OF MALAYSIAN PALM OIL YIELD
MALAYSIAN PRODUCTION OF PALM OIL & PALM KERNEL OIL (in tonnes)
Utilization of Palm Products in Malaysian Oleochemical Industry

% Utilization of Palm Products in Malaysian Oleochemical Industry

<table>
<thead>
<tr>
<th>Year</th>
<th>PO</th>
<th>PKO</th>
<th>Total P</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>2.0</td>
<td>13.3</td>
<td>3.4</td>
</tr>
<tr>
<td>1998</td>
<td>3.1</td>
<td>51.7</td>
<td>9.0</td>
</tr>
<tr>
<td>1999</td>
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<td>47.6</td>
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<td>2000</td>
<td>4.5</td>
<td>59.3</td>
<td>10.5</td>
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<td>2001</td>
<td>4.6</td>
<td>50.0</td>
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<td>2002</td>
<td>4.6</td>
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<td>2003</td>
<td>4.7</td>
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<td>4.9</td>
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<tr>
<td>2006</td>
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<td>62.5</td>
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</tr>
<tr>
<td>2007</td>
<td>5.0</td>
<td>58.0</td>
<td>11.2</td>
</tr>
</tbody>
</table>
SOME ADVANTAGES OF PLANT DERIVED PRODUCTS

- Plant derived products – linear structure – easily biodegradable
- Acceptable to all religions
- Good cost performance ratio (less sensitive to water hardness)

Performances very depending on chain lengths

More tolerance to water hardness
SUSTAINABILITY

Sustainable Development (SD) with Equal Emphasis on the 3Ps

Social equity and People

Environmental integrity and Planet

Economic growth and Profitability

Small population: Need to move to Capital intensive industry

Industry with Better value addition

Without extreme Modifications Plant derived products are More Environment friendly

Plant derived products are More Environment friendly without extreme Modifications
LCA OF PALM PRODUCTS PRODUCTION

**Upstream**
- Land Preparation
- Palm Seedling
- Oil Palm (immature)
- Oil Palm (mature)

**Midstream**
- Palm Fruit Bunches
- Crude Palm Oil
- Refined Oil
- Kernel
- Palm Kernel Oil
- Palm Kernel Cake

**Downstream**
- Export
- Processed Food (Cooking Oil etc.)
- Processed Non food (Biodiesel, Alpha SME etc.)
- Processed Food
- Processed Non food
- Animal Feed
- Biomass
  - Palm based products
  - In Estates
  - Agro-based Products
  - Renewable Energy
  - Compost (as soil Conditioner/fertiliser)
  - Mulch (Estates)
DIVERSIFY USES FOR BETTER PROFITABILITY

R&D TO:

- Find new uses for methyl ester
- Find uses for co-products
- Utilize waste
METHYL ESTER: FEEDSTOCK FOR MES (ANIONIC SURFACTANTS)

METHYL ESTER

Low Hydrogenation

SATURATED FATTY METHYL ESTER (IODINE VALUE < 0.5)

Sulfonation

Digestion

Bleaching

Neutralization

Drying

METHYL ESTER SULFONATES (MES)
<table>
<thead>
<tr>
<th>PERFORMANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DETERGENCY</strong> (*)</td>
</tr>
<tr>
<td><strong>FOAMING</strong> (*)</td>
</tr>
<tr>
<td><strong>SOLUBILITY</strong></td>
</tr>
<tr>
<td><strong>SKIN COMPATIBILITY</strong></td>
</tr>
<tr>
<td><strong>SENSITIVITY TO H₂O-HARDNESS</strong></td>
</tr>
</tbody>
</table>

(*) Very similar, using optimum chain length selection

Source: Ballestra
APPLICATION OF MES

- Powder detergent
- Liquid detergent
- Liquid dishwasher
- Gel dishwasher
- Handwash
- Paste dishwasher
Conventional quaternary ammonium compounds - an excellent softening performance.

Unfavourable biodegradation characteristics and can not meet stringent environmental regulations

ESTERQUATS surfactant of choice due to its excellent environmental profile
METHYL ESTER: FEEDSTOCK FOR MEE (NONIONIC SURFACTANTS)

Advantages:
- Faster dissolution in water
- Biodegradability
- Exhibit low aquatic toxicity
- Cheaper

Applications:
- Emulsifiers,
- dispersants,
- wetting agents and solvents for adjuvant concentrates,
- pesticide compositions
POSSIBLE APPLICATIONS OF METHYL ESTER ETHOXYLATES

- Liquid Detergent
- Solubilizer in Cosmetic Products
- Dishwashing Liquid
- Hard Surface Cleaner
- Emulsifier in personal care products
- Pesticide Composition
IMPORTANT TO DIVERSIFY USES

- Find new uses for methyl ester
- Find uses for co-products
- Utilize waste
POSSIBLE PRODUCTS FROM GLYCEROL
CONCLUSIONS

- Biodiesel/oleochemicals welcome additions to the OP supply chain.
- Methyl ester - feedstock required
- Palm Methyl Ester - sustainable & environmentally friendly:
  - renewable source,
  - high productivity,
  - adequate/predictable supply
  - plant-derived - easily biodegradable/acceptable to all religion
- The development enhances sustainability - reduce Malaysia’s dependence on foreign labours and improve value adding.
- Preferably complementing existing industries

** To further enhance the sustainability, it is further proposed the uses of methyl ester be diversified and value be added to the by-products. A possible strategy is to develop biorefinery complex
THANK YOU FOR YOUR KIND ATTENTION

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