Oleochemicals from Palm Kernel Oil

Fatty Alcohols

Fatty Acids

Glycerin
Share with this committees and participants the experience and challenges faced by Oxiteno in establishing a new plant that processes vegetable feedstock, for instance palm kernel oil.
Investment

- Oxiteno invested more than US$ 100 million, building a new Fatty Alcohol industrial unit in Brazil, the Oleoquimica.

- The new unit has capacity to process 100,000 tons/year of Vegetable Oils to produce Fatty Alcohols, Fatty Acids and Glycerin.

- First Fatty Alcohol unit in Latin America.

- The new unit also produces different kinds of Fatty Acids, with molecular chains from 8 to 18 carbons, including hydrogenated acids.
Feedstocks
Vegetable Oils
Raw Materials

- Palm Oil (Dendê)
- Shell
- Fiber
- Palm Kernel Oil
- COPRA (Pulp)
- Coconut Oil
- Babassu Oil

Production Proportion
Palm: Palm Kernel = 10:1
The major sources for lauric (C12) and myristic acids (C14) are Palm Kernel and Coconut Oils

<table>
<thead>
<tr>
<th>CHAIN</th>
<th>NAME</th>
<th>PALM KERNEL (PKO)</th>
<th>COCONUT (CO)</th>
<th>PALM (CPO)</th>
<th>SOY</th>
<th>TALLOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>C6</td>
<td>CAPROIC</td>
<td>0.3</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C8</td>
<td>CAPRIC</td>
<td>4.5</td>
<td>7.5</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>C10</td>
<td>CAPRILIC</td>
<td>3.5</td>
<td>8.0</td>
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<tr>
<td>C12</td>
<td>LAURIC</td>
<td>48.2</td>
<td>46.7</td>
<td>0.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C14</td>
<td>MYRISTIC</td>
<td>16.0</td>
<td>18.0</td>
<td>1.0</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>C16</td>
<td>PALMITIC</td>
<td>7.5</td>
<td>9.0</td>
<td>44.0</td>
<td>6.5</td>
<td>35.0</td>
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<tr>
<td>C18 (Total)</td>
<td>STEARIC</td>
<td>20.0</td>
<td>10.0</td>
<td>54.8</td>
<td>92.8</td>
<td>63.0</td>
</tr>
<tr>
<td>C20</td>
<td>ARAQUIDIC</td>
<td></td>
<td></td>
<td></td>
<td>0.7</td>
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</table>
The Oleochemical Unit
Location
Location

Photo: August/08
First Step: Vegetable oil will be hydrolyzed into Fatty acids and Glycerin

PKO = Palm Kernel Oil
Fatty Alcohol Plant

Second Step: Fatty acids are converted into methylester and hydrogenated into Fatty Alcohols

- **METHANOL**
- **Methyl Ester**
- **WATER**
- **HYDROGEN**
- **Fatty Alcohol Plant**

C12–C18 Fatty Acid → **Fatty acid esterification** → Methyl Ester → **Methylester Hydrogenation** → Fatty Alcohol → **Fatty Alcohol distillation**

C12–C14 Alcohol
C16C18 Alcohol
C16 Alcohol
C18 Alcohol
Oils Hydrolysis Reaction

Palm Kernel Oil  +  3 H₂O  →  Glycerin  +  Fatty Acids
**Esterification Reaction**

\[ R^\prime CO_2H + CH_3OH \rightarrow R^\prime CO_2CH_3 + H_2O \]

Fatty Acids  Methanol  Methyl Esters

**Hydrogenation Reaction**

\[ R^\prime CO_2CH_3 + 2H_2 \rightarrow R^\prime CH_2OH + CH_3OH \]

Methyl Ester  Fatty Alcohol
Main Uses of Fatty Alcohols
Detergent Alcohols

- Detergent alcohols are chemicals used as intermediates for Surfactants Production (e.g. alcohol ethoxylates, alcohol sulfates, alcohol ether sulfates) or as components in Personal Care and Household Products.

- Detergent alcohols can be classified as:
  - **Fatty Alcohols** if derived from natural oils
  - **Synthetic Alcohols** if derived from oil and natural gas

- Oxiteno is the major consumer of detergent alcohols in Latin America.
Total capacity: 95 kt/year of Oleochemical Products

<table>
<thead>
<tr>
<th>Chemical Description</th>
<th>Carbon Chain Length</th>
<th>Capacity (ton)</th>
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<tbody>
<tr>
<td>Lauryl Alcohol</td>
<td>C_{12}-C_{14}</td>
<td>47.000</td>
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<tr>
<td>Cetostearyl Alcohol</td>
<td>C_{16}-C_{18}</td>
<td>23.000</td>
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<tr>
<td>Cetyl Alcohol</td>
<td>C_{16}</td>
<td>5.000</td>
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<tr>
<td>Stearyl Alcohol</td>
<td>C_{18}</td>
<td>2.000</td>
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<tr>
<td>Capric-Caprylic Acid</td>
<td>C_{8}-C_{10}</td>
<td>7.000</td>
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<tr>
<td>Glycerin</td>
<td>C_{3}</td>
<td>11.000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>95.000</strong></td>
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Fatty Acids and Glycerin Unit
Fatty Alcohols Unit
Storage Tanks for Products
Flocculation Unit
Challenges

A new plant requires new competencies and knowledge which need to be developed throughout the years.

About the feedstock...

- Supply from Malaysian and Indonesian suppliers
- Storage capacity of 2.5 months for raw materials

RSPO – Roundtable on Sustainable Palm Oil

- As Brazil presents the ideal conditions to produce Palm Kernel Oil, Oxiteno is a member of RSPO organization and it is concerned about developing alternative suppliers in Brazil.
Conclusion

To sum it up the challenges have been overcome and we are achieving a good level of knowledge on:

- How to operate the plant making the most of it;
- How to manage vegetable feedstocks;
- How to improve our sustainable portfolio;
- Operation under fraction mode and manager by products

As a conclusion...
THANK YOU!