The Future of the Wax Industry

MEGH

ceras e emulsões
World Wax Market

- Paraffins
  - HOF Waxes
  - Micros
- FT Waxes
- PE Oxidized
- PE Wax
- Carnauba
- Montan
- Candelilla
- Beeswax
World Wax Markets 2007

~ 5,300 KTons

~ U$ 6.7 Billions

Paraffins + Micros 89%

Other Waxes 11%
World Wax Demand

KTons

85 90 95 00 05

~ 2% year
Correlation Between Wax Prices & GDP

Wax Price Index

World GDP

Index (1992 = 1.00)

degree of correlation ~ 80%

~ 60%
Installed World Wax Capacity

- 85: 62%
- 90: 63%
- 95: 65%
- 00: 74%
- 05: 91%

Years: 2007, 2010

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KTons
World Wax Market
Demand vs Capacity

KTons

- Capacity
- Demand

85 90 95 00 05 10
Worldwide Wax Market
(1.000 Tons) – 2007

Sales
- Asia/Pacific: 38%
- North America: 23.5%
- W. Europe: 12.8%
- E. Europe: 9.5%
- Middle East: 6.2%
- Africa: 5.0%
- Latin America: 5.0%

Purchases
- Asia/Pacific: 27.2%
- North America: 27.2%
- W. Europe: 20.8%
- E. Europe: 10.7%
- Middle East: 1.5%
- Africa: 2.5%
- Latin America: 2.5%

North America: 22.3% + Asia/Pacific: 27.2% + W. Europe: 20.8% = 83.8%

North America: 27.2% + Asia/Pacific: 27.2% + W. Europe: 20.8% = 85.9%
# Waxes & Energy Sources

Waxes & Energy Sources Have a Direct Relationship:

<table>
<thead>
<tr>
<th>Source</th>
<th>Energy Source</th>
<th>Waxes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude &amp;</td>
<td>Petroleum</td>
<td>Slacks/Paraffins (macros)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Micro waxes</td>
</tr>
<tr>
<td>Gas &amp; Coal</td>
<td>Syngas</td>
<td>Fischer-Tropsch (FT waxes)</td>
</tr>
<tr>
<td>Coal</td>
<td>Brown Coal</td>
<td>Montan Waxes</td>
</tr>
<tr>
<td>Petroleum</td>
<td>Ethylene</td>
<td>Polyolefin waxes (PE/PP)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PE/EVA + PE/Acrillic acid</td>
</tr>
<tr>
<td>Sugar Cane</td>
<td>Ethyl alcohol</td>
<td>Sugar Cane Wax</td>
</tr>
<tr>
<td>Oil &amp; Fats</td>
<td>Biodiesel</td>
<td>Ester Waxes/HOF Waxes</td>
</tr>
</tbody>
</table>
Once we know the different energy sector trends, we can begin to understand the world wax trends.
Paraffin Waxes
Paraffin Wax Demand (market share)

**World**
- Candles: 62%
- Packaging: 18%
- Others: 5%
- Emulsions: 8%
- Hot Melts: 4%
- Floor polishes: 3%

**Latin America**
- Candles: 65%
- Packaging: 9%
- Emulsions: 13%
- Floor polishes: 6%
- Matches: 2%
- Others: 5%
Crude Extraction & Refining

- Crude Oil
- Distillate
  - 5% GLP
  - 27% Gas Oil + Naftas
  - 47% Middle Distilates
  - 5% Fuel Oil
  - 9% Others
  - 7% Coke

- Lubricants
  - Paraffins ~ 0.2%
  - Asphalts

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Crude Based Wax Manufacturing Process

**BASE OILS**

- **light Lubricants**
  - crude destillation

- **Paraffin Waxes**
  - Slack Waxes
    - 3% < oil content < 50%
  - Scale Waxes
    - 1% < oil content < 3%
  - Fully Refined Paraffin
    - oil content < 0.5%

- **heavy Lubricants**
  - distillation + scrap oils

- **Microcristalline Waxes**
- **Petrolatums**

**Important!**

- scrap heavy oils filtration of microcristalline + semi solids

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1st Important Concept

**Base Oils** → **Lubricants**

**Paraffins**

(Base Oils)

Lubricants Manufacturing Process

Group I Solvent Extraction

Group II Hidrorefined (HCC)

Group II+ Hidrorefined (HCC)

Group III Hidrorefined (HCC)

Group IV

GTL Gas to Liquid
Base Oils Capacity
~ 927 kbd (based 2006)
World Base Oils (demand)

2003

Group I 84%

Group II/II+/III/IV 16%

700 kbd

2015

Group I 64%

Group II/II+/III/IV 36%

850 kbd

Source: National Petroleum & Refining Association (NPRA) / Kline and Company
Base Oils by Process

Solvent Process  \( \times \)  Hydrotreated (HCC)

- ✔ Only for paraffin’s crudes
- ✔ Process limitation due crude oil quality + process costs
- ✔† Production costs
- ✔ Reach paraffin waxes

- ✔ Crude flexibility
- ✔† High quality products
- ✔↓ Production costs
- ✔ Hi Tech Technology
- ✔↓ Energy demand
2nd Important Concept

Base Oils

<table>
<thead>
<tr>
<th>Impurities Count</th>
<th>Group I</th>
<th>Group II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aromatics %</td>
<td></td>
<td></td>
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<tr>
<td>Sulphur %</td>
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<tr>
<td>Nitrogen ppm</td>
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Latest News:

A raft of new base oil capacity is set to enter the global market from 2008, with new plants geared towards higher specification products. Some new production will have higher specifications than base oils currently on the market. Some will be from new sources and suppliers.

While the majority of announced new capacity lies in Asia and the Middle East, technical demand for these higher quality oils is being driven by increasingly stringent specifications for lubricants in Europe with Euro V and in North America with GF-5. OEMs are also apt to take advantage of the forecasted excess in base oil quality by raising their specifications still further.

Meanwhile, Europe continues to export a growing proportion of its Group I base oil production whilst facing cost pressures due to rising feedstock costs. Further pressure could be imminent as naphthenic producers target the European process oil markets currently served by Group I refineries.

These and other imbalances are likely to result in greater inter-regional flows where logistics will play an increasingly important element in future base oils supply.

Join your colleagues and peers to discuss and debate these issues at the 12th ICIS World Base Oils conference in London. We hope to see you there!
3rd Important Concept

Lubricant Technological Trend

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Paraffin Wax Content

API G I

API G II

G II+

G III

PAO

GTL
World Lubricant Demand by Region

- North America: ~30%
- South America: ~7%
- Asia Pacific: ~30%
- Middle East: 4%
- W. Europe: ~27%
- E. Europe: ~14%
- Africa: ~2%
- ~87% (~slide 7)

Source: Petroleum trends international
Paraffin Refining Trend

World Lubricant Demand by Application

2002

Automotive Lubricants 56%
Industrial Lubricants 44%

GF4 → GF5
..... → GF6
...... Euro IV

37.5 MTons

Source: National Petroleum & Refining Association (NPRA) / Kline and Company
Paraffin Refining Trend

World Lubricant Demand

Timeline:
- 2005: Euro IV
- 2008: Euro V
- 2010: GF 5
- 2012: Euro VI
- 2014: GF 6

Timeline to new lubs
Paraffin Refining Trend

Base Oils (group I) – Brazilian Market

Production
Demand

Source: ANP (Brazil)
Paraffin Refining Trend

Equation Analysis:

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Paraffin Refining Trend

Group I Base Oil Refineries - USA

# of refineries

Source: National Petroleum & Refining Association (NPRA)
Paraffin Refining Trend

# refineries in operation

Source: National Petroleum & Refining Association (NPRA)
Paraffin Refining Trend

Chinese Refinery Capacity

Source: Energy Information Administration (EIA) – USA government
Paraffin Refining Trend

Paraffin Wax Content in Chinese Crude

Source: MEGH
Event

Slow down in world demand for group I base oils.

Group I refineries conversion through hidrocracking.

Automotive lubricants migrating from GF-4 to GF-5.

Group I refineries shut down due to obsolescence.

New “clean” refineries with GTL process generating “clean” lubricants.

Consequences

Base oils with ↓ paraffin content

↓ Paraffin generation

↓ Group I demand
↓ Paraffin generation
↓ Group I generation
↓ Paraffin generation

No paraffin generation in GTL process
Paraffin Wax in the Refinery Context

Refinery Manager: Do we Mfg. Paraffins?
Paraffin Waxes

X

World Refineries

654 Refineries Worldwide

~ 75% Manufacture Only Fuels

~ 25% Manufacture Lubricants

150 Refineries mfg. Base Oils

(70 Refineries)

Only Slack Wax (50 refineries)

Fully Refined Paraffins (30 refineries)

~ 47% no waxes

~ 53% mfg. waxes (80 refineries)

Slack Waxes are Manufactured in ~12% of Worldwide Refineries

Fully Refined Paraffins are Manufactured in ~ 5% of Worldwide Refineries
64% of LA paraffins are manufactured in Brazil
San Roque (Venezuela) y Barrancabermeja (Colombia) refineries have irregular production
La Plata (Repsol Argentina) y Salamanca (PEMEX Mexico) refineries mfg. on a regular base
Paraffin Wax Supply
Latin American Refineries

Capacity
- Refineries: 235,000 Tons/year
- No refineries: 20,000 Tons/year
- Total: 245,000 Tons/year

Supply:
- 38,000 Tons
- 10,000 Tons
- 22,000 Tons
- 107,000 Tons
- 43,000 Tons
- 15,000 Tons

Paraffin Wax Supply
Latin American Refineries
Main World Paraffin Production Capacities 2006

(slide 22 → Lubricant Demand)

245,000 Tons/year
~ 4.0% mkt share

ROW = rest of world

ROW 15%

N. America 21%

Europe 24%

Asia/Pacific 40%

85% (~ slide 8)
Chinese crudes trend to reduce paraffin content.
Chinese crude fields with higher paraffin content are slowing down.
Gaoqiao & Moaming run with less paraffin content.
Dalian refinery is under possible HCC conversion to only fuels.

REDUC HCC forecast to 2008 (reducing ~ 800 tons/month) (???)
Possible HCC at RELAM in 2012 (????)

New lubricant oils generation according with new specs in USA y Europa, affecting Japan.
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Paraffin Refining Trend
e xample - Brazil

HCC project at REDUC

PETROBRAS

Projeto do HCC na REDUC

- Objetivo: Produção de óleos básicos lubrificantes com qualidade adequada as novas exigências do mercado.
  Motive: High quality base oils production to adapt to the new marketing specs

- Impactos no segmento de Parafinas
  Impact on paraffin wax marketing

  - Queda de ~45% na produção de parafinas;
    Breakdown at ~45% in paraffin production

  - Não haverá alteração na qualidade;
    No quality changes

IV Enafave – João Pessoa (PB), november 2006
World Paraffin Demand (per capita)
World Paraffin Production
(historical series)

Per Capita Demand = 0.70 – 0.80 Kg/year
Brazilian Paraffin Production
(historical series – 64% LA mkt share)

Per Capita Demand = 0.60 – 0.70 Kg/year

life cycle?
Latin American Paraffin Production
(historical series)

Per Capita Demand = 0.85 – 0.95 Kg/year
Product Life Cycle

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<th>Introduction</th>
<th>Growth/Ascent</th>
<th>Maturity</th>
<th>Retirement</th>
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<td>Product Management &amp; Design</td>
<td>Product Customization</td>
<td>R&amp;D</td>
<td>Product Re-engineering</td>
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<td>Product Development &amp; Testing &amp; QA</td>
<td>Core Product Enhancement</td>
<td>Product Differentiation</td>
<td>Maintenance</td>
</tr>
<tr>
<td>Deployment</td>
<td>Bug Fixing</td>
<td>Product Migration</td>
<td>Technical Support</td>
</tr>
<tr>
<td>Product Versioning</td>
<td>Product Implementation</td>
<td>Product Implementation</td>
<td>Testing &amp; QA</td>
</tr>
</tbody>
</table>
Crude Price Evolution (historical series)
Fully Refined Paraffin Wax
average price (net cash)
(refinery based)
The future of paraffin waxes will depend on which technology will be used to manufacture lubricants (GTL/Fischer Tropsch).

Cracking of heavy fractions, generating lighter fuels (Hidrocracking).

Petroleum waxes are passing through their maturity phase going to a decline phase in their life cycle.

Paraffin demand has shown signs of slowing down in the last years.

Substitute waxes are already a reality (ex: GTL waxes / HOFs).
Paraffin Replacement by Other Waxes

- Candles: 62%
- Packaging: 18%
- Emulsions: 8%
- Hot Melts: 4%
- Floor Polishes: 3%
- Others: 5%
Oils & Fats
Most Consumed Oils & Fats Worldwide – 2000
(raw material source for hydrogenation / esterification)
Oils & Fats vs Crude

World Oils & Fats Production vs Paraffin Wax Demand
(average evolution 92 – 06)

- Palm Oil Production: 8.0%
- Soybean Oil Production: 4.6%
- Tallow Production: 2.1%
- Paraffin Demand: 1 – 2%
Oils & Fats vs Crude

Price Index Evolution
(1998 = 1,00)

$ index

Crude Tallow (Brazil) U$/Ton
Crude Palm (Malaysia) U$/Ton
Crude (Nymex future) U$/barrel
Crude Soy (Chicago) U$/Ton
Crude (avg world) U$/barrel
Biodiesel
Biodiesel vs Diesel Demand

Billions Liters

- Diesel demand
- Biodiesel demand

0,45%
Main Biodiesel Producers 2006

Germany: 1.921
France: 557
USA: 284
Italy: 227
Check Rep.: 136
Austria: 85
Spain: 84
Denmark: 80
Poland: 80
UK: 74
Brazil: 70
Australia: 57
Sweden: 7
Others: 176

Main Harvest:
- = canola
- = soy
Main Biodiesel Producers

ICIS news

German Biodiesel market “dead”

ICIS Chemical business, January 21-27, 2008

Many german biodiesel producers are facing bankruptcy following a tax hike on biodiesel, effective January 1, industry association “Verband der Deutschen Biokraftstoffindustrie (VDB)” said last week.

“Only two weeks after the tax was hiked by 6 euro cents to 15 cents (a liter), our predictions came true: the market for B100 (100% biodiesel) is dead”, said VDB president Arnd von Wissel, adding that B100 accounted for about 60% of Germany’s biodiesel market.
Oils & Fats vs Biodiesel
example - Brazil (12/2007)

Price Index Evolution
(1998 = 1,00)

$ index

- 3,00
- 2,50
- 2,00
- 1,50
- 1,00
- 0,50
- 

98 99 00 01 02 03 04 05 06 07 08

Brazilian Price

Crude Palm Oil (Malaysia) U$/Ton

Crude Soy Bean Oil (Chicago) U$/Ton

Crude Tallow (Brazil) U$/Ton