CREATING NEW BUSINESSES BASED ON LACTIC ACID CORE COMPETENCES

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New Business Ventures
Outline

1. Corbion profile
2. Lactic Acid technology
3. Lactic acid products and applications
4. Growth of lactic acid market
5. Growth opportunities beyond lactic acid
6. Summary and conclusions
Corbion profile

- **Corbion:**
  - A Dutch multinational formed by former Purac and Caravan Ingredients
  - Headquartered in Amsterdam, The Netherlands
  - Listed at Amsterdam Stock Exchange (Corbion)
  - 2013 turnover € 744 million, EBITDA € 99 million
  - 1900 employees, 200 in R&D
  - 10 manufacturing facilities

- **Focus on:**
  - Natural food preservation
  - Biobased building blocks & chemicals
  - Monomers for bioplastics

- **80 years of experience in the development, production and marketing of natural and biobased chemicals**

- **Largest and most experienced producer of Lactic Acid**

- **Global sales network & manufacturing footprint**
Corbion-Purac Global Presence
Current Lactic Acid Production

- Sugar
- Lime
- Biomass
- Sulfuric acid
- Gypsum
- Residue
- Lactic acid

1. **Fermentation**
2. **Acidification**
3. **Purification**
4. **Energy**
5. **Co-Products**
6. **Lactic acid**

**Current Lactic Acid Production**
Future Lactic Acid Production with Corbion’s proprietary Platform Technology

Fermentation → Acidification → Purification → Lactic acid

Energy

Biomass

Gypsum

Co-Products

Corbion

December 9, 2014
Demonstration of gypsum-free Lactic Acid process in Gorinchem, NL

- 10 kTon/yr Demo Plant
- Start-up July 2013
- Product within specifications
- Running within >95% of design specifications since early August 2013
Cellulose options for High Volume Biobased Chemicals in the Pipeline

Bagasse
Empty corn cobs
Wood

Corbion assets in 2G Biomass value chain:

• Superior Process performance Lactic Acid vs. Bio Ethanol
• Biomass scouting & evaluation
• Pretreatment Technologies scouting & evaluation
• Fermentation and tailor made strain development
• Pilot and Demo capabilities
Lactic acid: 2 stereoisomers

L (+) lactic acid     D (-) lactic acid

Purac® Lactic Acid: Pure L(+) or D(-)
Synthetic LA is a 50/50 mixture of L(+) and D(-)
Corbion value propositions for food markets: Preservation, taste and nutrition enabled by deep understanding of functionalities

Healthy food
Nutritious food
Delicious food
Fresh food
Safety
Shelf Life
Nutrition
Taste
Safe Food
Natural food
Acidified food
Low Calory food
L(+) Lactic acid Applications enabled through dedicated application and market development and understanding of market needs

<table>
<thead>
<tr>
<th>Application Category</th>
<th>Image</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Agro</td>
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<td>Agricultural applications</td>
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<td>Home Care</td>
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<td>Home care products</td>
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<tr>
<td>Medical</td>
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Natural lactic acid market growth has been driven by continuous innovation

Figure for illustrative purposes only (Index)

Innovation topics:
- Technology
- New products
- Product purity
- Functionalities
- Applications
- Services
- Partnerships

External drivers:
- Safety
- Natural
- Environment
- Regulations
- Sustainability

In each growth phase different trends needed to be addressed
### Growth drivers for lactic acid market in different phases

<table>
<thead>
<tr>
<th>Phase</th>
<th>Key Products</th>
<th>Key Applications</th>
<th>Functionalities</th>
<th>Market Drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Until 1980</td>
<td>Synthetic lactic acid</td>
<td>• Leather Tanning • Metal plating • Textile dyeing</td>
<td>• pH control</td>
<td>Basic functions</td>
</tr>
<tr>
<td>1980-1990</td>
<td>• Natural Lactic acid • Lactate salts</td>
<td>• Food applications</td>
<td>• pH control • Preservation • Fortification • Bio-availability</td>
<td>• Replacement of synthetic by natural L(+) LA • Taste profile</td>
</tr>
<tr>
<td>1990-2000</td>
<td>• Lactate esters • Lactate salts</td>
<td>• Cosmetics • Personal care • Microelectronics • Agro • Detergents • Oil Field • Animal Feed • Bioremediation</td>
<td>• Moisturizing • Safety • Solvency • Adjuvancy • Descaling • Anti-bacterial</td>
<td>• Product Purity • Regulatory for chemicals, solvents, biocides</td>
</tr>
<tr>
<td>2000 onward</td>
<td>• D(-) lactic acid • Lactides</td>
<td>• PLA • Acrylic Acid, PDO • Resins • Chiral synthesis</td>
<td>• Biodegradability • Bio-based • Chirality • Intermediate</td>
<td>• Sustainability • Technology</td>
</tr>
</tbody>
</table>
Lactic acid: a Biobased Intermediate Platform

- **Lactic acid**
  - L(+) and D(-)

- **Lactate Esters**
  - (ML, EL, BL)

- **Lactate Salts**
  - (K, Na, Ca)

- **Lactides**
  - (LL, DD, DL)

- **Acrylic Acid**

- **1,2-PDO**

Formulations:
- **Food, Feed, Home and Personal Care**
- **Solvents, Cleaning, Agro, Electronics**
- **Food, Feed, Home and Personal Care**
- **(PLA, PU, CASE)**
- **(Acrylate resins, SAP)**
- **(Coolants)**

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[Image: Pacific Rim Summit on Industrial Biotechnology and Bioenergy, December 7-9, 2014 • San Diego, California]
Growth Opportunities Enabled by Corbion Proprietary Technology Platform Synergies

C5-C6 sugars

upstream
non-food feedstock

80 years
lactic acid

bio based building blocks

downstream
salt free

Adapted DSP

• Detoxification
• C₅ fermentation
• C₆ fermentation

Lactides & PLA

D(-) LA

Succinic acid

FDCA

Acrylic Acid

......
Corbion moving beyond Lactic Acid

Lactic acid and lactates
> 80 years experience

L and D-Lactide
Partnership with: SULZER

Succinic acid
Partnership with: BASF

FDCA
Acquisition

Acrylic Acid
Partnerships

1,2-PDO based on Lactic Acid

Building on Corbion Purac core capabilities
- Fermentation and down-stream processing
- Salt-free production of organic acids
- Purac global production sites & network

2010

2014

Manufacturing
- Globally
- Thailand (75 kton)
- Spain (Montmeló)

Partnership with:

L and D-Lactide

Succinity

FDCA

Acrylic Acid

1,2-PDO based on Lactic Acid
Key Success Factors in Lactic acid market growth and Beyond

- **Strong and protected Technology**
  - Continuous improvement of manufacturing process
  - Sustainability as driver for improved process with low environmental impact
  - Continuous improvement of technology and product specifications

- **Application development** to identify functionalities in key applications
  - Low taste for preservation
  - High purity solvents for electronics
  - Specific registrations for different application fields
  - Strong value propositions

- **Biobased in itself not the key-driver for growth, but rather safety, regulatory, functionality and performance**

- **Development of derivative products** to broaden addressable market:
  - Solvents for electronics and agro
  - Blends for food
  - Purac Sanilac® for household & personal care
  - D(-) and Lactides for PLA
  - Large drop-in markets like Acrylic Acid and 1,2-PDO
"Designed by Science, Powered by Nature and delivered through dedication"