Building New Fermentation platforms based on lactic acid capabilities

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Hans van der Pol, Ph.D
Director Biobased Innovations
Corbion
Outline

1 | Corbion profile
2 | Lactic acid products and applications
3 | Growth of lactic acid market
4 | Case study: PLA
5 | Growth opportunities beyond lactic acid
6 | Key success factors in lactic acid market growth and beyond
Corbion: Who we are today

- Employees: around 1,800
- Revenue (2014) of € 770.1 M and EBITDA of € 109.6 M
- Leading market positions in food and biochemical ingredients
- Unique technology platform: fermentation of organic acids
- 11 production facilities across the globe
- Listed at NYSE Euronext Amsterdam: CRBN

“Designed by science, powered by nature, delivered through dedication”
Corbion’s global footprint

We market our products through a worldwide network of sales offices and distributors.
Lactic acid: 2 stereoisomers

L (+) lactic acid  

D (-) lactic acid

Purac® Lactic acid: Pure L(+) or D(-)  
Synthetic LA: 50/50 mixture of L(+) and D(-)
Corbion functionalities for food markets: Preservation, taste and nutrition

Healthy food

Nutritious food

Delicious food

Fresh food

Safe food

Natural food

Acidified food

Low calorie food
L(+) Lactic acid Applications For Chemicals and Pharma Applications enabled through deep understanding of functionalities and performance
## 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 • Biobased • Chirality • Intermediate</td>
<td>• Sustainability • Technology</td>
</tr>
</tbody>
</table>
Natural lactic acid market growth has been driven by continuous innovation

Figure for illustrative purposes only (Index)

In each growth phase different trends can be addressed
CASE: PLA

D(-) lactic acid opening up higher value PLA markets

Value & Performance

Disposables

Semi-durables

Durables

Ongoing technology development enables high volume applications like PLA
SUPLA has started construction of a 10kT/y PLA facility

- Lactide monomers supplied by Corbion to make PLLA
- Located in China
- Samples available for pre-market launch

**Benefits:**

- PLLA for short cycle time
- High stereochemical purity
- Using GMO free biomass

**SUPLA:** high heat PLA for durable and demanding applications, such as automotive and electronics parts
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
Gypsum free lactic acid process now proven on demo scale 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
- Process now proven
Biobased Innovations
From lactic acid to biobased building blocks

Core Process Innovations
• Gypsum-free fermentation opens access to biobased building blocks
• 2nd generation biomass

Market led Innovations
• PLA biodegradable plastic
• Succinic acid (JV with BASF)
• FDCA
Lactic acid: a biobased intermediate platform

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

Lactate esters
(ML, EL, BL)

Formulations
Food, Feed, Home and Personal Care

Formulations
Solvents, Cleaning, Agro, Electronics

Lactate salts
(K, Na, Ca)

Formulations
Food, Feed, Home and Personal Care

Lactides
(LL, DD, DL)

Polymers
(PLA, PU, CASE)

Polymers
(Acrylate resins, SAP)

Acrylic Acid

Formulations
(Coolants)

1,2-PDO
Corbion moving beyond lactic acid

2010

Lactic acid and lactates

> 80 years experience

L and D-lactide

Partnership with: Synbra, SUPLA

Succinic acid

Partnership with: BASF, Succinity

FDCA

Acquisition

Building on Corbion core capabilities
• Fermentation and down-stream processing
• Gypsum free production of organic acids
• Global production sites & network

2015

Manufacturing:
• Globally
• Thailand (75 kT)
• Spain (Montmeló)

New opportunities
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
  - D(-) lactic acid and Lactides for PLA

- **New opportunities fitting with Corbion technological and market capabilities**
“Designed by science, powered by nature and delivered through dedication”