Carbon Fiber Composites

Sustainable Global Growth Through Collaborative Innovation

Composites Without Borders
November 1, 2013
Moscow
Combine the power of science and technology to passionately innovate what is essential to human progress

1897 Founded by Herbert H. Dow in Midland, Michigan

$57 billion Global Revenue in 2012

~160 Countries in which we serve customers

More than 5,000 products are manufactured at 188 sites in 36 countries

54,000 Approximate Employees worldwide
Through meaningful, science-based innovation and strong collaboration, Dow is delivering the value our customers want and the world needs.

- Helping achieve higher yield potential through plant biotechnology
- Enabling better quality in electronic displays and general lighting
- Tackling water challenges in a sustainable way

2012 Innovative Milestones

412 U.S. patents granted to Dow in 2012

Dow R&D features an elite team of nearly 7,000 employees globally

$7 billion Net Present Value of R&D projects in commercialization
Dow Russia: Key Part of Global Company

– Almost 40 years of continued presence in Russia and CIS
– Approximately 770m USD of sales in 2012
– > 250 highly qualified employees
– 2 manufacturing facilities
– 3 representation offices in Russia, Ukraine and Kazakhstan
Dow Products for Composites Industry

Dow Chemical’s Market Position

• World’s largest producer of epoxy resins & intermediates.
• Broad product mix and strong global presence.
• Backward integration into feed stocks for consistent, reliable product supply.
• 9 manufacturing facilities in:
  • Asia Pacific – China, Japan, Korea
  • Europe – Germany, Italy
  • Latin America – Brazil
  • North America – USA
• 50+ years of industry service
• Strong commitment to product & technology innovation
• Strong re-investment in the business
Dow Products for Composites Industry
Many Market Uses

- **PRESSURE VESSELS**
  - VORAFORCE™ Systems for Filament Winding Processing

- **MANHOLE COVERS**
  - VORAFORCE™ Systems for Long Fiber Injection

- **COMPOSITE PIPES**
  - VORAFORCE™ Systems for Filament Winding Processing

- **VEHICLE PARTS**
  - VORAFORCE™ Systems for Long Fiber Injection

- **BUILDING PROFILES**
  - VORAFORCE™ Systems for Pultrusion Processing

- **CURVED PANELS**
  - VORAFORCE™ Systems for Filament Winding Processing

- **Composite Pipes**
  - VORAFORCE™ Systems for Long Fiber Injection

- **Vehicle Parts**
  - VORAFORCE™ Systems for Infusion and Hand Lay-Up
Carbon Fiber Composites Market Projection: Capturing Value Downstream

KEY FACTORS
- Continuing Push to Lightweighting driven by Energy Efficiency and New Performance Requirements
- Potential for Cost reductions in Applications that use more Material than necessary
- Modelling/Process Automation help to overcome concerns of designers in using composites

Driven by supply and demand; margins/ dynamics vary in polyester (3-8%) vs. epoxies (7-12%)
- Driven by supply and demand; glass margins much lower than carbon
- Much higher margins (25%+) in spec-driven industries
- Driven by product ingenuity, brand, IP, industry, etc.
  Can range from 5-50%+

SOURCE:
Lucintel Global Composites 2009-2014;
Company annual reports,
Team analysis
Aksa: The Right Match for Dow

Aksa
- #1 in acrylic fiber capacity and market share
- World’s largest acrylic fiber plant in Yalova
- 310 kt/y, easily expandable to 400 kt/y
- Uniquely positioned to deliver up to 200 kt of precursor (~100 kt carbon fiber)

Dow Chemical
- World class chemistry and manufacturing capabilities
- Expert resin and composite discovery, formulation and commercialization
- Established global market reach
- 2011 Turnover: 55 B $
  Number of Employees: 55,000
  R&D Budget: 2.1 B$
Concept
• Combine World’s largest epoxy resins producer (Dow) with the........
• World’s largest acrylic fiber producer (Aksa) to create the.....
• World’s only fully integrated player with....
• Unparalleled expansion capability

Why Carbon Fibers for Lightweighting

<table>
<thead>
<tr>
<th>CF vs Fiberglass</th>
<th>CF vs Steel</th>
<th>CF vs Aluminum</th>
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<tbody>
<tr>
<td>3-4 times stiffer</td>
<td>5-8 times stronger</td>
<td>2 times stiffer</td>
</tr>
<tr>
<td>50% lighter</td>
<td>2 times stiffer</td>
<td>67% lighter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50% lighter</td>
</tr>
</tbody>
</table>
AKSA Akrilik Kimya Sanayii A.Ş.

- Established in 1968
- Largest acrylic fiber producer for textile industry in the world!
- 14% market share
- 978 million USD sales in 2012
- Selling internationally since 1977 to more than 50 countries
- Leader in Quality, in Products Offered, in Continuous Improvement and in Manufacturing Technology

AKSA’s Capacity Development

1972, 5,000mt


Today, 308,000mt

AKSA Shareholders

- Akkok Group; 39%
- Public Held (IMKB); 42%
- Emniyet AS; 19%
- ; 0

Aksa’s production site in Yalova Turkey
DowAksa İleri Kompozit Malzemeler Ltd. Şti.
Overview

- **DowAksa** established on June 29, 2012

- **DowAksa** is an international 50:50 joint venture between The Dow Chemical Company and Aksa Akrilik Kimya Sanayii A.Ş.

- JV will manufacture and commercialize **carbon fibers and derivatives** with a specific focus on following markets
  - Energy
  - Infrastructure
  - Transportation

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**Dow and Aksa Announce Formation of Joint Venture for Carbon Fiber and Derivatives**

- **DowAksa** to focus on solutions that reduce overall costs, thereby enhancing economics and driving adoption in a broader array of industrial markets
- **Emphasis** to be on integrated carbon fiber composite solutions for growing energy, transportation and infrastructure markets globally

**MIDLAND, Mich., USA and ISTANBUL, TURKEY – June 29, 2012** – The Dow Chemical Company (NYSE: DOW), through its wholly-owned subsidiary Dow Europe Holding BV, and Aksa Akrilik Kimya Sanayii A.Ş. (ISE: AKSA), a world-leading acrylic fiber company, today announced the official formation of DowAksa Advanced Composites Holdings BV (DowAksa), a joint venture (JV) to manufacture and commercialize carbon fiber and derivatives. Aksa and Dow had previously signed a definitive agreement to form the JV on December 20, 2011.
What is Carbon Fiber?

- Carbon fibers are extremely fine fibers (typ. 5-7 μ in dia.) consisting mostly of carbon atoms.

- Carbon fiber is >95% carbon.

- The structure of carbon fiber is similar to graphite: sheets of carbon atoms, arranged in hexagonal patterns, aligned along the axis of the fiber.

- Carbon fibers are produced in tows (yarns) ranging from 1.000 filaments (1k), to 3k, 6k, 12k, 24k, 50k, etc.
Uses of Carbon Fiber

Current Demand for Carbon Fiber
< 40,000 mt p.a.; > US$1B
Most Carbon Fiber goes through Intermediate Processing before making Composite Parts

For every $ / € / ¥ of carbon fiber, there is another $ / € / ¥ of weaving / prepregging / other material processing, and several multiples of that to fabricate the composite part.

The total carbon fiber composites value chain today, generates $ 8-10B annually.

Source: Aksa Marketing.
Most uses of carbon fiber are early in the product life cycle

Positioning of Products Made Using Carbon Fiber in 2012

<table>
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<tr>
<th>Market for Carbon Fiber</th>
<th>2012</th>
<th>2015</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>mt</td>
<td>&gt;40.000</td>
<td>&gt;75.000</td>
<td>~150.000</td>
</tr>
<tr>
<td>value</td>
<td>US$ 1.0-1.5 B</td>
<td>US$ 2-3 B</td>
<td>US$ 3-5 B</td>
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Growth in Demand for Carbon Fiber over 50 years from 1970-2020

- 1st CF in Aerospace
- 1st CF in Sporting Goods
- 1st CF in Commercial Airliners
- CF Adopted in Electronics
- CF Adopted in Earthquake Retrofitting
- CF in F1 Cars
- CF Trials in Offshore Oil
- CF Adopted in Wind Blades
- Boeing 787
- BMW City Car
DowAksa Milestones for CF Production Realisation

- From 2006 to 2009 within 3 years, it was achieved to produce CF by creating own knowhow and high technology.

- Brandname for Carbon fiber is Aksaca

- This time frame is far beyond from industry average and this is success story!

- Last 30 years, there was no new entrance to industry except DowAksa.
DowAksa JV Projected Joint Business Plan
Potential New Partners

The Hobo-Dyer Equal Area Projection
This new map belongs to the family of Cylindrical Equal Area projections in which the latitude and longitude lines form a rectangular grid. Other projections in this family include the Lambert, Gall, Baltham, Edwards, and Peters projections. In the present case the “spindles” is sewn-months warp round the globe and cut through it at 31° north and south. In order to preserve the equal area property the shapes of the landmasses become progressively flattened towards the poles, but shapes between 45° north and south are well preserved.
спасибо