China Acrylic Fiber Industry during 12th Five-Year Plan Period – Expanding or Shrinking?

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Outline:

• Targets for China acrylic fiber industry in the 12th Five-Year Plan period
• Status quo and development of China AF industry
• Key factors for development of China AF industry
• Future developing direction for China AF industry
China aims to become a world acrylic fiber production base with global competitiveness.

**Targets:**
- Total capacity of 1.2 million t/a, with capacity utilization ratio higher than 95% and average capacity of producers over 70kt/a.
- Unit processing cost below 3,500 yuan
- Average labor productivity per capita above 1.08 million yuan
- Higher quality, more environment-friendly; ISO18001, ISO19001 and ISO14001 certificated

In 2011, total capacity of acrylic fiber in China is 915 kt/a. With the three long-idled units (combined capacity of 135 kt/yr) excluded, the total capacity is actually 780 kt/a.
Status quo — Output and Consumption in China

Change of Acrylonitrile Capacity, Output and Consumption during 2000-2010

Status quo — Production in China and the World

Acrylonitrile Production 2002-2011

Production in China and the World
**Development — Lower Import, Higher Output and Self-supply**

**Output & Import 2000-2010**

**Self-supply rate 1999-2011**

![Graph showing Output & Import Volume of Acrylic Fiber during 2000-2010]

**Development — Consumption and Demand**

![Graph showing AF Consumption and Output of Some AF Derivatives 2000-2010]
In 2010, the proportion of AF consumption in textile & apparel, decoration and industrial fields is 70%, 27%, 3%. Hereinto, the proportion of textile & apparel increases by 3 points, that of decoration up by 7 points, while that of industry falls by 10 points, to 3%.
Development — Global

Global Growth of Staple Fibers 1990-2010

![Graph showing global growth of staple fibers 1990-2010.](source: Oerlikon)

Development — Global

Global Synthetic Fiber Output Proportion by Variety 1990-2010

![Graph showing global synthetic fiber output proportion by variety 1990-2010.](source: Oerlikon)
Proportion of acrylic fiber output of major origins 1995-2010

- China
- West Europe

Source: Oerlikon

Key Factors for Development of China AF Industry

- Smaller market share. To seek more applications?
- Feedstock — short supply and high prices
- Technology progress — equipments, R&D, applications
- Industry integration — Mergers and acquisitions — Wash-out — Intra-industry cooperation
Key Factors for Development of China AF Industry

- Downstream demand — to explore for more fields of application and wider market share
- To be more self-dependent in ACN supply
- To accelerate technology progress — equipments, R&D, applications
- Measures for industry integration
  — Mergers and acquisitions
  — Wash-out
  — Intra-industry Cooperation

Characters and Applications of Acrylic Fibers

- Main characters:
  - Resilience: 2 times higher than nylon fibers, only just below PET fibers. Fluffy, curly and soft, with a resilience rate of 65% even after extended by 20%.
  - Tenacity: 22.1~48.5cN/dtex, 1~2.5 times higher than wool, while lower than PET and nylon fibers.
  - Heat-resistance: Softening point at 190~230℃, ranked just below PSE fibers.
  - Light-resistance: Losing just 20% tenacity after 1 year under direct sunshine, the best in all synthetic fibers.
- Widely applied in apparel, decoration and industrial fields. 100 acrylic yarn or blended yarns with natural fibers.
  - Acrylic fiber — resistant to acid, oxidant and many organic solvents, unresisting to alkali
  - Acrylic fiber end products — Fluffy, soft touch, warm-keeping, good weather resistance, mould-and-moth-proof
  - Warm-keeping — 15% higher than wool, could be blended with wool, mainly used to produce textiles including hand-knitting yarn, blanket, knitted spots suits, tarpaulin, curtain, artificial fur, plush, etc.
  - Acrylic fiber is the feedstock for high-performance carbon fiber
Differentiated Acrylic Fiber

- The differentiated acrylic fiber is defined as a chemically or physically modified acrylic fiber, an innovation to regular acrylic fibers, or providing acrylic fiber with some special characters.

- Types of such fibers: High-shrinkage, compound, cross-section-profiled, antistatic, UV-cut, far-infrared, antibacterial, flame-retardant, fragrant, negative ion, anti-pilling, etc.

General Evaluation

Projects of carbon fiber, aramid fiber, UHMWPE fiber and PPS fiber have successfully realized commercial production, and many other high-tech-fiber projects are in smooth progress, with notable achievements in production process, equipments, products’ application and standardization.

- Begin to take shape
- Just make some achievements in technology
- Primarily meet the requirement for economy and society development
### Application Progress of Carbon Fiber and Aramid Fiber

|-------|---------------------------|-----------------------|-----------------------|-----------------------------|-----------------------------|
| History | Pilot application  
• Comonomer production process for PAN precursor  
• Fast pre-oxidation process  
• Engineering solutions for PAN-based carbon fiber and aramid fiber  
• Start commercial production | Trial application  
• Carbon fibers used in fishing rod and golf club  
• Carbon fibers used as secondary structural materials of Boeing 757 and 767  
• Aramid fibers used in police bulletproof vest for the first time | Wider applications  
• Carbon fibers widely applied in rockets and golf club  
• Carbon fibers used as primary structural materials of Airbus A330  
• Aramid fibers used in military bulletproof helmet | Industrial applications  
• Carbon fibers used as primary structural materials of B777 and A380  
• Aramid fibers widely used in industries  
• Carbon fibers started industrial application | Wider application in industry fields  
• Wide application of carbon fiber and aramid fiber in new industries such as energy and automobile  
• Large aircraft project  
• Wind power generation and marine crude oil exploration  
• Automobile |
| Reason | Engineering of R&D achievements | Improving performance and quality | More varieties and advanced molding technologies | Lower costs, Matured material production tech | Diversified production tech, matured recycling tech |

### Development Progress of Carbon Fiber in China

<table>
<thead>
<tr>
<th>Period</th>
<th>History and Investments</th>
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<tbody>
<tr>
<td>Late 60's</td>
<td>Starting R&amp;D of carbon fibers</td>
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<td>1976</td>
<td>ICC built the first pilot carbon fiber production line (with tech level close to Japan’s T200)</td>
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<td>Late 70's</td>
<td>The pilot line transferred to Liaoyuan Special Fiber Plant; starting R&amp;D for T300</td>
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<td>1981-1985</td>
<td>Starting R&amp;D for HT T300 Type-1</td>
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<tr>
<td>Mid 80's</td>
<td>Introducing tow pre-oxidization line and carbonizing equipments but not carbonizing process</td>
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<tr>
<td>1996-2000</td>
<td>Jilin Petrochemical and JLICT cooperated in R&amp;D of high-performance DMSO PAN precursor</td>
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| 2002 | MOST allocated RMB 100 million in Project 863 for R&D of carbon fiber  
MOST started basic research for Project 973  
RMB 6 million for key theoretical researches |
| 2005 | RMB 30 million for basic research for Project 973 |
| 2005-2006 | Primarily achieving stable pilot production of homemade CCF-1(T300), setting a mile stone for industrialization and wider applications.  
NDRC had supported Weihai Tuozhan Fiber’s 1,000-t/a CCF-1 project and Anhui Huawan Carbon Fiber’s 500-t/a project. |
| 2007-2009 | NDRC started high-tech and high-performance compound fiber project in 2008  
NDRC continuously supported new-type and special fiber projects, allocating RMB 230 million for 9 projects in 2007, 164 million for 12 projects in 2008, and more projects in evaluation |
### Development of Carbon Fiber

<table>
<thead>
<tr>
<th>Scope</th>
<th>Fields</th>
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<tr>
<td>Narrow</td>
<td>Satellite, fishing rod, secondary structural material of aircraft</td>
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<tr>
<td>Expanded</td>
<td>Rackets, golf club, primary structural material of aircraft</td>
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<td>Machinery, pressure vessel, ship, reinforcement</td>
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<td>Wider</td>
<td>Aircraft, automobile, ship</td>
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<td>Energy (wind power generation, uranium enrichment, marine oil exploration)</td>
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<tr>
<td></td>
<td>Machinery, compound material products</td>
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### Japan and the US are Dominating Global Carbon Fiber Market

**Major Suppliers and Their Market Share**

- **Cookson (UK)**: 14.8%
- **Tohoku (Japan)**: 3.2%
- **Toray (Japan)**: 0.3%
- **Formosa (Taiwan)**: 5.6%
- **Zoltek (the US)**: 21.3%
- **Aldila (the US)**: 4.3%
- **CYTEC (the US)**: 2.0%
- **AKSA (Turkey)**: 1.6%
- **HEXCEL (the US)**: 7.4%
- **MRC (Japan)**: 7.9%
- **SGL (the US)**: 3.2%
- **TOHO (Japan)**: 14.8%
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Thank You!