DEVELOPMENT OF NON-ASBESTOS FIBRE CEMENT PRODUCTS IN CHINA

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Introduction

- China – One of the bigger countries in manufacturing AC, among which the main products are corrugated sheets;

- Number of AC corrugated factories: >400
- Number of the production lines: >600
- Annual output: ~300 million m²

The share of AC/FC sheets in total output of fibre cement roof & siding materials in 2005

- 79%
- 13%
- 8%

□ Asbestos Corrugated sheet
□ Asbestos flat sheet
□ Non-Asbestos flat sheet
Three types of non-asbestos fibre cement have been developed within last 20 years:

- a) Autoclaved cellulose fibre reinforced cement (CCA)
- b) Vinylon fibre reinforced cement (VRC)
- c) Glass fibre reinforced cement (GRC)

CCA - Conventional CCA Boards

Two categories of CCA boards are being produced according to the production process:

A : Conventional CCA boards - Hatschek or flow on process

- Raw materials: Kraft or bleached pulp, OPC, quartz sand, other fillers
- Production: Hatschek process, flow-on process
- Curing: Steam curing (70°C) → autoclaving (170°C ~ 190°C)
- Products: LD (0.8~1.0g/cm³), MD (1.2~1.4g/cm³), HD (1.5~1.7g/cm³)
- Application: LD, MD – mainly used for interior wall, partition & ceiling. HD – used for high quality interior wall & exterior wall
### Development of Non-Asbestos Fibre Cement Products in China

#### “Kafu” CCA Board

“Kafu” board was developed by Jiangsu Ai Fu Xi Co., Ltd.

#### Table 1— Property test results of ‘Kafu’ CCA board-HD grade

<table>
<thead>
<tr>
<th>Property</th>
<th>Test value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (g/cm³)</td>
<td>1.5~1.7</td>
</tr>
<tr>
<td>Bending strength* (MPa)</td>
<td>18~20</td>
</tr>
<tr>
<td>Impact strength* (KJ/m²)</td>
<td>1.8~2.0</td>
</tr>
<tr>
<td>Screw pull-out force (N/mm²)</td>
<td>80~90</td>
</tr>
<tr>
<td>Water absorption (%)</td>
<td>25~28</td>
</tr>
<tr>
<td>Wet expansion rate (%)</td>
<td>0.12~0.15</td>
</tr>
<tr>
<td>Thermal conductivity (W/m·K)</td>
<td>0.40~0.45</td>
</tr>
<tr>
<td>Brinell hardness</td>
<td>86~90</td>
</tr>
<tr>
<td>Frost-thaw resistance (25 cycles)</td>
<td>Passed</td>
</tr>
<tr>
<td>Impermeability (24h)</td>
<td>Passed</td>
</tr>
<tr>
<td>Combustibility</td>
<td>Incombustible, grade A</td>
</tr>
</tbody>
</table>

#### Extrude CCA boards/panels

B. Extrude CCA boards/panels

In comparison with wet process the main advantages of extrusion process:

1. Cleanliness- No waste water & residues discharged;
2. Integrated structure of product – non-laminated products;
3. Diversification of products – one production line, various profile.

Extruding machines made by Handle, Germany
Development of Non-Asbestos Fiber Cement Products in China.

Two typical extrusion production lines
Located in Suzhou, owned by Beijing New Building Materials Public Co., Ltd.

Raw materials: cardboard, OPC, quartz sand, methyl cellulose, other fillers
Autoclaved temperature: <170
Two series siding boards: S Series & K Series.

(a) CCA siding board
Located in Suzhou, owned by Beijing New Building Materials Public Co., Ltd.

Raw materials: cardboard, OPC, quartz sand, methyl cellulose, other fillers
Autoclaved temperature: <170
Two series siding boards: S Series & K Series.

S-Series – with solid cross section
S series siding boards
Length: 3300mm, valid width: 455mm, thickness: 15mm
Different surface patterns & colours
K series siding board
Length: 2400~3000mm, valid width: 300mm, thickness: 15~27mm
Different surface patterns, dimensions of groove & tongue, and colours

Located in Tianjin, owned by Tianjin Construction Engineering New Wall Material Co., Ltd.
Raw materials: waste paper, OPC, quartz sand, methyl cellulose, fillers
Autoclaving temperature: 180
CCA boards have been used in quantities in some state key construction projects. More than 200,000 m² CCA boards will be used in the Grand Stadium for Beijing 2008 Olympic Games.

Application cases of "Kafu" board

1. Used as superior interior wall panels
   e.g. South Station of Shanghai Subway line No. 1
2. As exterior wall panels of buildings
e.g. The Sino-French Centre in Tongji University, Shanghai

VRC-PVA(HM) fibres reinforced fibre cement product

- VRC corrugated sheets – difficult to be popularized due to higher cost
- VRC flat boards – produced only by few companies
- VRC cable protection pipes - Trial Production was started in the late of 1990s, which satisfied the demands of domestic market.
VRC cable protection pipes

Raw Technology

- Raw materials: HM-PVA fibre, cellulose fibre, OPC, silica fume, water
- Zhejiang Gaoxin Non-Metallic Production Co., Ltd. has been producing VRC pipes adopting the new technology successfully and these pipes have been exported to Germany
“Two Insurance” technical line has been promoting the development of China’s GRC.

AR-Glass fibre + sulphaolunate cement (SAC)

GRC production process:
- Direct spray
- Spray-suction
- Scrim lay-up
- Vertical mould casting (using scrim)
- Premixing
- Premix-spray (new)

Premix-spray process

- Principle:
  Chopped AR-glass fibre mixed with cement mortar – direct spray the mixture into the moulds

- Advantages:
  1. flexible output rate;
  2. reduced manpower;
  3. no overspray;
  4. guaranteed fibre content;
  5. clean producing;
  6. good appearance products.

Comparison of mechanical strength of GRC made by two processes

<table>
<thead>
<tr>
<th>Process</th>
<th>MOR (MPa)</th>
<th>Impact strength (KJ/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-mix spray</td>
<td>14-16</td>
<td>8-10</td>
</tr>
<tr>
<td>Pre-mix</td>
<td>10-12</td>
<td>6-8</td>
</tr>
</tbody>
</table>
Application of premix-spray process

• Especially suitable for architectural decorative components and landscape decorative art works

  e.g. Some scenic spots with GRC in Changchun Century Movie Park
Main GRC products used in China

• Lightweight partition panels
• Roof slabs with prestressed concrete ribs for grid structure
• Exterior wall panels
• Ventilation ducts
• Tube-shaped formworks (newly developed)

Conclusion

• Due to the sustained and unremitting efforts made by many Chinese scientists and experts, the old aspect of China’s fibre cement industry has been changed greatly; which means that the long period of the solely existing fibre cement product, AC, is closed, and a new transition period of AC and non-asbestos fibre cement, co-existing, has appeared.

• The main non-asbestos fibre cement products being developed are CCA, VRC and GRC. Though at present the share of these non-asbestos products in the annual fibre cement total output is still less than that of AC, the manufacturing processes and application techniques of the former are getting more and more ripe.

• Furthermore, many people in the country have already understood that certain properties of non-asbestos fibre cement are even better than those of AC.

• Undoubtedly, non-asbestos represents the future development of the fibre cement industry in China.
THANK YOU!

Development of Non-Asbestos Fiber Cement Products in China.