Fybre® for Molded Fiber Applications

Producing High Strength Molded Fiber Products

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What is Fybrer®?

Fybrer (Polyolefin Synthetic Pulp) is a hydrophilic, highly fibrillated, polyolefin fiber.

- Wood pulp
- Fybrer®
- Polyolefin cut fiber
Process for Production of Fibrillated HDPE

Process patent by Crown Zellerbach – 1970s

HDPE $\xrightarrow{\text{Hexane}}$ HDPE solution in hexane

$+$ PVOH $\xrightarrow{}$ Emulsified HDPE/hexane PVOH

Pressure through die $\xrightarrow{\text{vacuum}}$ base fiber produced

Refined to cut length $\xrightarrow{}$ Finished product
Synthetic Wood Pulp

This is a single fiber – the main branch is 20 microns in Diameter but the three dimensional structure is complex!
Features and Applications

Features
- Highly Fibrillated
- Fine
- Polyolefin
- Hydrophilic

Functions
- Binding
- Pore Size Control
- Chemical resistance
- Processability
- Mixing

Applications
- Tea Bag
- Coffee Pod
- Printing Paper
- Decorative Paper
- Paint
- Cement
- Industrial Appl.
Using Highly Fibrillated HDPE in Molded Fiber

- Produce articles of high durability and strength
- Loaded 15% or less maintain re-pulpability
- Process similar – one added heat setting step
- Articles possess
  - Higher tensile, flexural, tear strengths
  - Greatly increased abrasion resistance
Molded Fiber Process with Fybrer® Added

980# H20 + 20# Fybrer™
E400 Mix for 10 minutes

3,420# H20 + 200# Recycled Pulp Mix for 30 minutes

5% Fiber Content
4,400# Total H20
220# Total Fiber

~ 2,000 RPM
Fybrer™ E400

5% Total Fiber Content
~ 10%
Fybrer™ E400

MINIFIBERS, INC.
Examples of molded fiber using Fybrel®

**Ex.1)**
Mold for register

**Ex.2)**
Support for paper pallet

**Ex.3)**
Cap for electronic parts

**Merit**
- **Blending ratio**
  - Fybrel; 5%
  - Waste paper; 95%  
  (Corrugated fiberboard)

**Merit**
- **Higher load resistance**

**Blending ratio**
- Fybrel; 15%
- Waste paper; 85%  
  (Corrugated fiberboard)

**Merit**
- **Dimension stability**

**Blending ratio**
- Fybrel; 15%
- Waste paper; 85%  
  (Corrugated fiberboard)
Manufacturing flow of molded fiber using Fybrel®

<table>
<thead>
<tr>
<th>Raw materials</th>
<th>Material mixing</th>
<th>Molding</th>
<th>Drying</th>
<th>Air-cure</th>
<th>Hot press forming</th>
<th>Inspection &amp; Shipment</th>
</tr>
</thead>
</table>

Fybrel

Waste paper (Corrugated fiberboard)

Pulper

Adjust density

Dryer

[THERMOZONE (Arawaka)]

Air-cure

Hot press machine

[30-100ton press machine]

**Condition** *

Mixing time; 30-40min.

Drying time; 10-30min.
Temperature; 100-180deg-C

Air-Cure time; 3days-1month

Press time; About 1min.
Temperature; About 200deg-C

*) Example of a Japanese pulp mold manufacturer “TAISEI Co., Ltd.”.

These conditions depend on the product.
Details on using Fybel® for molded fiber

**Recommendation Grade of Fybel**
1. E400 (Standard)
2. E620 (Good disperse-ability)

**Recommendation condition of disintegration**
1. Pulper for low-middle concentration disintegration
2. Concentration of Fybel; 2%
3. Water temperature; 40-60 deg-C
4. Disintegration time; about 30 min.

**Recommendation equipment**
1. Dryer: A dryer “THERMOZONE” manufactured by Arakawa Co. Ltd

For drying:
In this system, the high speed air jetted out from the Jet-Tubes placed both above and under the product passing zone vertically hits the upper and back sides of the product, breaks the boundary layers containing a lot of moisture on the surface of the product. This enables to reduce the treatment time drastically.
The air containing much moisture which comes out of the product is circulated for removal of the moisture and re-heating.
The air to be jetted out from the Jet-Tube is controlled in the pressure plenum so that an uniform processing could be made at any point of the product passing zone.
Advantages using Fybrel®
Physical Property Improvements

Molded pulp : Tray & Cardboard

<table>
<thead>
<tr>
<th>Molded Pulp</th>
<th>Item</th>
<th>With Fybrel (15%)</th>
<th>Without Fybrel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tray</td>
<td>Compressive strength (N)</td>
<td>584</td>
<td>200</td>
</tr>
<tr>
<td>Cardboard</td>
<td>Bending strength (MPa)</td>
<td>13.3</td>
<td>6.1</td>
</tr>
<tr>
<td></td>
<td>Tensile strength (MPa)</td>
<td>9.1</td>
<td>3.7</td>
</tr>
<tr>
<td></td>
<td>Tear strength (the crepe method) (N/cm)</td>
<td>603</td>
<td>224</td>
</tr>
<tr>
<td></td>
<td>Surface friction strength (taper abrasion) Friction loss (mg)</td>
<td>2.8</td>
<td>117</td>
</tr>
</tbody>
</table>

Compressive strength : tray , 10mm/min
Bending strength : cardboard , 25mm strip of paper , Span interval : 32mm, 1mm/min
Tensile strength : cardboard , 15mm strip of paper , Chuck interval : 100mm, 10mm/min
Tear strength : cardboard , Crepe piece , Chuck interval : 56mm, 200mm/min
Friction strength : cardboard , CS-10, 1000g, 60r.p.m., 100 times
Method

Compressive strength: tray, 10mm/min – Improved 292%

Before

After

With SWP (15%)
**Method**

Bending strength: cardboard, 25mm strip of paper, Span interval: 32mm, 1mm/min  
**Improved 218%**

Tensile strength: cardboard, 15mm strip of paper, Chuck interval: 100mm, 10mm/min  
**Improved 245%**
Method

**Tear strength:**
- Cardboard, Crepe piece, Chuck interval: 56mm, 200mm/min
- Improved 247%

**Friction strength:**
- Cardboard, CS-10, 1000g, 60 r.p.m., 100 times
- Improved 42X!

With SWP (15%)

Without SWP
Summary

• Highly Fibrillated HDPE contributes to
  – Higher compression strength (nearly 3X)
  – Higher tensile strength (nearly 3X)
  – Higher flexural strength (>2x)
  – Higher tear strength (nearly 3x)
  – Higher abrasion resistance (>40X)

At 15% loading – molded articles are re-pulpable and remarkably durable

MAKE PRODUCTS TO COMPETE WITH PLASTICS!!
Thank You!