MINIFIBERS, INC.

The Technology of Fybrel® Fibrillated Synthetic Fiber in Fiber Cement

Since asbestos is an excellent fiber that unites the properties of flame retardance, abrasion resistance, high tensile strength, and thixotropic properties, it is impossible to replace it with any other single kind of fiber.

In fiber cement production - such as slate boards, pipes, and roofing tiles - in which the Hatschek process (wet process) has been mostly used in Europe or in other countries, most manufacturers are using a mixture of reinforcing fibers and process fibers as an asbestos replacement recipe. Those are:

Reinforcing fiber: Polyvinyl alcohol (Polyvinylformal) fiber, Polyacrylonitrile fiber

Process fiber: Synthetic pulp, Cellulose fiber

Characteristics

	Reinforcing Fiber	Process Fiber
Advantages	- Mechanical strength	- Trapping of cement particles - Controlling of drainage
Disadvantages	- Unable to trap cement particles	- Unable to give mechanical strength

Fybrel® percentage:	May be 2-4% wt % / product
Grade:	Mostly E620
Advantages of Fybrel®:	Fybrel® as a process fiber shows better weatherability and higher stability in qualities than cellulose fiber.

Introduction

Ever since it became apparent in the early 1970s through epidemiological studies in the United States that asbestos could become an induced cause of cancer of the respiratory system, the search for and research of substitute products for asbestos has been conducted extensively in the various areas where it is used industrially; e.g., the fields of fiber cement, paint, resin reinforcements or anti-sag agents, and filters for wines and liquors. As a result, the 1984 U.S. consumption of asbestos (200,000 tons) had already decreased to one-third of the 1980 consumption.

We present below the basic data and blending illustrations pertaining to the replacement of asbestos utilizing fibrillated synthetic pulp in the respective areas.

I. Properties of Fibrillated Synthetic Pulp

The grades of fibrillated synthetic pulp (trade names : Fybrel® and Short Stuff® Polyethylene) used for asbestos substitution are as follows:

Trade Name	Fybrel®			Short Stuff®		
Grade	E600	E620	E380	E780F	E380F	ESS2F
Melting point (°C)	132	132	132	132	132	132
Specific gravity	0.96	0.96	0.96	0.96	0.96	0.96
Freeness (cc)	500	350	200	-	-	-
Fiber length (mm)	1.3	1.3	0.7	1.6	0.7	0.5
Water content (%)	60	65	68	1	1	1
Product appearance	Sheet			Fluff		
Use area	Wet sheet-making area			Paint/coating area		

Please select the optimum grade according to the application area and combination with various types of materials. Grades other than those shown in the above table are also available.

II. Application Areas and Blending Illustrations

A. Fiber Cement (Slating)

Since asbestos unites the properties of flame retardance, abrasion resistance, high tensile strength, and thixotropic properties, it is impossible to replace it with a single fiber. Generally, in the production of slating, asbestos served the functions mentioned below.

Asbestos Properties

Handling properties during sheet-making	(1) Trapping of cement particles
	(2) Drainage and water retention
	(3) Dispersibility
Product properties	(1) Mechanical strength
	(2) Durability
	(3) Dimensional stability

So far, synthetic fibers comprised of polyvinyl alcohol, polyolefins, aramids, polyamide, polyester and polyacrylonitrile, carbon fibers, and glass fibers have been examined as reinforcing fibers and already put to practical use. These reinforcing fibers, however, hardly contribute to the trapping of cement particles and control of drainage, which are required during the production of slating; and, in all cases, they are not used alone, so that they are always utilized in combination with another fiber or ancillary materials.

As an ancillary material uniting the trapping of cement particles, drainage and dispersibility, Fybrel® fibrillated synthetic pulp - a multi-branched polyethylene fiber - has achieved wide recognition and use.

There is another method of adding natural pulp as an ancillary material, but this pulp has been pointed out as having problems with durability and alkali resistance.

1. Trapping of Cement

Being a multi-branched fiber, Fybrel® has a large surface area (about 10 m^2/g); consequently, it shows an excellent cement-trapping property. Although the cement trapping of Fybrel® varies substantially with the kind and ratio of addition of the secondary raw material with which Fybrel® is combined, we cite one instance as follows:

Cement	Additive	Fybrel®	PVA Fiber	Ratio of Cement Trapping
92.5 parts	2.0 parts	4.0 parts	1.5 parts	56.9%
92.5	2.0	2.0	3.5	38.1
92.5	2.0	0.8	4.7	28.9
92.5	3.0	3.0	1.5	51.2
94.5	1.0	3.0	1.5	42.3

Notes:
1) PVA Fiber = Polyvinyl alcohol fiber
2) After adding water 20 times in quantity against the total solid content and mixing uniformly, the mixture is made into a sheet on a 150-wire mesh. Then it is dried for over 10 hours at 50oC.

2. Dispersibility

Fybrel® is a multi-branched fiber and has a hydrophilic nature. Therefore, as it interlocks with the reinforcing fiber and disperses uniformly, it makes the production of homogenous slates possible.

Blending Illustration

Cement	89.5 % wt
Polyvinyl alcohol fiber	3.0
Additive	5.0
Fybrel®	2.5
	100.0

B. Paints, Coating Materials, Adhesives, and Sealing Mediums

SHORT STUFF® Polyethylene, which is Fybrel® in sheet form fluffed and dried, has the effect of providing thixotropic properties as shown in Table 1 below. For this reason, SHORT STUFF® Polyethylene - winning recognition as an excellent substitute material for asbestos in the field of paints, coating materials, adhesives, and sealing mediums where asbestos had been used as a thixotropic agent - has come into wide use in the United States and Europe, not to mention Japan.

Table 1 - Viscosity of Epoxy Resin with SHORT STUFF®

Spindle Speed	Control Pa.s	ESS5F Pa.s	ESS2F Pa.s	E380F Pa.s	E780F Pa.s	E990F Pa.s	Fume Silica
6 rpm	1.50	4.40	14.70	10.70	17.00	23.60	2.02
12 rpm	1.51	3.75	11.60	8.70	15.05	20.95	2.04
30 rpm	1.53	3.24	8.38	6.54	10.22	17.78	2.02
60 rpm	1.51	2.98	6.58	5.36	8.06		2.00
Thixo Index	1.00	1.48	2.23	2.00	2.11		1.01

Composition:		
	Epoxy Resin:	108.0 parts
	Benzyl Alcohol:	12.0
	SHORT STUFF®:	1.2
		121.2

Blending Illustration (Part 1): **Latex Traffic Coating Material**

TiO^2 (Rutile type)	14.5
$CaCo^3$ (Precipitated type)	14.5
Talc	6.0
Diatomaceous earth	5.0
Mica	6.0
Vinyl toluene copolymer	32.7
Desiccant	0.3
Thinner	19.0
SHORT STUFF Polyethylene E380F	2.0
	100.0

Blending Illustration (Part 2): **Protective Coating**

Cut-back asphalt	71.4
Clay	1.0
Acetone	0.6
Rubber	9.0
$CaCo^3$	6.0
Mineral Spirits	10.0
SHORT STUFF Polyethylene E380F	2.0
	100.0

C. Filters for Wines and Liquors

Asbestos had formerly been used as a filtration aid during the production of wines and liquors. Now, however, diatomaceous earth and cellulose, among others, are used as a filtration aid replacing asbestos; filters using fibrillated synthetic pulp are also utilized for liquor filtration. Particularly in Europe, there are actual instances where sheets having the following composition:

Natural Pulp: 60-80%
Fybrel® E620: 20-40%

are heat treated to cause the Fybrel® to dissolve and bind with the natural pulp, then used for wine filters.