

TECHNICAL BULLETIN

JOHNS-MANVILLE

POLYESTER PREMIXES

with

PLASTIBEST 20 ASBESTOS FIBERS

TB-5 February, 1962

PLAINTIFF'S EXHIBIT

BIR-950

ASBESTOS FIBRE DIVISION

J-M Plastibest — an asbestos fiber developed especially for plastics reinforcement — offers several distinct properties of advantage in polyester molding.

Plastibest 20, when used particularly in premixes incorporating glass or sisal fibers, has demonstrated an ability to improve the performance of the accompanying fibers as well as add benefits especially its own.

PLASTIBEST 20 PHYSICAL CHARACTERISTICS

Type of Asbestos: Chrysotile
Specific Gravity: 2.4-2.6
Color: Dry - very light gray
Wet - light gray

Chemical Analysis (approximate)

MgO	40	42
SiO ₂	35	42
H ₂ O	12	15
FeO	Tr	6
Fe ₂ O ₃	Tr	6
Al ₂ O ₃	Tr	3

BENEFITS OF PLASTIBEST IN POLYESTERS

- Improves surface.
- Improves flow characteristics.
- Reduces costs (as compared to some commonly used reinforcing agents).
- Improves flexural strength.
- Improves flexural modulus.
- Impact strength suitable for many and varied applications.
- Tensile strength suitable for many and varied applications.
- Increases Rockwell hardness even at low loadings.
- Improves dimensional stability over many reinforcing agents.
- Reduces stress cracking.

- Compressive strength increased at all practical loadings.
- Resists degradation in shear type mixers when compared with many commonly used reinforcing agents.
- No surface treatment needed as asbestos has excellent affinity for polyester resins.
- Good shelf life.
- Provides added heat resistance.
- Provides low moisture susceptibility.
- Aids those applications where heat distortion is a problem.

MOLDED PART PROPERTIES

Exceptional finishing characteristics
Light color
Excellent surface
Good reinforcing properties
High heat resistance
Excellent dimensional stability

PREMIX PHYSICAL PROPERTY DATA

The following conditions of preparation were used:

Mixer	Baker Perkins Sigma Blade
Molding Temperature	275°F
Molding Pressure	500 psi
Cure Time	2 min/1/4-in. thickness
Catalyst	2% catalyst by weight of resin
Lubricant	1% Zinc Stearate by weight of total mix

The following qualitative observations should be noted:

- Absorption**—Protrusions of glass or sisal fiber, which are prime sites of attack by environmental conditions, are eliminated or lessened by substitution or combination with Plastibest 20.

Our representative in your area is
H. A. Boisclair
270 Madison Ave.
New York 16, N. Y.

HEADQUARTERS: Canadian Johns-Manville Co., Ltd.
P.O. Box 1500, Asbestos, P. Q., Canada
U. S. REGIONAL SALES OFFICE: Johns-Manville Research
Center, Asbestos Fibre Sales, Manville, N. J.



The information in this report is, to our knowledge, true and accurate but all recommendations or suggestions are made without guarantee, since conditions of use are beyond our control.

2. *Flow*—A premix containing Plastibest 20 flows as a uniform mass under pressure — there is no separation of components with subsequent resin-rich areas as often observed with all-glass or all-sisal reinforcement compounds.

3. *Flash*—Removal of flash from the part is easier with Plastibest 20 compounds than with sisal compounds.

4. *Handleability*—Plastibest 20 premix handleability is much better than all-glass or all-sisal compounds. Far less sticky and more easily extruded compounds are produced.

5. *Degradation*—Plastibest 20 is far less susceptible to fiber degradation, requiring a less critical compound mixing operation.

COMPARISON OF PLASTIBEST 20-GLASS PREMIXES

(Correlation)

1. Impact Strength

General trend—Impact strength is increased by increasing total reinforcement content, or glass length, or glass to Plastibest ratio.

Exceptions—1-in. and 2-in. glass, without Plastibest, going from 20 to 30 per cent total reinforcement, decreases in impact strength.

Explanation—Decrease is attributed to high degree of glass fiber degradation.

Degradation of the glass fiber was observed in all cases where glass was used. It became greater with increasing glass concentration and/or length. However, a degraded, long fiber may still yield greater strength than a more intact, shorter fiber.

It is believed the longer fiber inherently possesses greater potential strength; but is more susceptible to degradation, which has a weakening effect. A point of diminishing returns is therefore reached. With impact strength, this is not observed until a concentration greater than 20 per cent of all glass of either 1-in. or 2-in. length is reached.

2. Flexural Strength

General trend— There was a general trend toward decreasing strength as total reinforcement content increased from 20 to 30 per cent.

Exceptions—Samples containing 100% glass of $\frac{1}{4}$, $\frac{1}{2}$, and 1-in. lengths, and samples containing 100% Plastibest 20, increased in flexural strength, probably because the effect of degradation does not overcome the inherent strength.

Explanation—Plastibest fibers are less susceptible to degradation.

The trend of increasing flexural strength with increasing glass fiber length is not as prominent as with impact strength. In many cases, at the 30 per cent level of total reinforcement, the shorter fibers yield higher strength values.

It is believed the resulting flexural strength is more dependent on fiber orientation and degree of degradation than is impact strength.

3. Ultimate Strength

Ultimate strength depends to a large extent on the surface contact of the fiber with the resin. When Plastibest 20 and glass are in combination, there is competition for this contact; therefore, full surface saturation is required to yield full potential strength.

This might explain the fact that some combinations yield strength values which are not proportional to the values obtained with either 100% glass or 100% Plastibest 20.

4. Coefficients of Variation

Coefficients of variation show lower values, thus greater uniformity, with samples containing all Plastibest rather than all glass.

It would be expected that combinations of glass and Plastibest yield values proportionately between those for either of the two, but this was not observed. The glass fiber was controlling. One would expect some lowering of the coefficient of variation with an increase in Plastibest to glass ratio, but the values will still be closer to the all-glass side of the scale. Values of 10 to 15 per cent should be considered to be good in any case.

PHYSICAL PROPERTY COMPARISON OF PLASTIBEST 20 - GLASS PREMIXES

Resin: 30% General Purpose Polyester

Filler: Calcium Carbonate

Total Fiber Content %	Plastibest 20- Glass Ratio	Glass Length in.	Flexural Strength		Impact Strength, Izod		Specific Gravity	Material Cost, F.O.B. \$/lb.	Cost, F.O.B. \$/in. ³
			Value psi	Coeff. of Variation %	Value ft. lb./in. notch	Coeff. of Variation %			
30	0:1	1/4	18,713	14.2	8.59	19.1	1.87	0.2171	0.01466
30	0:1	1/2	22,500	11.1	14.81	26.5	1.87	0.2171	0.01466
30	0:1	1	19,000	20.6	10.12	28.5	1.86	0.2171	0.01458
30	0:1	2	13,656	28.3	11.71	27.9	1.86	0.2171	0.01458
30	1:2	1/4	13,655	22.9	5.04	13.5	1.87	0.1991	0.01344
30	1:2	1/2	11,665	15.0	5.37	22.3	1.87	0.1991	0.01344
30	1:2	1	13,932	29.2	5.85	30.8	1.86	0.1991	0.01337
30	1:2	2	14,276	12.9	7.73	40.2	1.86	0.1991	0.01337
30	2:1	1/4	12,517	19.6	2.10	9.6	1.86	0.1811	0.01212
30	2:1	1/2	10,287	23.1	3.75	33.1	1.85	0.1811	0.01209
30	2:1	1	11,442	10.9	3.39	23.9	1.85	0.1811	0.01209
30	2:1	2	10,152	10.3	3.65	34.5	1.84	0.1811	0.01203
30	1:0	—	12,217	8.0	1.25	15.5	1.83	0.1631	0.01101
20	0:1	1/4	15,804	14.6	8.24	19.5	1.87	0.1842	0.01243
20	0:1	1/2	17,054	14.4	10.86	26.4	1.87	0.1842	0.01243
20	0:1	1	15,614	19.9	11.31	31.0	1.85	0.1842	0.01230
20	0:1	2	18,325	13.0	14.17	34.6	1.83	0.1842	0.01217
20	1:3	1/4	14,830	10.6	5.55	26.2	1.86	0.1752	0.01176
20	1:3	1/2	16,539	12.1	5.19	15.5	1.86	0.1752	0.01176
20	1:3	1	15,412	21.4	6.42	34.2	1.85	0.1752	0.01170
20	1:3	2	19,385	25.9	6.95	49.3	1.82	0.1752	0.01151
20	1:1	1/4	13,550	15.9	2.74	15.5	1.87	0.1662	0.01122
20	1:1	1/2	13,060	6.5	3.05	8.9	1.87	0.1662	0.01122
20	1:1	1	13,756	20.4	4.42	68.9	1.84	0.1662	0.01104
20	1:1	2	11,817	16.2	5.14	55.7	1.83	0.1662	0.01098
20	3:1	1/4	11,131	23.6	1.97	16.2	1.87	0.1572	0.01061
20	3:1	1/2	11,793	6.4	2.00	8.9	1.87	0.1572	0.01061
20	3:1	1	13,463	12.5	1.73	27.4	1.85	0.1572	0.01050
20	3:1	2	10,977	21.4	1.73	35.0	1.85	0.1572	0.01050
20	1:0	—	10,306	10.7	1.17	18.1	1.83	0.1482	0.00979
10	0:1	1/4	14,653	11.3	5.03	24.6	1.83	0.1513	0.00999
10	0:1	1/2	9,582	21.2	5.81	32.9	1.81	0.1513	0.00989
10	0:1	1	11,781	20.2	4.60	52.2	1.81	0.1513	0.00989
10	0:1	2	11,165	21.6	6.84	32.2	1.81	0.1513	0.00989
10	1:1	1/4	8,769	15.9	1.96	23.8	1.83	0.1423	0.00940
10	1:1	1/2	7,822	13.7	2.27	28.6	1.82	0.1423	0.00935
10	1:1	1	9,993	15.4	2.16	37.6	1.82	0.1423	0.00935
10	1:1	2	7,017	22.2	3.65	61.3	1.81	0.1423	0.00930
10	1:0	—	8,659	11.7	0.63	15.7	1.83	0.1333	0.00881

PLASTIBEST 20 - GLASS REINFORCED PREMIXES

Indicated Reinforcement for Greatest Economy

Resin: 30% General Purpose Polyester

Filler: Calcium Carbonate

<i>Specified Flexural Strength psi X10³</i>	<i>Reinforcement Indicated</i>			<i>Material Cost, F.O.B. \$/in.³</i>	<i>Impact Strength Obtained, Izod Ft. lb./in. notch</i>
	<i>Total Content %</i>	<i>Plastibest 20- Glass Ratio</i>	<i>Glass Length in.</i>		
> 20	30	0:1	1/2	0.01466	14-15
18-20	20	1:3	2	0.01151	6-7
16-18	20	1:2	2	0.01131	6-7
15-16	15	1:2	2	0.01045	5-6
13-15	10	0:1	1/4	0.00999	5-6
11-13	15	3:1	1	0.00976	1-2
10-11	10	1:2	1	0.00953	4-5
9-10	10	3:1	1	0.00905	1-2
< 9	10	1:0	—	0.0081	< 1

<i>Specified Izod Impact Strength ft. lb./in. notch</i>	<i>Reinforcement Indicated</i>			<i>Material Cost, F.O.B. \$/in.³</i>	<i>Flexural Strength Obtained psi X10³</i>
	<i>Total Content %</i>	<i>Plastibest 20- Glass Ratio</i>	<i>Glass Length in.</i>		
12-15	20	0:1	2	0.01217	18-19
7-12	15	0:1	2	0.01101	ca. 16
6-7	10	0:1	2	0.00989	11-12
5-6	10	1:3	2	0.00958	ca. 8
4-5	10	1:2	2	0.00949	ca. 8
3-4	10	1:1	2	0.00930	7-8
1-3	10	3:1	2	0.00905	7-8
> 1	10	1:0	—	0.00881	8-9

EFFECTS OF DIFFERENT SEQUENCES OF REINFORCEMENT INCORPORATION

Total Fiber Content: 20%
Resin: General Purpose Polyester

Total Resin Content: 30%
Filler: Calcium Carbonate

<i>Plastibest 20- Glass Ratio</i>	<i>Glass Length inches</i>	<i>Fiber Incorporated First</i>	<i>Flexural Strength</i>		<i>Impact Strength, Izod</i>	
			<i>Value, psi</i>	<i>Coefficient of Variation, %</i>	<i>ft. lb./in. notch</i>	<i>Coefficient of Variation, %</i>
1:3	2	Plastibest 20	16,364	27.4	10.02	50.8
1:3	2	Glass	12,612	20.1	4.74	57.3
1:3	2	Simultaneously	19,385	25.9	6.95	49.3
3:1	2	Plastibest 20	11,750	19.9	1.79	22.6
3:1	2	Glass	12,814	11.9	2.14	16.1
3:1	2	Simultaneously	10,977	21.4	1.73	35.0
1:3	1/4	Plastibest 20	16,882	8.5	5.37	19.8
1:3	1/4	Glass	15,654	5.8	2.97	15.3
1:3	1/4	Simultaneously	14,830	10.6	5.55	26.2
3:1	1/4	Plastibest 20	11,458	21.0	1.68	17.1
3:1	1/4	Glass	13,530	13.2	1.93	16.9
3:1	1/4	Simultaneously	11,131	23.6	1.97	16.2

When Plastibest No. 20 and Glass 2" are premixed and then added to the gunk, the glass fiber is cushioned by the asbestos; therefore, a greater flexural strength is obtained. The glass fiber is not degraded as much when protected by asbestos.

COMPARISON OF PLASTIBEST 20 AND CONVENTIONAL ASBESTOS FIBERS IN POLYESTER PRE MIX COMPOUNDS

Resin: 30% General Purpose Polyester

Filler: Calcium Carbonate

Reinforcement	Flexural Strength, psi	Impact Strength, ft. lb./in. notch	Shrinkage, in./in.	Specific Gravity	Material Cost, \$/lb.	F.O.B. \$/in. ³	Shelf Life, Room Temp.
30% Plastibest 20	12,217	1.25	0.0035	1.83	0.1631	0.0110	> 1 week
30% 4K28	9,077	0.93	0.0045	1.84	0.1421	0.00945	< 1 week
30% 5R	9,498	0.64	0.0050	1.85	0.1301	0.00870	< 1 week
30% 7R06	7,790	0.28	0.0045	1.85	0.1187	0.00792	2 days
20% Plastibest 20	10,306	1.17	0.0035	1.83	0.1482	0.0098	
20% 4K28	9,651	1.00	0.0055	1.85	0.1342	0.00896	
20% 5R	8,795	0.36	0.0050	1.85	0.1262	0.00844	
20% 7R06	7,850	0.28	0.0070	1.85	0.1186	0.00791	
15% Plastibest 20 +10% 1/4-in. Glass	11,780	3.20	0.0030	1.84	0.1690	0.01121	
15% 4K28 +10% 1/4-in. Glass	14,167	2.31		1.85	0.1590	0.01061	
15% 5R +10% 1/4-in. Glass	12,890	2.95		1.85	0.1525	0.01019	
15% 7R06 +10% 1/4-in. Glass	14,827	2.74	0.0055	1.85	0.1470	0.00983	

Effect of increasing fiber length increased increased decreased unchanged increased increased usually increased

TYPICAL LOW-COST FORMULATION (for automotive heater housings)

Material	Percent by Weight
General Purpose Polyester Resin	32
Catalyst	0.64
Plastibest 20	10
Black Pigment	0.5
Zinc Stearate	1
Ground Limestone	16.5
Clay	39.36

Flexural Strength	8831 psi
Flexural Modulus	1.1 x 10 ⁶ psi
Impact Strength, Izod	1.95 ft. lb./in. unnotched
Specific Gravity	1.82
Material Cost, \$/lb., F.O.B.	0.1237
Material Cost, \$/in. ³ , F.O.B.	0.00813

Flow	most excellent
H ₂ O Absorption, 24 hr.	0.28 per cent, max.
Shelf Life, Room Temperature	2 weeks, min.

EFFECTS OF VARIATION OF RESIN CONTENT

Resin: General Purpose Polyester

Filler: Calcium Carbonate

Resin Content %	Total Fiber Content %	Plasti- best 20- Glass Ratio	Glass Length inches	Izod Impact Strength ft-lb/in. notch	Flexural Strength psi	Flexural Modulus psi x 10 ⁶	Shrinkage in./in.	Water Absorption 24 hr. %	Specific Gravity	Material Cost, F.O.B.	
										\$/lb	\$/in. ³
25	30	1:2	1/4	4.52	12,164	1.30	0.0030	0.43	1.92	0.1835	0.01271
25	30	1:2	2	4.56	13,700	1.27			1.93	0.1835	0.01279
25	30	2:1	1/4	2.09	12,509	1.39	0.0025	0.31	1.92	0.1655	0.01147
25	30	2:1	2	3.55	11,193	1.36			1.93	0.1655	0.01153
25	20	1:3	1/4	4.29	14,194	1.28	0.0030	0.30	1.89	0.1596	0.01089
25	20	1:3	2	6.17	13,197	1.18			1.89	0.1596	0.01089
25	20	3:1	1/4	2.00	8,310	1.12	0.0025	0.30	1.88	0.1416	0.00961
25	20	3:1	2	1.54	9,836	1.17			1.88	0.1416	0.00961
30	30	1:2	1/4	5.04	13,655				1.87	0.1991	0.01344
30	30	1:2	2	7.73	14,276				1.86	0.1991	0.01337
30	30	2:1	1/4	2.10	12,517				1.86	0.1811	0.01216
30	30	2:1	2	3.65	10,152				1.84	0.1811	0.01203
30	20	1:3	1/4	5.55	14,830				1.86	0.1752	0.01176
30	20	1:3	2	6.95	19,385				1.82	0.1752	0.01161
30	20	3:1	1/4	1.97	11,131				1.87	0.1572	0.01061
30	20	3:1	2	1.73	10,977				1.85	0.1572	0.01050
35	30	1:2	1/4	4.90	16,285	1.27	0.0035	0.30	1.75	0.2147	0.01356
35	30	1:2	2	7.61	15,155	1.04			1.70	0.2147	0.01318
35	30	2:1	1/4	2.53	14,514	1.09			1.74	0.1967	0.01236
35	30	2:1	2	3.69	14,370	0.98			1.71	0.1967	0.01214
35	20	1:3	1/4	4.43	13,342	1.00	0.0030	0.32	1.75	0.1908	0.01205
35	20	1:3	2	6.55	13,600	0.95			1.71	0.1908	0.01178
35	20	3:1	1/4	2.14	10,320	1.01			1.75	0.1728	0.01092
35	20	3:1	2	2.12	9,360	0.89			1.70	0.1728	0.01060

PROPERTIES OF PLASTIBEST 20-SISAL NO. 70 PREMIXES

Resin Content: 30%, Constant Resin: General Purpose Polyester Filler: Calcium Carbonate

Total Fiber Content %	Plastibest 20- Sisal No. 70 Ratio	Flexural Strength psi	Izod Impact Strength ft-lb/in. notch	Flexural Modulus psi x 10 ⁶	Water Absorption 24 hr. %	Shrinkage in./in.	Specific Gravity	Material Cost, F.O.B.	
								\$/lb	\$/in. ³
30	0:1	6,233	3.16	0.611	9.64	0.0045	1.50	0.1646	0.00891
30	1:5	7,087	3.19		5.75	0.0035	1.55	0.1644	0.00920
30	1:2	8,910	2.23		2.94	0.0043	1.58	0.1641	0.00936
30	1:1	9,543	2.31	0.876	2.42	0.0045	1.59	0.1639	0.00944
30	2:1	10,780	2.20		1.46	0.0047	1.69	0.1636	0.00998
30	5:1	11,210	1.70	0.996	1.24	0.0040	1.75	0.1634	0.01032
30	1:0	12,217	1.25	1.092	0.57	0.0035	1.83	0.1631	0.01101
20	0:1	5,320	3.20	0.785	2.43	0.0060	1.57	0.1492	0.00846
20	1:3	8,720	2.43		2.03	0.0059	1.64	0.1490	0.00882
20	1:1	8,569	1.84	0.908	1.23	0.0055	1.69	0.1487	0.00907
20	3:1	9,763	1.45		0.73	0.0057	1.75	0.1485	0.00938
20	1:0	10,306	1.17	1.068	0.43	0.0055	1.83	0.1482	0.00979
10	0:1	6,257	2.25	0.945	2.09	0.0041	1.68	0.1338	0.00811
10	1:1	6,290	1.01	0.944	0.38	0.0045	1.76	0.1336	0.00849
10	1:0	8,659	0.63	1.061	0.32	0.0050	1.83	0.1333	0.00881

Addition of Plastibest No. 20 to Sisal No. 70:

Flex—increase

Impact—decrease

Flexural Modulus—increase

Water Absorption—decrease considerably

Shrinkage—slight decrease

Specific Gravity—increase

Flash—removal improved substantially