Foseco Inc. U.S.A.

VEM/DJB/
PMO.

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Asbestos-free Insulators - Foseco Inc., U.S.A.

Situation at 1/2/1973.

1) Profax 31.

No further development work was carried out since the last situation report.

Further investigation of the Alumino Silicate long fibre system gave disappointing results in Proflex (it was hoped to gain advantages with this system in Profax) since no compromise could be found between good flexibility and poor formability on the one hand (using no X1281) and good formability but loss of flexibility on the other (using X1281). Since Profax 31 (no Asbestos) types contain X1281, the Alumino Silicate is too effectively dispersed and no advantage can be gained here.

Further communications have been received from Hedman which again state that the Hedman fibre (HCF) is considered to be non health hazardous. Foseco Inc. have taken the decision to use this material if necessary. No further trials havebeen made with HCF at F.I.L.

A new material X3562, has been used with some success at Inc. in Profax and their latest recipe (XS 1494) has been evaluated on a lab scale and on the SAM. Full details are given in a seperate report. XS1494 has been tested successfully during plant trials at Inc. and the first field trials are now being carried out - results still awaited. XS 1494 has the advantage of low R.M. cost compared with earlier recipes (contains no X3198) but still requires the R.M. 117/R.M. X1281 suspension system, X3562 may also be useful in improving the green strength particularly with one piece tops because of its needle like structure.

2) Proflex Gaskets - No further work carried out.

3) Proflex Boards.

As mentioned above, the idea of using minimum pulped Alumino Silicate as a source of long fibres failed. Various other formulations based on different Alumino Silicate types and combinations with R.M.546 and X2782 were tried but with no success either (mainly owing to poor formability). A summary of the formulations tested is attached.

4-7=

The U.S.A. recipe XS 1500 was evaluated on a lab scale and on the SAM. There was indention in the board formed on the SAM. Full details are given in the separate report on the properties of X 3562. A steel pour test carried out on XS 1500 gave very poor results, i.e. severe penetration and slagging.

Summary and Conclusions.

Asbestos is a multifunctional raw material in insulator manufactured by the aqueous slurry/pressure forming process. In each of the product types in which it was attempted to replace asbestos, different aspects of the role of asbestos were of most importance.

1) Profax 31.

The major contribution of asbestos to this product is in slurry dispersion and suspension. It was found possible to match these properties by using flocculated bentonite.

The new raw material X3562 shows promise in this product particularly from the cost standpoint.

XS 1494 or a modification thereof should be a suitable asbestos free Profax 31.

2) Proflex Gaskets.

Asbestos contributes significantly to the compressibility of this product type.

Although no complete solution was arrived at the experience obtained during the visit to Foseco Inc. from 17/8 to 2/9/1972 suggested that a recipe of the 49G type should yield a solution. X3562 may also offer some advantages in this product if not used as the main filler.

3) Proflex Boards.

The fibre bulk effect of asbestos together with suspension/ filter aid properties, is of paramount importance for this application.

Despite intensive work using glass fibre, alumino silicate fibre, slag wool singly or in combination it was not possible to match the performance of asbestos.

Initially Foseco Inc. had hoped to use this material (X3562) in a high proportion (95%) as filler/fibre. This has not been substantiated by subsequent tests which have shown that X3562 does not improve formability and has poor refractoriness. (A formulation containing 20% Alumino Silicate and 75% X3562 showed even worse refractoriness). Therefore further development work is required here.

EXAMINATION OF R.M. X3562 EX FOSECO INC., U.S.A. IN PROFAX AND PROFLEX.

Introduction:

This material has been used recently at Foseco Inc. in Profax and Proflex (Asbestos free) recipes with some success as an aid to improving the forming characteristics of these products. Since it was thought that it could fulfil the dual functions of fibre and filler to some extent, the material appeared to be ideal as a means of simplifying the existing recipes, and its cheapness could bring about useful reductions in R.M. costs. The short investigation was carried out to test the properties of the two latest recipes received from U.S.A. (i.e. Proflex XS 1500 and Profax XS 1494) incorporating R.M. X3562.

1) Profax XS 1494.

a) Laboratory Scale Tests.

Small tiles of XS 1494 and Profax 31 were formed on the Profax hand machine and the properties of each product compared. The recipes and mixing procedures are given in Appendix 1.

(i) Experimental results.

	Profax 31	XS 1494
Solids content %	20	23
Suspension (% clear liquid after 24 hours standing - 500 ml cylinder)	12.0 (clear supernatant)	43.0 (clear supernatant)
Formability		
Fill time (secs.)	20	20
Dewatering time (secs.)	15	30
Tile thickness	1½" - 2"	1½" - 2"
Nature of top surface	Flat - no indents	Flat - no indents
Finished product Density (g/cm3)	0.81	0.85
Steel pour test	(See Appendix 2)	
Muffle furnace - Shrinkage test (1400°C)	shrinkage practically nil in all cases (all samples of equivalent hardness when hot).	

(ii) Conclusions.

XS 1494 appeared to be equivalent to Profax 31 in its main properties. In order to fully test the slurry forming properties, the above tests were repeated for XS 1494 on the SAM.

(b) SAM tests.

Large boards 1.5 metres x 37 cm were formed since these gave the most severe forming conditions. The properties of XS 1494 were compared with those of Profax 31 formed under similar conditions.

(i) Experimental results.

	Profax 31	XS 1494
Solids content %	18.9	30.0
Machine characteristics - Pressure (line)	40 p.s.i.	
Pump (form) time (secs.)	12.5	15
Dewater time (secs.)	25	45
Tile thickness (inches)	0.9	1.0
Formability	Very smooth top surface - very even fill - no cavitation	Reasonably smooth top surface - even fill - slight cavitation.
Green strength	Good	Adequate for board

Conclusions.

Formability of XS 1494 was almost as good as Profax 31, and most of the other properties were equivalent, with the exception of the dewatering time which was longer. XS 1494 therefore appears to be a satisfactory replacement for Profax 31.

2) Proflex XS 1500.

a) Laboratory scale and SAM tests.

XS 1500 was compared with Proflex G3 using the Hand machine and the SAM as for Profax.

Recipes and mixing procedures are given in Appendix 31.

(i) Experimental results.

	Hand machine		SAH	
	G3	XS 1500	G3	XS 1500
Solids content %	5.9	5.0	4.9	5.0
Formability				
Fill (pump) time (secs.)	-	20	20	20
Dewatering time (secs.)	-	6	15	10
Tile thickness	-	20 mm	20-25 mm	ca. 25 mm
Formability	Excellent flat surface - no indents.	Slight indentations	Flat surface - no indents.	Board indented.
Finished product density (g/cm3)	-	0.43	-	0.46
Flexibility/Compressibility	Good	Excellent Compressibility Slightly flexible	Good	Flexible and compressible but poor strength
Steel pour test				
Hot strip (1 hour)	Board residue fairly easily removed - clean surface	Back face glowing red before strip - apparent severe penetration	-	-
Cold strip	Fairly rough surface with slight burn on	Very severe slagging and penetration.		
Muffle Furnace Shrinkage Test (1400°C)	-	Sample intact Poorer hot strength than G3. Area shrinkage 10.9%	Sample remained intact - good hot strength. Area shrinkage 30.7%	

(ii) Conclusions.

XS 1500 is an inferior product to Proflex G3 and would be unsatisfactory both for boards and gaskets since the refractoriness is low. Apart from this the SAH tests showed that formability was unsatisfactory and the dry strength of the cured product was poor.

b) Further examination of X3562.

Further tests were carried out using X3562 in previous Fibrex recipes which had shown some promise, and in modifications of XS 1500 to try to overcome its disadvantages.

a) Recipe PB 134.

This was a board recipe which had previously given satisfactory formability using R.M. 131A as filler but the cured boards were too friable. R.M. X3562 was used as a direct substitute for R.M. 131A.

Recipe: (see Appendix 4).

Experimental results: (Hand machine).

Slurry dispersion - good.
Formability - good (flat surface).
Cured tile - good compressibility but no flexibility.

b) Recipes PB 135 and PB 136.

The resin content of PB 134 was reduced in order to improve flexibility (PB 135 contained 0.5% 468B, and PB 136 1.0% 468B). There was no improvement in flexibility which indicated that it was the X3562 rather than the R.M. 468B which was primarily responsible for the low flexibility. (Microscopic examination of the material showed that it consisted of needle like crystals which it is thought probably interlock to form a rigid structure). It was also observed during this test that the excessive foam produced caused segregation of fibres and filler. (For recipes see Appendix 4).

c) Recipes PB 137, 138 and 139. (Appendix 4).

Recipe PB 137 was made to confirm the apparent "inflexible" properties of R.M. X3562. The board was not flexible and strength was poor. The forming properties were also unsatisfactory (a flat but indented surface was obtained). The compressibility was also low. This test indicated therefore several deficiencies of X3562.

Recipe 138 and 139 were made to try to increase the flexibility of the previous series (PB 134-136) by using an intermediate X2782 content between that used in XS 1500 and in PB 134-136. The results were again disappointing - no improving in flexibility being achieved.

d) Recipe PB 140 and 141. (Appendix 4).

Because of the poor refractoriness of XS 1500 these formulations were tested to try to improve this. The formability of both mixes was not satisfactory - the boards being indented. Flexibility was also poor, but refractoriness as assessed by the Muffle Furnace shrinkage test at [illegible] was [illegible] than XS 1500.

APPENDIX 3A.

Recipes - Profax 31 and XS 1494.

(Hand machine tests).

	Profax 31	XS 1494
R.M. 131C • (131D)	75.92	61.9
447	1.37	1.0
468B • (177A)	4.33	3.0
265A	2.89	-
319	1.06	-
452 • (546)	10.63	-
122A • (X1790)	3.80	2.5
X2782	-	0.5
117	-	1.0
X1281	-	0.1
X3562	-	30.0

• Since the original U.S.A. R.M's were not available, the nearest U.K. equivalents were used.

Mixing procedure (Mastermix pulper).

Profax 31: Solids weight = 3 Kg.
Water addition = 12 Kg.
% Solids = 20.0

1)	Pulped R.M. 452 with 6 litres water	1 min.
2)	Pulped R.M. 319 + 265A + 4 litres water	½ min.
3)	Pulped rest of R.M's (except 122A)	½ min.
4)	Pulped R.M. 122A + 2 litres water	15 secs.

XS 1494: Solids weight = 3 Kg.
Water addition = 10 Kg.
% Solids = 23.0

1)	Pulped all R.M's except 117, X1281 and 122A with 10 litres water	½ min.
2)	Sprinkled in R.M. 117 while pulping	½ min.
3)	+ X1281	20 secs.
4)	+ 122A	10 secs.

APPENDIX 1.

Trials - Profax 31 and XS 1494.

(Mill tests).

	Profax 31	XS 1494
R.M. 131D	-	61.9
447	0.68	1.0
465B * (177A)	4.36	3.0
122A * (X1790)	-	2.5
X2702	-	0.5
X3562	-	30.0
117	-	1.0
X1281	-	0.1
131C * (131D)	76.46	-
265A	2.91	-
319	1.07	-
546	10.70	-
X1790	3.82	-

* U.K. equivalent R.M's.

Mixing procedure (90 gall. hydropulper).

Profax 31: Solids weight = 40 Kg.
Water addition = 172 Kg.
% Solids = 18.9

1) Pulped R.M. 447, 465B, 131C with 8½ litres water for 2 mins.
2) Added R.M. 265A, 319, 546, plus 60½ litres water - pulped 2 mins.
3) Added R.M. X1790 plus 30½ litres water - pulped 1-2 mins.

XS 1494: Solids weight = 50 Kg.
Water addition = 117 Kg.
% Solids = 30%

1) Pulped all R.M's except 117, X1281, 122A with 110 litres water for ½ min.
2) Sprinkled in R.M. 117 during ½ min. while pulping.
3) Added X1281 plus 17 litres water - pulped 15 secs.
4) Added R.M. 122A - pulped 15 secs.

APPENDIX ...

Profax 31 and XS 1494.

Steel Pour Test.

One tile (10" x 9" x 1") of each material was used to line two sides of a steel box into which molten steel at ca. 1600°C was teemed. After one hour, the box was removed and the tiles stripped from the casting. The surface characteristics of the metal were examined when the casting had cooled.

	Profax 31.	XS 1494
Hot Strip (after 1 hour)	Tile residue fairly easily removed - clean surface.	Tile more difficult to remove - considerable burn on.
Cold Strip	Fairly smooth surface. Slight burn on.	Smooth surface, no burn on. Tile residue next to metal surface sintered. Easily removed.

The performance of XS 1494 was considered to be equivalent to that of Profax 31.

APPENDIX "A".

Recipes - Proflex G3 and XS 1500.

(Hand machine tests).

	Proflex G3	XS 1500
X2782	6.0	4.0
X3562	-	94.6
468B	2.0	0.8
447	-	0.5
X1281	0.5	0.1
131D	51.0	-
265A	15.0	-
X2286	25.5	-

Mixing procedure (Mastermix pulper).

Proflex G3: Solids weight = 1 Kg.
Water addition = 15 Kg.
% Solids = 5.9%

1) Pulped X2782 + X1281 for 1 min. (with 7½ litres water).
2) Added R.M. 265A + 2½ litres water - pulp 1 min.
3) Added rest of R.M's plus 3 litres water, - pulp 1 min.
4) Added 3 litres water - pulped ½ min.

XS 1500: Solids weight = 800 gmm.
Water addition = 15 litres.
% Solids = 5.0%

1) Pulped X2782 + X1281 + 10 litres water - pulp 1 min.
2) Added X3562, 468B, 447 - pulp ½ min.
3) Added 5 litres water - pulped 15 secs.

APPENDIX 7B.

Recipes - Proflex G3 and XS 1500.

(RAM tests).

	Proflex G3	XS 1500
X2782	6.0	4.0
X3562	-	94.6
460B	2.0	0.8
447	-	0.5
X1281	0.5	0.1
131D	51.0	
265A	15.0	
X2286	25.5	

Mixing procedure (Hastermix pulper).

Proflex G3: Solids weight ~ 20 Kg.
Water addition = 385 litres.
% Solids = 4.9

1) Pulped X2782 + X1281 + 121 litres for 2 mins.
2) Added 265A + 60 litres water - pulped 1 min.
3) Added rest of R.M's and 60 litres water - pulped 2 mins.
4) Added rest of water - pulped ½ min.

XS 1500: Solids weight = 10 Kg.
Water addition = 190 litres.
% Solids = 5.0

1) Pulped X1281 + X2782 + 110 litres water for 2 mins.
2) Added rest of R.M's and water - pulped 1 min.

APPENDIX 1.

	PB 134	135	136	137	138	139
X3562	85.7	87.2	86.7	99.0	93.6	93.6
468B	2.0	0.5	1.0	1.0	0.8	0.8
X2782	12.0	12.0	12.0	-	6.0	6.0
447	-	-	-	-	0.5	0.5
X1281	0.3	0.3	0.3	-	0.1	0.1

Mixing procedure: (Mastermix pulper).

P 134, 135, 136, 138, 139.

1) Pulped X1281 + X2782 + 10 litres water - 1 min.
2) Added other R.M's - pulped 1 min.
3) Added 5 litres water - d ½ min.

P 137.

1) Pulped X3562 + 468B + 10 litres water - 1 min.
2) Added 5 litres water - pulped ½ min.

	PB 140	141
X3198	12.0	20.0
X3562	86.0	72.6
X2782	-	6.0
468B	2.0	0.8
447	-	0.5
X1281	-	0.1

Mixing procedure: (Mastermix pulper).

PB 140
1) Pulped X3198 + 10 litres water - 10 secs.
2) Added other R.M's - 30 secs.

PB 141
1) Pulped X3198 + 10 litres water - 10 secs.
2) Added X2782 + X1281 - 30 secs.
3) Added other R.M's - 30 secs.

APPENDIX 3.

134	135	136	137	138	139
85.7	87.2	86.7	99.0	93.6	90.6
2.0	0.5	1.0	1.0	0.8	0.8
12.0	12.0	12.0	-	6.0	8.0
-	-	-	-	0.5	0.5
0.3	0.3	0.3	-	0.1	0.1

ng procedure: (Mastermix pulper).

136, 138, 139.

Pulped X1281 + X2782 + 10 litres water - 1 min.
Added other R.M's - pulped ½ min.
Added 5 litres water - pulped ½ min.

Pulped X3562 + 468B + 10 litres water - 1 min.
Added 5 litres water - pulped ½ min.

	PB 140	141
X3198	12.0	20.0
X3562	86.0	72.6
X2782	-	6.0
468B	2.0	0.8
447	-	0.5
X1281	-	0.1

Mixing procedure: (Mastermix pulper).

PB 140 1) Pulped X3198 + 10 litres water - 10 secs.
2) Added other R.M's - 30 secs.

PB 141 1) Pulped X3198 + 10 litres water - 10 secs.
2) Added X2782 + X1281 - 30 secs.
3) Added other R.M's - 30 secs.

APPENDIX 1.

134	135	136	137	138	139
85.7	87.2	86.7	99.0	93.6	90.6
2.0	0.5	1.0	1.0	0.8	0.8
12.0	12.0	12.0	-	6.0	8.0
-	-	-	-	0.5	0.5
0.3	0.3	0.3	-	0.1	0.1

g procedure: (Mastermix pulper).

36, 138, 139.

ped X1281 + X2782 + 10 litres water - 1 min.
ed other R.M's - pulped ½ min.
ded 5 litres water - pulped ½ min.

Pulped X3562 + 468B + 10 litres water - 1 min.
Added 5 litres water - pulped ½ min.

	PB 140	141
X3198	12.0	20.0
X3562	86.0	72.6
X2782	-	6.0
468B	2.0	0.8
447	-	0.5
X1281	-	0.1

Mixing procedure: (Mastermix pulper).

PB 140 1) Pulped X3198 + 10 litres water - 10 secs.
2) Added other R.M's - 30 secs.

PB 141 1) Pulped X3198 + 10 litres water - 10 secs.
2) Added X2782 + X1281 - 30 secs.
3) Added other R.M's - 30 secs.

APPENDIX 1.

	135	136	137	138	139
	87.2	86.7	99.0	92.6	90.6
	0.5	1.0	1.0	0.8	0.8
	12.0	12.0	-	6.0	8.0
	-	-	-	0.5	0.5
	0.3	0.3	-	0.1	0.1

e: (Mastermix pulper).

39.

- X2782 + 10 litres water - 1 min.
.M's - pulped ½ min.
s water - pulped ½ min.

2 + 460B + 10 litres water - 1 min.
.res water - pulped ½ min.

PB	140	141
	12.0	20.0
	86.0	72.6
	-	6.0
	2.0	0.8
	-	0.5
	-	0.1

procedure: (Mastermix pulper).

Pulped X3198 + 10 litres water - 10 secs.
Added other R.M's - 30 secs.

Pulped X3198 + 10 litres water - 10 secs.
Added X2782 + X1281 - 30 secs.
Added other R.M's - 30 secs.

APPENDIX 5.

Muffle Furnace Shrinkage Test at 1400°C.

XS 1500 and Proflex G2 - Samples remained intact after 1 hour although XS 1500 was more easily broken down.

% shrinkage (area) - G3 30.7%
XS 1500 10.9%

Recipe 137 - Melted in contact with the silicon carbide plate but to a lesser extent than the fibre alone.

Recipe 141 - completely melted.

X3502 - partial melting in contact with silicon carbide plate.