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322: Tape Joint Compds

BUSINESS CONFIDENTIAL PROJECT REPORT

COMPARATIVE EVALUATION OF VARIOUS LATEXES IN AN ASBESTOS-FREE TAPE JOINT CEMENT MIX

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SUMMARY Evaluation results in asbestos-free tape joint cements indicate that polyvinyl acetate homopolymer emulsions stabilized by lower cost water-soluble resins represent the best short-term solution to maintaining Union Carbide's dominant TJC latex binder position. These emulsions provide performance properties equivalent to and often superior to UCAR® Latex 131 at a substantial savings in raw material costs. In addition, they can be made in existing production facilities.

Our long-term dominant latex position should be ensured by improved TJC latexes prepared from lower cost monomers.

INTRODUCTION The wide usage of gypsum wallboard in the building industry necessitates a large amount of material to cover and provide a smooth surface over the wallboard joints and nailhead indentations. Tape joint cements (TJC) are low-cost compositions formulated to fill this need and to meet other necessary economic and performance properties required by modern building methods. Tape joint cements are supplied as a ready-mix or as a dry powder which is mixed with water at the construction site. The convenient ready-mix joint cements eliminate many of the problems encountered when water is stirred into dry mixes. As a result, ready-mix usage has grown rapidly at the expense of dry-mix compositions.

Ready-mix joint cements are highly filled compositions generally consisting of blends of a calcium carbonate filler, a clay filler, a platy filler such as mica, a polyvinyl acetate latex binder, a water-soluble cellulosic thickener, and various minor ingredients such as preservatives, freeze-thaw agents, and dispersing aids. Fibrous asbestos fillers widely used in the past have been removed from most

commercial joint cements. The fillers contribute over 90 percent by weight of the solids in the formulation with calcium carbonate forming the largest part of the filler mix. Latex solids contribute approximately 3.5 to 6.0 percent by weight of the solids. Cellulosic thickeners are vital to TJC performance properties, but contribute only approximately one-half percent by weight of the solids. Water content, which depends on the choice of fillers and the necessary application viscosity, varies from 30 to 40 percent by weight of the finished ready-mix.(1)

The tape joint cement market is highly competitive and extremely cost conscious. The major raw material costs in ready-mix TJC are the latex binders, the cellulosic thickeners, and the various other additives.(2) As a result, raw material suppliers, especially latex and thickener suppliers, are under competitive pressure to reduce costs of these materials. Furthermore, removal of asbestos from TJC compositions has placed more demands on the latex binders and cellulosic thickeners. This has resulted in pressure to improve joint cement performance properties of these materials, while at the same time reducing their cost.

Union Carbide currently supplies polyvinyl acetate latex binder and cellulosic thickeners to TJC manufacturers. Several CELLOSIZE® thickeners are presently sold in the tape joint cement market with CELLOSIZE TJC-500 especially designed for this area. However, competitive cellulosic thickeners currently enjoy the larger market share. It would appear to be worthwhile to seek ways to improve the performance properties of CELLOSIZE thickeners in asbestos-free joint cements.

UCAR Latex 131 currently dominates the binder business in the ready-mix market. However, this position is threatened by competitive binders. Competitive threats include lower cost polyvinyl acetate latexes, ethylene-vinyl acetate copolymer latexes, and styrene-butadiene copolymer latexes.(3) Especially threatening is the competitive pressure felt from the cost/performance properties of the ethylene-vinyl acetate copolymer latexes. Therefore, if we are to continue this dominant latex position, we must find ways to lower the cost and improve the performance of our latexes in asbestos-free TJC compositions. The work described herein was carried out to seek ways to improve the cost/performance properties of UCAR latexes in asbestos-free tape joint cements.

RESULTS AND DISCUSSION Removal of asbestos from TJC compositions has resulted in several problems for joint cement manufacturers. The most notable ones are reduced low- and room-temperature adhesion and poor

crack resistance. These problems are present at some of our major accounts; and as a result, they have been evaluating a variety of different raw materials. To ensure that we maintain a dominant latex position, we have increased our laboratory efforts seeking acceptable ways of decreasing our raw material costs and/or enhancing critical performance properties.

U.S. Gypsum, a major latex account, has been evaluating several different UCAR and competitive latexes in their TJC compositions. Recently they agreed to a joint evaluation program with us and have supplied us with 150 pounds of their commercial asbestos-free filler mix for our latex evaluations.

Since U.S. Gypsum had been evaluating several UCAR latexes and had found initially promising results with UCAR Latex 828 and UCAR Latex 365, we decided to look at other presently available UCAR latexes. We also included several competitive and experimental latexes in the evaluations. The initial work included latexes of varying particle sizes and minimum film-forming temperatures. This was done to determine if TJC adhesion could be correlated with latex particle size and/or minimum film-forming temperature. Unfortunately, no such correlation could be clearly established.

The latexes were evaluated in TJC formulations consisting of 1000g of U.S. Gypsum filler mix, 3.6 percent by weight latex solids on filler solids, and enough water to provide a viscosity range of 540-570 Brabender units. An example formulation is shown in Table I. Table II lists the evaluated latexes and shows the TJC physical properties. The formulations were evaluated for workability, room temperature adhesion, cold room adhesion recovery, and crack resistance (Table III).(1)

Examination of the evaluation data shows that tape joint cements 2, 4, 7, 8, 16, 19, and 20 perform better than the control sample. The results show that all the TJC formulations have approximately the same cracking properties. This is expected since cracking is controlled by the fillers rather than by the latex binder.

Tape joint cements 19 and 20 were prepared with the Experimental Textile Latexes 6-NAS-10 and 5-NAS-10, respectively. Although they show better adhesion properties than the control, their adhesion is less than that of the joint cement prepared from UCAR Latex 131. This, along with their higher raw material costs, precludes any further consideration for TJC usage.

UCAR Latex 828 used to prepare formulation 16 gave the best room temperature adhesion although workability was slightly inferior. This latex is presently being sold to U.S. Gypsum as UCAR Latex 128. U.S. Gypsum laboratory formulations prepared with UCAR Latex 128 showed outstanding adhesion and suitable workability properties. However, plant production batches yielded formulations with poor workability. In addition, selling this latex into the tape joint cement business creates an unfavorable economic position for Union Carbide. These problems will probably eliminate UCAR Latex 128 as a long term tape joint cement binder.

The remaining formulations showing better performance than the control were prepared with polyvinyl acetate latex binders. Tape joint cements 7 and 8 were prepared from experimental polyvinyl acetate latexes 3-RLZ-8 and 3-RLZ-3, respectively. Experimental latex 3-RLZ-3 is a polyvinyl acetate homopolymer stabilized with a water-soluble acrylic acid-vinyl acetate copolymer; 3-RLZ-8 is a similar latex stabilized with an acrylic acid-butyl acrylate-vinyl acetate terpolymer. These latexes represent promising TJC binder candidates since their performance properties are equivalent to and in some instances superior to UCAR Latex 131 performance properties. Evaluations of these latexes in other tape joint formulations have shown similar results.

In addition, these latexes provide two attractive advantages:

- They can be made at significantly lower raw material cost than UCAR Latex 131.
- They can be made in existing plant facilities.

Initial cost calculations indicate a net savings of approximately 2.5 cents per latex pound.

CONCLUSIONS AND RECOMMENDATIONS At the present low binder level used in tape joint cements, the overall performance properties do not undergo major changes when only the latex is changed. Considering this, it is felt that a lower cost latex binder that retains or improves the performance characteristics of UCAR Latex 131 represents the best economic advantage for Union Carbide. Accordingly, two recommendations are as follows:

- Our dominant TJC latex position should be maintained for the short term by offering lower cost polyvinyl acetate binders.

- Our long term dominant position should be ensured by continued investigation into ways to produce lower cost TJC binders with improved performance.

The first recommendation can be met by identifying, customer sampling, and marketing the best latex similar to the previously described 3-RLZ-3 and 3-RLZ-8 latexes. Laboratory work now in progress should establish the best possible candidate for customer sampling.

Long-range laboratory investigations should explore the economics and performance properties of binders made by copolymerizing lower cost monomers, such as ethylene, with vinyl acetate. This appears desirable since much of our current competitive threats are from ethylene-vinyl acetate copolymers.

PATENTABLE FEATURES At the present, we are not aware of any potential patentable features.

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ATTACHMENTS: 3 Tables

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TABLE I

TJC FORMULATION EXAMPLE

Component	Grams
U.S. Gypsum Filler	1000.0
UCAR® Latex 131	60.0
Water	550.0
	1610.0

Specifications

T_g	64-66%
% Water	34-36%
Viscosity	540-570 Brabender Units

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TABLE II

LATEXES USED IN TJC FORMULATIONS

TJC Ref. No.	Latex	Amount Latex, grams	H_2O, grams	Additives
1	CONTROL, U.S. GYPSUM READY-MIX			
2	UCAR 131	60	550	-
3	TPX-6201	60	546	-
4	UCAR 131	60	553	2g Benzoflex 9-88
5	UCAR 131	83	534	-
6	3-RLZ-8	54	518	-
7	3-RLZ-8	69	531	15% DBP
8	3-RLZ-3	60	547	10% Paraplex WP-1
9	TPX-6151	66	572	-
10	TPX-6151	66	553	10% DBP
11	UCAR 365	66	515	-
12	UCAR 365	66	546	10% DBP
13	UCAR 366	66	525	-
14	UCAR 380	75	546	-
15	UCAR 508	68	530	-
16	UCAR 828	80	500	-
17	UCAR 879	80	484	-
18	6-NAS-4	69	535	-
19	6-NAS-10	73	523	-
20	5-NAS-10	68	547	-
21	5-NAS-40	74	506	-
22	5-NAS-70	74	544	-
23	8-JJ-10	109	437	-
24	8-JJ-10	109	464	10% DBP
25	Airflex 728	69	568	-
26	Rhoplex AC-73	77	524	-
27	Elvace	66	540	-

TABLE III

TJC PERFORMANCE PROPERTIES

TJC Ref. No.	Viscosity, B.U.	Workability	% Adhesion	% Adhesion	% Crack Resistance
1	580	9	12.5	0.3	51
2	550	7	38	1.7	51
3	560	7	7.5	1.0	50
4	560	8	22.5	3.0	50
5	570	10	22.5	2.0	51
6	550	7	2.0	0	48
7	570	6	17.5	15	49
8	570	8	28	38	51
9	545	6	0	0	51
10	570	7	0	0	-
11	570	7	1.0	-	-
12	560	8	1.0	-	-
13	560	7	17.5	6.7	50
14	550	9	7.5	1.7	50
15	550	9	10	0	49
16	550	6	65	2.7	50
17	570	8	0.5	0.3	50
18	535	8	6.5	4.3	50
19	560	9	25	0.7	50
20	550	7	25	27	50
21	560	10	3.5	0.3	50
22	560	9	1.0	0.7	50
23	550	6	0	-	-
24	555	5	0	-	-
25	540	7	1.5	2.0	50
26	555	9	0	0.7	50
27	550	8	1.0	-	54