United States
Environmental Protection
Agency

Water Engineering
Research Laboratory
Cincinnati OH 45268

Research and Development

EPA/600/S2-87/091 Jan. 1988

EPA

Project Summary

Evaluation of Encapsulants for Sprayed-On Asbestos-Containing Materials in Buildings

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About 150 water-based liquid coatings sprayable by conventional airless paint-spraying equipment were applied to 2-in.-thick *sprayed, mineral wool* test matrices mounted overhead. After curing, specimens of the encapsulated test matrix were tested for fire resistance, flame spreading index, smoke generation, and toxic gas release. Cohesive and adhesive strengths were measured as well as impact resistance. All of the criteria established for satisfactory performance were met by 11 coatings and 19 others met most of the criteria. Special circumstances explained in the report text caused two more to be rated ''acceptable'' and another two to be rated ''marginally acceptable.''

This Project Summary was developed by EPA's Water Engineering Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

There is an increasing awareness of the carcinogenic properties of asbestos fibers. One possible source of exposure of the general population to this contamination is from deteriorated, friable, sprayed-on, asbestos-containing materials. These materials were used in the construction industry until banned by the U.S. Environmental Protection Agency in 1978. Much of this asbestos-containing material is in a loosely bonded form. It was applied to ceilings and structural steel columns in public buildings for thermal insulation, fireproofing, acoustical insulation, and even as decorative finishes. It is presently found in such buildings as schools, apartments, night clubs, hotels, office complexes, and industrial plants.

The research program described herein was undertaken to:

1. determine what commercial products, if any, are available that could be used as encapsulants to either contain, prevent, or restrict the release of asbestos fibers from friable asbestos-containing materials;

2. determine methods of evaluating these commercial products for their efficiency as encapsulants;

3. determine the effectiveness of the methods used to evaluate a group of commercial products; and

4. evaluate fiber release during field trials.

Methods

Initially, 74 commercially available candidate encapsulants were identified using standard communication methods, such as telephone, contacts, direct mailings, and an insert in the February 10, 1978, issue of *Commerce Business Daily*. Later, in Phase II, an additional 84 commercial products were identified giving a total of 158 candidate encapsulants.

Desired Encapsulant Properties

The researchers developed the following list of properties an effective encapsulant should exhibit. The encapsulant should:

1. Seal or lock in the asbestos fibers by either bridging over the surface or penetrating into the matrix (asbestos-containing materials),
2. Not add any toxic substance to the insulation and also not break down under direct flame impingement to release any toxic gases or an undue amount of smoke,
3. Not reduce significantly the fire-retardant properties of the insulation,
4. Be applied with a minimum of effort and technical skill,
5. Have sufficient impact resistance, flexibility, and resistance to penetration to withstand some moderate physical contact,
6. Be water insoluble when cured,
7. Be nontoxic and without noxious fumes during application, and
8. Have sufficient aging characteristics to withstand normal atmospheric changes for a minimum of 6 years and still have sufficient surface integrity to allow recoating.

Encapsulant Classifications

Each encapsulant was classified by type of resin used for the binder and whether or not the encapsulant was pigmented. Further screening consisted of determining the percent solids and viscosity of each encapsulant and its degree of penetration into the test matrix. The test matrix consisted of a dry-blended, non-asbestos-containing insulation (United States Mineral's Cafco Blaze Shield D C/F)* that was spray applied approximately 5.1-cm (2-in.) thick on a foam insulation board. This test matrix exhibited key properties such as high friability, poor cohesive strength, and high water absorption. These are similar to the properties of the spray-applied, asbestos-containing insulation that had been removed from an existing site for use as the control matrix.

From the results of the screening program, it was possible to divide the initial 74 encapsulants into 2 distinct groups. The first group (43 encapsulants) was classified as bridging encapsulants, and the second group (31 encapsulants) as penetrating encapsulants.

The bridging encapsulants were defined as those that formed a continuous surface membrane over the test matrix. These encapsulants also exhibit minimal penetration into the test matrix (0.6 cm [0.25 in.] maximum) even when reduced up to one-third with water. The bridging encapsulants, in general, were above 35% solids (maximum 50%) and had high viscosities (greater than 1,000 centipoise).

The penetrating encapsulants were defined as those that penetrated 0.5 to 3 cm (0.25 to 1.25 in.) into the test matrix and thus improved the cohesive strength of the friable matrix to the depth of penetration. The adhesion of the matrix to the underlying substrate can also be improved when the encapsulant penetrates all the way through the asbestos-containing material to the substrate. In general, the penetrating type encapsulants were low in solids (minimum 15% to 35%), nonpigmented, and had low viscosities (water thin).

After initial screening evaluation, division of the encapsulants into 2 groups (bridging and penetrating), and classification by resin binder, the following 10 encapsulants were selected for more extensive evaluation in Phase I (Table 1).

This selection was based on the following factors:

1. Inclusion of as many types of resin binders as possible,
2. Inclusion of both encapsul· groups, i.e., bridging and penetr. ing, and
3. Meeting the properties desired for an effective encapsulant.

The 10 encapsulants selected for an effective encapsulant evaluation included 3 bridging and 7 penetrating encapsulants.

The predominance of the penetrating encapsulants was because they appeared to exhibit more of the desired properties for an effective encapsulant, e.g., improving the cohesive strength of the matrix and improving the adhesion of the asbestos-containing materials to the substrate when complete penetration was achieved.

Extensive Evaluation

The 10 encapsulants selected for extensive evaluation and those encapsulants with similar resin binders included 64 of the 74 encapsulants received. The remaining 10 encapsulants included 7 other classes of resin binders. Although several of these encapsulants exhibited promise, no further work was done with them in Phase I of the study because the limit of 10 encapsulants for extens. evaluation and because the 10 encapsulants selected for this evaluation included a greater representation of the commercial encapsulants submitted as classified by type of resin binder. The selection of these encapsulants did not mean that the other encapsulants were considered unsatisfactory.

The extensive evaluation included determination of flexibility (bend), impact strength, and abrasion properties. In most cases, these physical properties were determined with the encapsulants applied by airless spray onto metal panels.

Table 1. Encapsulants Evaluated in Phase I

Class of Type of Binder	*Group*	*Battelle Code*
Vinyl acrylic	*Penetrating*	*33775-3B*
Butyl rubber	*Bridging*	*" -4A*
Epoxy, two-component	*Bridging*	*" -4B*
Acrylic	*Penetrating*	*" -12B*
Acrylic	*Bridging*	*" -13B*
Acrylic	*Penetrating*	*" -15B*
Polyester	*Penetrating*	*" -15C*
Polyvinyl acetate copolymer	*Penetrating*	*" -19A*
Acrylic vinyl acetate copolymer	*Penetrating*	*" -21A*
Polyester, acrylic-modified	*Penetrating*	*" -21I*

*Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

The encapsulants were also examined for smoke generation and toxic gas release. For these evaluations in Phase I, the encapsulant was applied to three substrates: (1) asbestos board, (2) non-asbestos friable test matrix, and (3) plywood. The criteria for evaluation were the performance levels given in the "National Bureau of Standards Technical Note 808." Both the smoke generation and toxic gas release data from the 10 encapsulants were below the value classified as "potential problems." Therefore, the encapsulants were considered satisfactory in these performance areas.

One main concern was whether the encapsulants, when applied by airless spray, would penetrate into an asbestos-containing matrix and thus improve the cohesive strength. In Phase II, to evaluate the degree of penetration and possible increase in cohesive strength, test panels were mounted on a rack in an overhead position to simulate a ceiling and then a measured amount of encapsulant was applied using airless spray equipment. After drying, the sealed test matrix was evaluated for adhesion to the substrate and cohesion using a modification of the inspection method recommended by the International Association of Wall and Ceiling Contractors. This inspection method gives an indication of the ability of spray-applied, fire-resistant materials to remain in place and resist separation during anticipated service conditions. The method measures the adhesive force required to either separate the material from the base substrate or overcome the cohesive force within the material.

Field Application of Selected Encapsulants

There were 4 encapsulants selected for field evaluation from the 10 that underwent the extensive evaluation in Phase I. The selection process for field application consisted of (1) attempts to achieve a good mix of bridging and penetrating encapsulants, (2) selection of representative products based on the evaluation, and (3) the availability of sufficient amounts of the encapsulants.

The four encapsulants selected for field evaluation were:

1. 13B, a bridging acrylic-based material;
2. 19A, a penetrating polyvinyl acetate copolymer-based material;
3. 21A, a penetrating acrylic-vinyl acetate copolymer; and
4. 21B, a penetrating acrylic-modified polyester.

These encapsulants were then evaluated for fire resistance using a modification of ASTM Method E-162. The encapsulants were applied to three substrates: (1) asbestos board, (2) the test matrix, and (3) plywood. The coated panels were evaluated using a modification of ASTM Test Method E-162. The asbestos board substrate was used as a control. The bridging encapsulant, 13B, had a Class C flame spread index when evaluated on the test matrix using the Department of Housing and Urban Development Minimum Property Standards. Class C materials have a limited application. The three penetrating encapsulants, 19A, 21A, and 21B, were rated as Class A on the same substrate. The field trials were conducted during two different time periods. However, both trials were conducted at the same location and on the same asbestos-containing substrate in different rooms.

Description of Field Substrate

The field trial matrix was a friable, asbestos-containing material (30%-35% chrysotile) applied approximately 5.1-cm (2-in.) thick over the underside of a precast cement floor and also on steel, support I-beams. The material, although highly friable (released visible fibers when brushed), was in good condition (no loose material hanging down).

First Field Trial

The bridging encapsulant, 13B, and penetrating encapsulant, 19A, were applied to the asbestos-containing material with an airless spray gun. The pump pressure was kept as low as possible to minimize asbestos fiber release, but sufficient to get a good, uniform, spray pattern. The pump pressure resulted in a nozzle pressure of 1,050 to 1,200 psi.

The bridging encapsulant, 13B, was applied in two coats. The first coat was applied as a mist coat with the encapsulant reduced approximately 10% with water. The second coat of encapsulant was applied without reduction approximately 4 hours after the first coat. The combination of the two coats formed a very tough elastic film about 0.3-cm (0.13-in.) thick over the surface of the asbestos. Penetration of the two coats including the mist coat was approximately 1-cm (0.38-in.) deep.

The penetrating encapsulant, 19A, was also applied in two coats. However, the first coat was actually applied as a "double coat." The encapsulant penetrated into the asbestos-coated material very quickly. Therefore, after coating approximately a 1.1-m^2 (12-ft^2) area, the same area was recoated immediately. The application of the second coat was made after allowing the first "double" coat to cure for a minimum of 12 hours. The second coat application was done in one pass. This method of application resulted in penetration by the encapsulant up to 1.9-cm (0.75-in.) into the 9.1-cm-thick (2-in.-thick), asbestos-containing material.

Second Field Trial

The second field trial application of two additional penetrating encapsulants was conducted following the same procedure used for the penetrating encapsulant in the first trial. Similar airless spray nozzles and pump pressures were used. Also, the first coat application was applied as a "double coat" and the second application as a single coat.

Penetrating encapsulant 21A penetrated approximately 0.6-cm (0.25-in.). Observations from a core sample indicated that the resin binder did not carry nor penetrate as deeply into the asbestos material as water in the encapsulant system. This resulted in an apparent resin-rich, top layer that sealed the surface, preventing the release of asbestos fibers. However, the surface did not exhibit the impact resistance desired.

Encapsulant 21B foamed during the airless spray application of the first coat. This problem was solved during the application of the second coat by reducing the encapsulant with water. The foaming apparently restricted the penetration of the encapsulant, because a core sample indicated that the maximum penetration achieved was 1 cm (0.38 in.). Although the foaming was overcome during the second coat application, no further penetration was achieved, possibly because the surface of the asbestos material was partially sealed by the first coat. Even though the encapsulant did not penetrate as desired, it did form a sealed surface over the asbestos material that could restrict asbestos fiber release.

Air Sampling and Analysis

Description of Test Area

The original ceiling with asbestos insulation had been concealed by a drop ceiling that was removed before application of the encapsulant. The test rooms were actually two large rooms at opposite ends of the building, divided into three rooms by flexible partitioning. Two of these three rooms at each site were used for encapsulant application rooms and the third room was a work/control room. Although the rooms were divided by the flexible partitioning up to the level of the drop ceiling, the area above the drop ceiling was continuous throughout the entire building. The test rooms were sealed and isolated from each other using polyethylene sheet both over and extending above the flexible partitioning. However, complete isolation was not achieved in the area extending throughout the building. This allowed some cross contamination of the two test rooms and the work/control room, as indicated by air sampling data, thus demonstrating the need for careful sealing of the isolated work area.

Air Sampling

A series of air samples was taken during the field evaluations. The samples were collected during the following periods:

1. Before any work was initiated,
2. During removal of drop ceiling,
3. Immediately after drop ceiling removal,
4. 3 to 5 hours after drop ceiling removal,
5. During application of first coat of encapsulant,
6. During cure of first coat,
7. During application of second coat,
8. During cure of second coat,
9. During clean up procedure,
10. 18 hours after clean up, and
11. 7 weeks after application of sealant.

Analysis of Air Samples

The analysis was performed using transmission electron microscopy (TEM) at 20,000X magnification. Also, selected area diffraction patterns were obtained to confirm identification of fibers as chrysotile asbestos. No fiber counts were made using the Occupational Safety and Health Administration (OSHA) method. The data were processed by a computer program designed to provide the following information:

1. 'Calculate mass of chrysotile per m^3 of air based on length and width measurement,
2. Calculate number of chrysotile fibers per m^3 of air,
3. Calculate the mean length versus length, width, and length/width aspect ratios of chrysotile.

The results of the air sampling analysis demonstrated the strong direct dependence of airborne asbestos fiber concentration on activity in the work room. Also shown was the increase in airborne fiber concentration during active periods. For example, in the room where encapsulant 13B was applied, the initial ambient level was 8.5×10^4 fibers/m^3 as measured using TEM. When the ceiling tile was removed, the level of fibers increased to 1.3×10^6 fibers/m^3 After a settling period the count decreased to 9.7×10^4 fibers/m^3. However, during airless spray application of the first coat, the count increased to 6.4×10^7 fibers/m^3. Between coats the level dropped to 4.3×10^6 fibers/m^3. Application of the second coat of encapsulant again increased the fiber count (6.8×10^6 fibers/m^3), but the level was much lower than during application of the first coat. This demonstrates that even one coat of sealant is effective in reducing the release of fibers during strong air currents and on slight impact. An increase in fiber count was also shown during clean-up procedures; however, after clean up the count was very near ambient levels. An air sample taken after 7 weeks showed the level of fibers to be at the initial mean outdoor level.

In all cases of encapsulant application in the field trials, peaks in airborne fiber concentrations were shown during periods of activity (ceiling removal, encapsulant application by airless spraying, and clean up). Without exception, the highest levels of airborne asbestos fiber were observed during the application of the first coat of encapsulant, as would be anticipated. This occurs because loose surface fibers are released by the spray disturbance of adjacent areas of the matrix.

The second phase of the resear program was undertaken to determi the effectiveness of the test methods by evaluating additional commercial products. These were restricted to waterborne systems because of the fiber-containment procedures recommended during application.

Methods Used to Evaluate Candidate Encapsulants

This study evaluated 100 commerically available candidate encapsulants. Each was applied by airless spray to a specially designed, 1.5-m^2 (16-ft^2) test matrix. Application rates, pump pressure, and spray nozzle size data were recorded. After the encapsulant cured for a minimum of 7 days, core samples were taken to determine the degree of penetration when a penetrating encapsulant was applied, or the thickness when a bridging encapsulant was spray applied.

The test matrix with the encapsulant applied and cured was then sectioned into a series of test blocks and evaluated for the following:

1. Impact resistance,
2. Smoke generation,
3. Toxic gas release,
4. Fire resistance, and
5. Surface rub test,

Each encapsulant evaluated was discussed separately. The 33 acceptable and marginal encapsulants are described in the full report and unacceptable encapsulants are described in Appendix D of the full report. Most of the unacceptable encapsulants failed in one or more of three modes:

1. Flame Spread Index greater than Class A limit,
2. Smoke generation greater than 50%, and
3. Poor adhesion to test matrix.

Results and Discussion

A total of 158 candidate encapsulants were evaluated. Phase I evaluated 74 encapsulants and many of them were more extensively tested in Phase II, where about 100 evaluations were performed. All materials evaluated w applicable by standard airless spr, equipment and were water base so that they could be applied in an unventilated work area without hazard to the workers.

The evaluation included tests for flexibility, abrasion resistance, penetration, cohesive strength, flame spreading properties, emissions of smoke and toxic gas in a fire, viscosity, percent solids, impact resistance, and a subjective judgment of ability to retain asbestos fibers based on dusting when rubbed with the hand.

Based on test results and criteria established for desired performance, 13 encapsulants met all criteria for satisfactory performance and 21 met most of the criteria and were judged to be "marginally satisfactory" by the principal investigator (see Table 2).

Conclusions and Recommendations

From the results of the screening study, the field trials, and the second-phase program, several conclusions were reached.

1. Encapsulants should not be employed when friable, asbestos-containing materials show evidence of poor cohesive strength and extensive damage such as material hanging loose.

2. The use of an encapsulant, either bridging or penetrating, should not be considered where there is extensive water damage to the asbestos-containing material.

3. When applied correctly, penetrating encapsulants, improve the cohesive strength of the asbestos-containing matrix, and if the encapsulant penetrates to the substrate it will improve the adhesion between the asbestos-containing matrix and the substrate.

4. Selection of appropriate application techniques, such as airless spray and multiple coats, is important to the achievement of uniform, impervious membranes and the desired depths of penetration.

5. Application of encapsulants to friable asbestos thicker than 3.2 cm (1.25 in.) is not recommended because the penetration of the water from the encapsulant into the thicker, friable material can increase the probability of delamination.

6. The air sampling data indicated that complete barrier systems to contain the released asbestos fibers within the work area were not obtained.

7. Worker activity increases the level of airborne asbestos in the work area during the work period.

8. Following periods of activity, the airborne concentrations return to background levels in approximately one-half day. Therefore, after work activities, several thorough wet cleanings followed by waiting periods are necessary before allowing occupancy of the work area.

9. Evaluation of asbestos settling (supported by analytical observations) indicates that the airborne asbestos is most likely predominantly present as clusters and not individual fibers.

10. The 1.4-m^2 (16-ft^2) test matrix is an adequate method for screening encapsulants in the laboratory. However, because of the wide variations of spray-applied, friable material experienced in the field, it is recommended that a test area be encapsulated and evaluated before complete encapsulant of the building is begun.

11. Screening test of an encapsulant performed on any material other than a friable matrix may not give reliable indication of the performance of the encapsulant when applied to a friable, asbestos-containing material.

The full report was submitted in fulfillment of Contract No. 68-03-2552 by Battelle Columbus Laboratories under the sponsorship of the U.S. Environmental Protection Agency.

Table 2. *Sealants Rated Satisfactory*

Battelle Code	*Company Designation*	*Company*	*Address and Phone*	*Rating*
33775-4A	*Decadex Firecheck*	*Pentagon Plastics U.S.A. Ltd.*	*905 North Railroad Ave. West Palm Beach, FL William F. Russek (305) 655-2111*	*A**
33775-12B	*Chemex Ultra*	*Chemex Chemical & Coating Co.*	*P.O. Box 5072 Tampa, FL 33675 Herbert F. Ross (813) 248-6104*	*M†*
33775-15C	*Water-based Polyester*	*Western Coating Co.*	*P.O. Box 598 Oak Ridge Station Royal Oak, MI 48073 Jack Sheets (313) 588-3311*	*M*

**Acceptable.*
†Marginally Acceptable.
‡Not recommended where impact is expected.
***Same Material.*

Table 2. Continued

Battelle Code	Company Designation	Company	Address and Phone	Rating
33775-19A	Cafco-Bond-Seal	United States Mineral Products Co.	Stanhope, NJ 07874 Frank Meuwirth (201) 347-2100	A
33775-21A	554-21-1 "Protector" 2 Part System	H. B. Fuller Co.	Foster Products Div. P.O. Box 6255 Springhouse, PA 19477 Gene Secor (212) 628-2600 or Toll Free (800) 523-6017	A
33775-21B	Water-based XD-DG	Western Coating Co.	P.O. Box 598 Oak Ridge Station Royal Oak, MI 48073 Jack Sheets (313) 588-3311	M
33775-27A	#207 Special Sealer	Makus Development Corporation	P.O. Box 31 Mercer Island, WA 98040 Dan S. Makus (206) 621-8594	M
33775-28A	Pyrokote-Mx	Development Services International	2021 K St., NW Suite 305 Washington, DC 20000 (202) 331-7373	M‡
33775-29C	29-C Aqualoid 15-10	Essex Chemical Corporation	125 Blackstone Ave. Jamestown, NY 14701 (716) 665-6313	M
33775-30B	Asbestop BW225 Two Component	McGeddy International, Inc.	1043 Broadway W. Longbranch, NJ 07764 (201) 229-5580	A
33775-42-A	Ocean Fire Retardant #666	Ocean Fire Retardant Co.	1072 Cyrville Road Ottawa, Ontario KIJ 7S5 Canada (613) 741-4248 FTS: 950-5111	A
33775-52-A	FRC-AES	FRC Composite Ltd.	1993 Leslie St. Don Mills, Ontario M3B2MC Canada (613) 741-4243	A‡
33775-52-B	FRC-REPC	FRC Composite Ltd.	(Same as above)	A
33775-42-B	Metro Shield	Bertelson Assoc., Inc.	8 Delwood Lane Tinton Falls, NJ 07724 (201) 542-6393	M
33775-41-C	C-1019	California Products Corp.	169 Waverly St. Cambridge, MA 02139	M
33775-43-A	1583	H. B. Fuller Co.	Foster Division P.O. Box 625 Springhouse, PA 19477 Toll Free (800) 523-6017	M
33775-45-A	95-CO-104	M. A. Bruder & Sons, Inc.	600 Reed Road P.O. Box 600 Broomall, PA 19008 (215) 353-5100	M
33775-45-C	95-W-100	M. A. Bruder & Sons, Inc.	(Same as above)	M
33775-47-A	L 241-43 Part A & B	Carboline Co.	350 Hanley Industrial Ct. St. Louis, MO 63144	M

*Acceptable.
†Marginally Acceptable.
‡Not recommended where impact is expected.
**Same Material.

Table 2. *Continued*

Battelle Code	Company Designation	Company	Address and Phone	Rating
33775-47-C	Super Chemseal	Chemray Coatings Corp.	150 Lincoln Blvd. Middlesex, NJ 08846	M
33775-48-A	Hygienscote	Acalor Chemical Construction	33 Kenhar Dr. Weston, Ontario M9L 1M9 Canada (416) 749-2265	M
33775-50-A	TCI-750	Therma-Coustics	P.O. Box 190 Colton, CA 92324 (714) 783-0462	M
33775-51-A	25-2355	National Starch & Chemical Corp.	1164 N. Great Southwest Parkway Grand Prairie, TX 75050 (214) 647-9222	M
33775-53-A	Thermatek	Protek Manufacturing	520 South Muskego Ave. Milwaukee, WI 53208 (414) 643-7689	M
33775-13B-3	EX 64-3 OX-LINE-ABC	Lehman Brothers Corp.	22 Halladay St. Jersey City, NJ 07304 Carmine Spatola (201) 434-1882	M
33775-31A	Ultra Lok 40-871	Cellin Manufacturing, Inc.	P.O. Box 688 Springfield, VA 22150 (703) 550-7277	A
33775-33C	Penqua 200	United Coatings	E. 1130 Sprague Ave. Spokane, WA 99202 (509) 535-4131	M
33775-34C**	Product # HI-6625-583-9	Habersham Industries, Inc.	5212 Industrial Ct. Smyrna, GA 30080 (404) 351-7173	A
33775-35A	350-A-1 Asbestight 2000	Arpin Engineering, Inc.	1716 Melvill St. Oakhurst, NJ 97755 (201) 280-0400	A
33775-35B	Cable Coating 2-B	American Coatings Corp.	5235 N. Elston Chicago, IL 60630 (312) 286-6610	A
33775-36B	Dust-set	Mateson Chemical Corp.	1025 Montgomery Ave. Philadelphia, PA 19125 (215) 423-3200	M
33775-37A**	662-583	Findley Adhesives, Inc.	P.O. Box 3000 Elm Grove, WI 53122 (414) 782-2250	M
33775-37C	Mono-Therm F-100	Mono-Therm Industries, Inc.	Mono-Therm International 645 E. 60th St. Los Angeles, CA 90001 Toll Free (800) 426-8080	A
33775-42C	SK-13 Emulsion 360-0017	National Cellulose Corp.	12315 Robin Blvd. Houston, TX 77045 Dan Kelly (713) 433-6701	A

*Acceptable.
†Marginally Acceptable.
‡Not recommended where impact is expected.
**Same Material.

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***William Cain** is the EPA Project Officer (see below).*
The complete report, entitled "Evaluation of Encapsulants for Sprayed-On Asbestos-Containing Materials in Buildings," (Order No. PB 88-113 329/AS; Cost: $19.95, subject to change) will be available only from:
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650
The EPA Project Officer can be contacted at:
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