PLAINTIFF'S EXHIBIT
Union Carbide 437

# TAPE JOINT CEMENTS

BY

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SOUTH CHARLESTON, WEST VIRGINIA 25303

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## TAPE JOINT CEMENTS

Wide usage of gypsum wallboard in the building industry necessitates a large amount of material to cover and provide a smooth surface over 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 eliminates many construction site problems caused by mixing water into dry mix formulations. 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 polyvinylacetate latex binder, a water-soluble cellulosic thickener, and various minor ingredients such as preservatives, freeze-thaw agents, and dispersing aids. 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 3.0 to 5.0 percent by weight of the solids. Cellulosic thickeners are vital to performance properties but contribute less than one-half percent by weight to the solids. Water content, which depends on the choice of fillers, thickener,

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and the necessary application viscosity, varies from 25 to 35 percent by weight of the finished ready-mix.

The tape joint cement market is highly competitive and extremely cost conscious. The major raw material costs in ready-mix are the latex binder, the cellulosic thickener, and the various additives. As a result, raw material suppliers are under competitive pressure to reduce costs of these materials.

Union Carbide currently supplies polyvinylacetate latex and cellulosic thickeners to TJC manufacturers. Several CELLOSIZE thickeners are suitable for use in TJC manufacture with CELLOSIZE TJC-500 especially designed for this area. UCAR 131 currently enjoys the position as the dominant latex binder in the ready-mix market. However, this position is constantly being threatened by new competitive binders.

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## TAPE JOINT CEMENT

### PROPERTY REQUIREMENTS

LOW COST

WORKABILITY

LOW SHRINKAGE

CRACK RESISTANCE

SUFFICIENT OPEN TIME

ADHESION UNDER A VARIETY OF CONDITIONS

SAG RESISTANCE

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## TJC FORMULATION

| INGREDIENTS | PARTS BY WEIGHT | RMC |
|---|---|---|
| WATER | 27.25 | 0.000 |
| ETHYLENE GLYCOL | .35 | .091 |
| "CELLOSIZE" QP-52M | .42 | .672 |
| AMMONIUM HYDROXIDE | .07 | .006 |
| "UCAR" 131 | 4.89 | 1.027 |
| DOWICIL 75 | .07 | .105 |
| DAXAD 30 | .56 | .196 |
| LIMESTONE | 60.80 | .638 |
| TALC | 3.49 | .061 |
| MICA | 2.10 | .099 |
| | 100.00 | 2.895 |

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## TAPE JOINT CEMENT INTERMEDIATES

TPX-6307

"UCAR" 134

"UCAR" 131

"UCAR" 130

"CELLOSIZE" TJC-500

"CELLOSIZE" QP-4400

"CELLOSIZE" QP-15,000

"CELLOSIZE" QP-52,000

"CELLOSIZE" QP-100,000

PROPYLENE GLYCOL

ETHYLENE GLYCOL

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## TAPE JOINT CEMENT

## COMPETITIVE BINDERS

| LATEX | % | COMPOSITION |
|---|---|---|
| AIRFLEX 527BP | 55 | ETHYLENE - VINYL ACETATE |
| AIRFLEX 526BP | 55 | ETHYLENE - VINYL ACETATE |
| AMSCO 4104 | 49.7 | STYRENE - BUTADIENE |
| ELVACE 1875 | 55 | ETHYLENE - VINYL ACETATE |
| PLYAMUL 40-375 | 58 | PLASTICIZED VA |
| PLYAMUL 40-376 | 60 | PLASTICIZED VA |

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## TAPE JOINT CEMENT

## COMPETITIVE THICKENERS

METHOCEL J75MS

METHOCEL 228

NATROSOL 250H

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## TYPICAL PROPERTIES OF TPX-6307 (a)

| | |
|---|---|
| Total Solids | 59.0% |
| pH | 5.5 |
| Viscosity (b) | 4000 cps |
| Minimum Filming Temperature | 1.5°C |
| Glass Transition ($T_g$) | 8°C |
| Weight Per Gallon of Latex | 9.2 lbs. |
| Reaction to Borax | Stable |
| Reaction to Heavy Metallic Ions | Coagulates |

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(a) Should not be regarded as specifications.

(b) 60 RPM, Brookfield.

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## TYPICAL PROPERTIES OF "UCAR" 134

| | |
|---|---|
| TOTAL SOLIDS | 59.8% |
| VISCOSITY | 490 CPS |
| pH | 5.0 |
| MINIMUM FILMING TEMPERATURE | 15.5°C |
| GLASS TRANSITION | 15°C |
| WEIGHT PER GALLON OF LATEX | 9.2 |
| REACTION TO BORAX | STABLE |
| REACTION TO HEAVY METAL IONS | STABLE |

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TJC FORMULATION 2-WDM-29

| Ingredients | Parts by Weight |
|---|---|
| Water | 455.0 |
| Ethylene Glycol | 15.0 |
| Ammonium Hydroxide | 2.0 |
| Dowicil 75 | 1.0 |
| Latex (a) | 89.5 |
| Daxad 30 | 10.0 |
| Limestone #9 White | 780.0 |
| Mica P-80-F | 175.0 |
| ASP-400 | 80.0 |
| Attagel 40 | 10.0 |

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(a) Latex weight adjusted to provide equal latex solids in each formulation.

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PERFORMANCE PROPERTIES IN TJC FORMULATION 2-WDM-29

| Latex | % S | Viscosity[a] | Workability[b] | R.T. Adhesion | Crack Resistance |
|---|---|---|---|---|---|
| TPC-6307 | 68.0 | 520 | 8 | 62% | 93% |
| UCAR 131 | 68.3 | 540 | 8 | 96% | 95% |
| UCAR 134 | 68.2 | 550 | 8 | 81% | 100% |
| 14-TRS-71[c] | 67.4 | 510 | 8 | 78% | 88% |

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(a) Brabender Units, 80 rpm.

(b) Rating Scale 1-10 with 10 an excellent rating.

(c) Laboratory run of TPX-6307.

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TJC FORMULATION 7-WDM-78

| Ingredients | Parts by Weight |
|---|---|
| Water | 370.0 |
| Ethylene Glycol | 5.0 |
| QP-52,000 | 6.0 |
| Ammonium Hydroxide | 1.0 |
| Dowicil 75 | 1.0 |
| Latex (a) | 70.0 |
| Daxad 30 | 8.0 |
| Limestone #9 White | 810.0 |
| Talc T-50 | 100.0 |
| ASP-400 | 40.0 |

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(a) Latex weight adjusted to give equal latex solids in each formulation.

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## PERFORMANCE PROPERTIES IN TJC FORMULATION 7-WDM-78

| Latex | % S | Viscosity | Workability | R.T. Adhesion | Crack Resistance |
|---|---|---|---|---|---|
| UCAR 131 | 70.8 | 540 | 9 | 97% | 74% |
| UCAR 134 | 70.8 | 540 | 9 | 90% | 77% |
| TPX-6307 | 70.7 | 545 | 9 | 81% | 82% |
| Dupont JCM | 70.3 | 560 | 9 | 96% | 74% |
| Airflex 526BP | 70.1 | 560 | 9 | 93% | 90% |

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# TAPE JOINT CEMENT

# FORMULATION STUDY

## SUMMARY

Ingredients used in manufacture of tape joint cement were evaluated in several asbestos-free formulations. An experimental design with talc, mica, and clay levels and CELLOSIZE thickener types as variables was used to minimize the number of formulations made and tested.

The variables chosen provide a possible 81 formulations of which nine were made and evaluated. Data analysis establishes an order of influence for each variable on measured performance properties. For example, room temperature adhesion decreases with increasing talc content; crack resistance and workability improve with increasing talc content.

This approach allows selection of ingredient levels within the design limits which maximizes any desired performance property.

Formulations were based on total solids. Latex solids were set at 4.2%, thickener solids at 0.6%, and dispersant solids at 0.2%. Talc, mica, and clay percent solids and thickener type were varied according to the design. Limestone solids varied with each formulation so that solids persent totaled 100. Initial volatiles were adjusted to produce 70% total solids. If the initial viscosity was greater than 550 B.U., water was added to bring viscosity to 500-550 B.U.

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## EXPERIMENTAL DESIGN

| VARIABLES | VARIABLE LEVELS AND DESIGNATION | | |
|---|---|---|---|
| TALC T-50 | $T_1$, 5% | $T_2$, 10% | $T_3$, 15% |
| MICA P-80-F | $M_2$, 0% | $M_1$, 3% | $M_3$, 6% |
| CLAY, ASP-400 | $A_1$, 0% | $A_2$, 2% | $A_3$, 4% |
| CELLULOSIC THICKENER | | | |
| • QP-52M | $C_1$ | | |
| • TJC-500 | $C_2$ | | |
| • QP-52M/QP-100M (1:1) | $C_3$ | | |

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DESIGN

| | | |
|---|---|---|
| 74 $T_1M_1$ $A_1C_1$ | 75 $T_2M_2$ $A_2C_3$ | 76 $T_3M_1$ $A_3C_2$ |
| 77 $T_1M_2$ $A_2C_2$ | 78 $T_2M_2$ $A_2C_1$ | 79 $T_3M_2$ $A_1C_3$ |
| 80 $T_1M_3$ $A_3C_3$ | 81 $T_2M_3$ $A_1C_2$ | 82 $T_3M_3$ $A_2C_1$ |

EXPERIMENTAL DESIGN

| | Order of Influence on Property | | |
|---|---|---|---|
| | 1(a) | 2 | 3 |
| R.T. Adhesion | | | |
| Talc | $T_1$ | $T_2$ | $T_3$ |
| Mica | $M_2$ | $M_1$ | $M_3$ |
| ASP-400 | $A_2$ | $A_3$ | $A_1$ |
| Thickener | $C_3$ | $C_1$ | $C_2$ |
| Crack Resistance | | | |
| Talc | $T_3$ | $T_2$ | $T_1$ |
| Mica | $M_3$ | $M_1$ | $M_2$ |
| ASP-400 | $A_3$ | $A_1$ | $A_2$ |
| Thickener | $C_1$ | $C_2$ | $C_3$ |
| Workability | | | |
| Talc | $T_3$ | $T_2$ | $T_1$ |
| Mica | $M_1$ | $M_3$ | $M_2$ |
| ASP-400 | $A_3$ | $A_1$ | $A_2$ |
| Thickener | $C_3$ | $C_1$ | $C_2$ |

(a) Variables in Column 1 have the largest influence on measured properties.

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Union Carbide trial exhibit Union Carbide 437: William D. Massey, 'Tape Joint Cements,' 1978 Sales Training Prog...
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## SUMMARY OF TJC FORMULATION PROPERTIES

| Formulation | Viscosity[a] | % ₩ | % R.T. Adhesion | % Crack Resistance[b] | Workability[c] |
|---|---|---|---|---|---|
| 7-WDM-74 | 500 | 69.9 | 52 | 79 | 8.5 |
| -75 | 545 | 69.6 | 62 | 80 | 9.5 |
| -76 | 525 | 69.6 | 20 | 91 | 9.5- |
| -77 | 340 | 69.9 | 70 | 66 | 6 |
| -78 | 460 | 69.9 | 58 | 80 | 9- |
| -79 | 520 | 69.6 | 30 | 77 | 9 |
| -80 | 510 | 69.0 | 48 | 78 | 9.5- |
| -81 | 520 | 69.6 | 18 | 89 | 8.5 |
| -82 | 530 | 68.2 | 25 | 91 | 9.5 |

a. Brabender Units, Pin Style A, 80 rpm

b. 100% Crack Resistance indicates no cracking.

c. Rated from 1-10 with 10 indicating excellent workability.

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## TJC FORMULATION 7WDM74

| Ingredients | Pounds | Gallons |
|---|---|---|
| Water | 390.0 | 46.82 |
| Ethylene Glycol | 5.0 | .54 |
| QP-52M | 6.0 | .55 |
| $NH_4OH$ | 1.0 | .12 |
| UCAR 131 | 70.0 | 7.61 |
| Dowicil 75 | 1.0 | .10 |
| Daxad 30 | 8.0 | .84 |
| Limestone # 9 | 870.0 | 38.67 |
| Talc T-50 | 50.0 | 2.22 |
| Mica P-80-F | 30.0 | 1.29 |
| ASP-400 | 0.0 | 0.0 |
| | 1431.0 | 98.76 |

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## TJC FORMULATION 7WDM75

| Ingredients | Pounds | Gallons |
|---|---|---|
| Water | 395.0 | 47.42 |
| Ethylene Glycol | 5.0 | .54 |
| QP-52M/QP-100M | 6.0 | .55 |
| $NH_4OH$ | 1.0 | .12 |
| UCAR 131 | 70.0 | 7.61 |
| Dowicil 75 | 1.0 | .10 |
| Daxad 30 | 8.0 | .84 |
| Limestone # 9 | 800.0 | 35.56 |
| Talc T-50 | 100.0 | 4.44 |
| Mica P-80-F | 30.0 | 1.29 |
| ASP-400 | 20.0 | .93 |
| | 1436.0 | 99.40 |

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## TJC FORMULATION 7WDM76

| Ingredients | Pounds | Gallons |
|---|---|---|
| Water | 395.0 | 47.42 |
| Ethylene Glycol | 5.0 | .54 |
| TJC-500 | 6.0 | .55 |
| $NH_4OH$ | 1.0 | .12 |
| UCAR 131 | 70.0 | 8.61 |
| Dowicil 75 | 1.0 | .10 |
| Daxad 30 | 8.0 | .84 |
| Limestone # 9 | 730.0 | 32.44 |
| Talc T-50 | 150.0 | 6.67 |
| Mica P-80-F | 30.0 | 1.29 |
| ASP-400 | 40.0 | 1.86 |
| | 1436.0 | 99.44 |

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# TJC FORMULATION 7WDM77

| Ingredients | Pounds | Gallons |
|---|---|---|
| Water | 390.0 | 46.82 |
| Ethylene Glycol | 5.0 | .54 |
| TJC-500 | 6.0 | .55 |
| $NH_4OH$ | 1.0 | .12 |
| UCAR 131 | 70.0 | 7.61 |
| Dowicil 75 | 1.0 | .10 |
| Daxad 30 | 8.0 | .84 |
| Limestone # 9 | 880.0 | 39.11 |
| Talc T-50 | 50.0 | 2.22 |
| Mica P-80-F | 0.0 | 0.00 |
| ASP-400 | 20.0 | .93 |
| | 1431.0 | 98.84 |

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## TJC FORMULATION 7WDM78

| Ingredients | Pounds | Gallons |
|---|---|---|
| Water | 390.0 | 46.82 |
| Ethylene Glycol | 5.0 | .54 |
| QP-52M | 6.0 | .55 |
| $NH_4OH$ | 1.0 | .12 |
| UCAR 131 | 70.0 | 7.61 |
| Dowicil 75 | 1.0 | .10 |
| Daxad 30 | 8.0 | .84 |
| Limestone # 9 | 810.0 | 36.00 |
| Talc T-50 | 100.0 | 4.44 |
| Mica P-80-F | 0.0 | 0.00 |
| ASP-400 | 40.0 | 1.86 |
| | 1431.0 | 98.88 |

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## TJC FORMULATION 7WDM79

| Ingredients | Pounds | Gallons |
|---|---|---|
| Water | 395.0 | 47.42 |
| Ethylene Glycol | 5.0 | .54 |
| QP-52M/QP-100M | 6.0 | .55 |
| $NH_4OH$ | 1.0 | .12 |
| UCAR 131 | 70.0 | 7.61 |
| Dowicil 75 | 1.0 | .10 |
| Daxad 30 | 8.0 | .84 |
| Limestone # 9 | 800.0 | 35.56 |
| Talc T-50 | 150.0 | 6.67 |
| Mica P-80-F | 0.0 | 0.00 |
| ASP-400 | 0.0 | 0.00 |
| | 1436.0 | 99.41 |

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## TJC FORMULATION 7WDM80

| Ingredients | Pounds | Gallons |
|---|---|---|
| Water | 408.0 | 48.98 |
| Ethylene Glycol | 5.0 | .54 |
| QP-52M/QP-100M | 6.0 | .55 |
| $NH_4OH$ | 1.0 | .12 |
| UCAR 131 | 70.0 | 7.61 |
| Dowicil 75 | 1.0 | .10 |
| Daxad 30 | 8.0 | .84 |
| Limestone # 9 | 800.0 | 35.56 |
| Talc T-50 | 50.0 | 2.22 |
| Mica P-80-F | 60.0 | 2.57 |
| ASP-400 | 40.0 | 1.86 |
| | 1449.0 | 100.95 |

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# TJC FORMULATION 7WDM81

| Ingredients | Pounds | Gallons |
|---|---|---|
| Water | 395.0 | 47.42 |
| Ethylene Glycol | 5.0 | .54 |
| TJC-500 | 6.0 | .55 |
| $NH_4OH$ | 1.0 | .12 |
| UCAR 131 | 70.0 | 7.61 |
| Dowicil 75 | 1.0 | .10 |
| Daxad 30 | 8.0 | .84 |
| Limestone # 9 | 790.0 | 35.11 |
| Talc T-50 | 100.0 | 4.44 |
| Mica P-80-F | 60.0 | 2.57 |
| ASP-400 | 0.0 | 0.00 |
| | 1436.0 | 99.30 |

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## TJC FORMULATION 7WDM82

| Ingredients | Pounds | Gallons |
|---|---|---|
| Water | 425.0 | 51.02 |
| Ethylene Glycol | 5.0 | .54 |
| QP-52M | 6.0 | .55 |
| $NH_4OH$ | 1.0 | .12 |
| UCAR 131 | 70.0 | 7.61 |
| Dowicil 75 | 1.0 | .10 |
| Daxad 30 | 8.0 | .84 |
| Limestone # 9 | 720.0 | 32.00 |
| Talc T-50 | 150.0 | 6.67 |
| Mica P-80-F | 60.0 | 2.57 |
| ASP-400 | 20.0 | 0.93 |
| | 1466.0 | 102.95 |

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