BONDING COMPATIBILITY OF URALITE 3121S
ADHESIVE WITH THE MC 3125

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DEVELOPMENT DIVISION

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Normal Process Development
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ABSTRACT

Hexcel Uralite 3121S is recommended as an adhesive for assembly of the MC 3125. Surface preparation, assembly process, curing, and strength characteristics needed for assembly were evaluated.

DISCUSSION

The intent of this study was to develop Hexcel 3121S adhesive for use in assembly of the MC 3125 component.

Chemical and physical data for Hexcel Uralite 3121S(1,2,3) indicate this urethane adhesive may be used to replace the Adiprene L-100/MOCA(4) urethane system. The two-part adhesive does not contain the carcinogenic MOCA or free TDI/MDI(5,6).

Butt tensile specimens were utilized to evaluate the effect of surface cleaning solvent, adhesive bond thickness, cure temperature, and severe thermal environments on the cured adhesive bond. The aluminum (2024-T3) to aluminum bonded area was 1.26 cm². The eleven adhesive mixes were prepared from the same lot of raw materials (100 pbw Part A and 40 pbw Part B) to bond 55 specimens. An Instron tension tester was used at the constant crosshead speed of 1.27 mm/min.

CLEANING AND BOND THICKNESS

Fig. 1 illustrates the effects of two cleaning solvents and the initial bond thickness on butt tensile strength (23 C) after seven days cure at ambient temperature. The bulk tensile strength of Hexcel 3121S is 34 MPa. The lower butt tensile strength at the thicker bond lines is attributable to the bulk property of 300% elongation. The data indicate both polar solvents in the cleaning process are equal. Each point on the curves represent an average of five measurements.

POST CURE THERMAL TREATMENT

The Hexcel 3121S is normally cured at room temperature and should reach ultimate bulk properties in several days. Two additional test series were performed to evaluate the bonding properties after post-cure thermal treatment. The first series consisted of two sets of five each butt tensile cured for seven days at ambient. Each set was then exposed to a thermal cycle environment for 8 additional days:

Set I: 1 day at 121 C/3 at -54/1 at 121/1 at -54/1 at 121/1 at -54
Set II: 1 day at -54 C/3 at 121/1 at -54/1 at 121/1 at -54/1 at 121
Control: 14 days at 23 C

Sets I and II were allowed to equilibrate to 23 C in four hours and then tested for butt tensile failure. The resulting strengths were significantly different.

Set I: 37.6 MPa $\pm$ 3.4
Set II: 35.1 MPa $\pm$ 3.1
Control: 13.9 MPa $\pm$ 0.8

These specimens were cleaned with isopropyl alcohol and bond thickness set at 0.0127 cm average. The thermal cycle adhesive specimens gave butt strengths near the bulk property tensile.

BOND STRENGTH AS FUNCTION OF TEMPERATURE

The second series of specimens were cured at ambient over a 14 day period and tested at abnormal temperatures.

Set III at -54 C: 12.9 MPa $\pm$ 3.1
Set IV at 75 C: 3.7 MPa $\pm$ 0.8
Set V at 100 C: 3.8 MPa $\pm$ 0.7

These samples were prepared similar to the previous Set I and II. The test at temperature indicate a much greater scatter in strength data. Comparing coefficients of variation ($100 \sigma/\bar{X}$) the control samples ($100 \times 0.8/13.9$) have a 6% value which is reasonable, but the cold samples (Set III) have a 23% coefficient.

BULK HANDLING

Handling and storage of Hexcel 3121S is similar to other urethane systems. It should be reasonably protected from moisture. The cans should be closed when not in use and a dry gas injected before closing. Some gelation occurs in unprotected resin. A test was conducted for six days open storage in which the bulk viscosity was monitored. The original viscosity of the resin was 9.6 Pa.s and each day after the skin or gelled surface was removed, the viscosity remained essentially the same. The Hexcel 3121S has a health advantage since it does not contain MOCA or free TDI or MDI, as some other urethane systems.

CONCLUSIONS

The use of Hexcel 3121S for assembling MC 3125 components is recommended. It maintains strength through large variations in bond thickness and thermal cycles. Normal cleaning procedures may be used in the assembly process and it can be handled as a standard industrial chemical.

Fig. 1. 3121S Adhesive Bond

REFERENCES

1. H. W. Lichte, H. D. Johnson and J. L. Montague, "Evaluation of Hexcel Uralite 3121S Adhesive for Assembly Processes," MHSMP-75-20A (January-March 1975).
2. J. L. Montague, "Evaluation of Uralite 3121S," MHSMP-74-35C (July-September 1974).
3. Uralite is a registered trademark of Rezolin Division of Hexcel Corporation, Chatsworth, California.
4. Adiprene is a registered trademark of E. I. DuPont DeNemours & Co., Wilmington, Delaware.
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