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Polymer Highlights for September 1975

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NEW ADHESIVE DEVELOPMENT

(H. G. Hammon, L. P. Althouse, A. Buckner, B. McKinley, C. M. Walkup)

Introduction

Development of improved new adhesives is required in some projects to replace existing obsolescent formulations.

1. Polymer Synthesis

Progress Summary

Several new urethane polymers were prepared, including a three kilogram batch of MDI-terminated prepolymer 73, now designated Halthane 73, and two Hylene T-terminated prepolymers containing markedly different amounts of free Hylene T.

Work Planned

Specifications for this type of polymer are being developed in view of the imminent transfer of this technology to Bendix. The Hylene T polymers will be used for oligomer distribution studies.

2. Cure Rate Studies

Progress Summary

Rates of cure of new Halthane adhesives 73-14, 73-18 and 87-1 at 20, 25 and 30°C indicated that these formulations have acceptable working lives and reaction rates in this temperature range. The working life of 87-1 is significantly extended by holding temperatures at or below 20°C. Butt tensile strength tests showed that bonds of Adiprene L 315/polyol/DABCO adhesive to beryllium and to TPX have adequate strength for assembly operations. Be/Be bonds broke at 14 MPa (2000 psi) and TPX bonds to Al whose surface was treated with Herco-prime broke at 5 MPa (725 psi).

Work Planned

Multiple Halthane-adhered specimens will be cured and tested under several environments, including butt tensile accelerated aging tests. The physical properties and mechanical performance of unsupported films of the new adhesives are also being determined.

3. Dielectric Capacitance of Adhesive Bonds

Progress Summary

Capacitance measurements of the cured adhesive layers of twenty Al/Al butt tensile specimens correlated roughly with their rupture strengths. These results suggest that a capacitance inspection may help in selecting specimens having fewer imperfections for long term aging tests. In related tests, capacitance changes in adhesive bonds were recorded as a function of specimen strain while pulling butt tensile specimens apart. Such data may be useful in generating stress-strain relationships at low elongations.

Work Planned

A brief further study of capacitance changes of adhesive bonds during tension is planned.

SOLAR ENERGY
(J. Rinde)

Introduction

The LLL-Sohio shallow solar ponds program requires flexible plastic materials that will withstand outdoor exposure for fifteen years without failure.

Progress Summary

A test pond with bottom insulated by a two inch layer of polyurethane foam was 8-15% more efficient thermally than an uninsulated pond. To make the insulated pond also cost efficient, a stable, low-cost insulating material must be found.

Work Planned

Several insulating materials are already under study, including pumice, foamed glass and polyurethane foam. Accelerated tests of low-cost flexible materials as transparent pond covers are also continuing.

GEOHERMAL (L. L. Lorensen and C. M. Walkup)

Introduction

In the LLL "Total Flow" system for extracting heat from a geothermal well in the Imperial Valley, hot brine (25% dissolved solids, 250°C, 400 psi) from the well will be expanded into a specially designed turbine. Selected organic polymers and composites are being examined to determine their resistance to these severe conditions of corrosion, erosion and scale deposition.

1. Field Tests

Progress Summary

Turbine inlet nozzles made from promising organic materials were exposed for 18-108 hours in the Imperial Valley well. Nozzles made of Teflon PFA and TFE, Tefzel, Ryton and H Resin C cloth appeared little changed, except for scale on the inside surface and what appears to be minor stress cracking. Scale deposits in the nozzle during pressure let-down; it is worst at the exit ends and least at the inlet ends.

Work Planned

Tests of polymer lined pipe and of improved design nozzles made from the more resistant organic materials will be resumed when the well is available again in March 1976.

2. Static Tests at LLL in Synthetic Brine

Progress Summary

After 600 hours at 300°C Teflon PFA, Imidite 2803, H-Resin and PPQ continue to show little visible degradation or weight change. At 250°C Raychem Stylan aromatic polymer and Phillips Ryton R-4 polyphenylene sulfide are essentially unchanged after 100 hours. Ryton appears to be satisfactory at 250°C, although it flowed badly at 300°C.

Work Planned

Exposure tests are continuing at both test temperatures.

3. Publication

Chemistry Department Technical Note No. 75-33, "Semi-annual Geothermal Program Report--Evaluation of Polymeric and Composite Materials in the Laboratory and Field" was issued on September 19, 1975.

FLUID CUSHION
(W. E. Cady and L. E. Caley)

Introduction

A cushion concept requires a fluid that is compatible with cured Halthane adhesive.

Progress Summary

Swelling tests of three fluorinated polymers in four fluids have been under way for two months at 65°C. Two polymers, Kel F 800 and Kel F 5500 were swelled very slightly by Dow Corning DC 200/100 cs and only slightly by Fluorinert FC 40. Fluorinert liquids FC-48 and FC 75 caused moderate swelling.

Under the same conditions, FC 40 caused only slight swelling of polymer Viton AHV, but DC 200 extracted some Viton component. The other two Fluorinert:

liquids caused moderate swelling of Viton.

Cured Halthane adhesives 73-14, 73-18 and 87-1 were also immersed in these fluids and in 184/100 oil for one or two months at 65°C. The 184/100 oil swelled the three adhesives moderately, but DC 200 and two Fluorinert liquids extracted some soluble adhesive component. Halthane 73-14 in DC 200 and 87-1 in FC 40 showed the smallest losses.

Work Planned

It may be that the swelling data observed are the net effect of two simultaneous processes: solvent swelling and solvent extraction. To sort out the two effects, a new set of swelling tests is under way with the most promising combinations of Kel F 800 polymer in DC 200 and FC 40 fluids; adhesives 73-14 in DC 200 fluid and 87-1 in FC 40 fluid.