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COMPATIBILITY OF SELECTED ELASTOMERS WITH PLUTONIUM GLOVEBOX ENVIRONMENT

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Sample specimens of Neoprene, Urethane, Viton, and Hypalon elastomeric formulations were obtained from the Baxter Rubber Company. Strips of the elastomer specimens were placed in a plutonium glovebox and outside of a glovebox, and were observed for a period of three years. Of the four types of elastomers, only Hypalon remained completely viable.

Introduction

This illustrative test was undertaken as a result of on-going failure of elastomer components in plutonium gloveboxes. These failures represent one of the major sources of required maintenance to keep gloveboxes operational. In particular, it was observed that the introduction of high specific activity Pu-238 into a glovebox, otherwise contaminated with Pu-239, resulted in an inordinate failure of elastomer components. Desiring to keep replacement of elastomer components to a minimum, a decision to explore a few possible alternative elastomer candidates was undertaken and reported upon herewith.

Experiment

For this experiment, a two-inch long by one-inch wide strip of elastomer was cut from the end of each test elastomer specimen supplied by Baxter Rubber Company (see Figure 1). Then each strip was folded with an identification tag inserted in the fold, and stapled 1/8 to 3/16 inches from the edge of the elastomer to form a loop (see Figure 2). After photographing the test specimens, the loop shaped specimens were placed on the floor of workstation 6906. Workstation 6906 is a typical plutonium glovebox having an Argon gas atmosphere. Prior to this test, the workstation's internal surfaces were wiped down with Radiac wash twice to reduce exposure levels produced by Pu-238 and Pu-239 contaminates.

During the ensuing three years, each loop specimen was occasionally massaged and visually inspected to determine if any significant changes in test specimen properties could be noted. After three years of exposure to the plutonium

environment, each loop specimen including each remaining specimen of non-exposed parent material was photographed (see Figures 3 through 6). Significant findings are recorded in this document.

Results

One year after introduction of the elastomer loop specimens into the glovebox, there were no visible or physically discernible changes in loop specimen properties. After thirteen months, it was noted that the Urethane elastomer which originally had a light green color was taking on a tan coloration. At one year and four months, it was noted that the Urethane elastomer seemed to have slightly less memory (bounce back) and was continuing to become more tan. After one year and ten months, the Urethane had lost a considerable portion of its resiliency and seemed a bit sticky to itself on its inside loop surfaces. The remaining elastomer specimens had remained unchanged while the Urethane was undergoing alteration.

The elastomer loop specimens having accumulated three years of glovebox exposure had fared as follows:

- Neoprene - Has developed small hairline cracks on the tension side of the elastomer loop. Still has good shape and resiliency. (See Figure 3).
- Urethane - Has become somewhat gummy, no longer a resilient elastomer. The tan colored material has fused with itself at one site on the inside of its loop having virtually lost its loop shape by folding in on itself (see Figure 3).
- Viton - Has developed small pit-like cracks that appear to be centered about Viton bead inclusions on the tension side of the elastomer loop. Still has good shape and resiliency. (See Figure 4).
- Hypalon - No visible changes and appears to be undisturbed by the plutonium glovebox environment (see Figure 4).

The four pieces of non-contaminated parent sample material which had been stored on top of workstation 6906 during the same three year period had fared as follows:

- Neoprene - No visible changes (see Figure 5).

- **Urethane** - No longer has the original light green color as there appears to be a slight in-growth of amber coloration. Also, it appears to be somewhat less resilient. No cracks are present (see Figure 5).
- **Viton** - Close inspection of its surface reveals a somewhat pebble-like surface which upon flexing also reveals the same type of cracks as found in the loop specimen (see Figure 6).
- **Hypalon** - No visible changes (see Figure 6).

Conclusion

Though the scope of this test was limited, a pattern of potential long-term plutonium glovebox serviceability for the four elastomeric formulations has been determined. Focusing only upon long-term physical durability and retention of mechanical characteristics while exposed to the hostile environment of a glovebox, the following becomes apparent:

Neoprene the present material of choice for glovebox gaskets, glovebox gloves, and sphincter-port baffles has a limited life when directly exposed to plutonium contamination. This durability is apparently greatly reduced when it is subjected to tensile stresses as evidenced by the initiation of cracking on the outer surface of the Neoprene test loop. Neoprene should provide a relatively long-service life when used as a flat glovebox gasket because the material is largely shielded from plutonium by the glovebox walls and not subjected to stretching conditions. Neoprene sphincter-port baffles and glovebox gloves, both of which are subjected to stretching conditions and gross contact with plutonium, will have a lesser life span. Factors that would help maximize Neoprene durability in the above applications includes, reducing the dispersed loading in the box (cleanliness), using plutonium having lower specific activity, and tying-off gloves loosely.

Urethane was included in this test to see how well it would compare with elastomerics already utilized for glovebox construction. Of the four materials tested, Urethane was the first to show signs of degradation, and the only material judged to have completely failed. This material relatively quickly lost its resiliency becoming a sticky, gummy mass that was completely unsuitable for glovebox application.

Viton the present material of choice for elevated temperature and resistance to detrimental agents, such as ozone, was found to have an application limiting characteristic. The test samples as provided by Baxter Rubber Company contained small Viton bead inclusions within the parent Viton material. With time and application of flexing to the Viton, the boundary surfaces of these bead inclusions and the parent material were separating forming pit-like cracks. It is not known if the condition leading to pit-like cracking represents a defect in manufacture or a typical state of Viton. However, assuming that bead inclusions could be expected to be found randomly in Viton, application of Viton should be limited to compressive loading situations such as flat glovebox gaskets.

Hypalon remained unchanged both in-box and out-of-box for the three years of this test. This material clearly has a longer life expectancy than the three other materials investigated during this test. As a consequence, if the physical characteristics of Hypalon are properly addressed (i.e., not as flexible or elastic as Neoprene or Urethane), Hypalon should provide much greater serviceability and operator safety in the areas of glovebox gaskets, glovebox gloves, and sphincter-port baffles as compared to the present material of choice—Neoprene.

Figure 1
Sales Order

BAXTER RUBBER COMPANY

10 SPIELMAN ROAD, FAIRFIELD, N.J. 07004
TEL: (201) 227-1956 FAX: (201) 882-6873

SALES ORDER NUMBER: 15786

SALES ORDER DATE: 04/29/91

SALES PERSON: H

PAGE NO: 1

LAW 1635

LAURENCE LIVERMORE

NATIONAL LABORATORY

7000 EAST AVE.

LIVERMORE, CA 94550

SHIP VIA	BEST WAY
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QTY	ORDERED	SHIPPED	DESCRIPTION
20	1		EA SHEET, NEOPRENE 30 DURO 1/16" 2" X 6"
20	1		EA SHEET, URETHANE 30 DURO 1/16" OR SOFTEST 2" X 6"
30	1		EA SHEET, VITON 70 DURO 1/16" 2" X 6"
30	1		EA SHEET, HYALON 60 DURO 1/16" 2" X 6"
50	1		EA SAMPLES
60	1		EA LINE CARD & CATALOG

Figure 2
Specimens before exposure to glovebox environment

Parent and Specimen elastomers

Loop configuration of specimens

Figure 3
Exposed three years to glovebox environment

Neoprene

Urethane

Figure 4
Exposed three years to glovebox environment

Viton

Hypalon

Figure 5
Three years, on top of glovebox, lab environment

Neoprene

Urethane

Figure 6
Three years, on top of glovebox, lab environment

Viton

Hypalon

**DATE
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9/22/94

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