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PROPOSED RESEARCH ON DIFFUSION OF TRITIUM  
IN STAINLESS STEEL

MOUND LABORATORY MONSANTO  
RESEARCH FILE NO. 66-6-21

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The primary objective of this research effort is to determine the effect of the passive oxide surface layer present on 18-8 stainless steel on the penetration of tritium through the metal. In addition information on the diffusion of tritium (at temperatures up to 100°C) through 18-8 stainless steel can be obtained from the experimental data as outlined.

Two approaches to the problem will be tried; (1) measurements of penetration from outgassing of sections cut from unloaded reservoirs, (2) measurements of diffusion of tritium into steel sample containers, loaded with tritium at low pressure. Details of the experimental procedures for these tests are described below:

I. Outgassing Experiments:

(1) Samples: Complete rings cut from existing reservoirs (Surveillance 1188) which have contained known amounts of tritium under pressure. Sample dimensions: rings 1 1/4 in. diameter, 3/8 in. thick.

(2) Tests:  
(a) The standard diffusion tests will be run on two rings, according to Surveillance procedures, prior to the outgassing experiments.

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(b) Nine additional rings will be cut from the reservoir and given various surface treatments, then allowed to outgas prior to measuring the tritium penetration. The surface conditions studied will be:

1. Active Surface, prepared by cleaning and pickling, to provide oxide-free conditions
2. Air-oxidized, cleaned and pickled, then allowed to form passive oxide layer in air-layer thickness,  $\sim 50\text{\AA}$
3. Thick oxide coating, cleaned and pickled, then oxidized anodically or chemically, thickness as yet to be determined, probably in the range of  $500\text{-}1000\text{\AA}$ .

Three rings will be prepared in each of the surface conditions. Two of these rings will be used for duplicate diffusion analyses and one for metallography and autoradiography.

(c) Outgassing will be done in argon at a temperature of  $100^{\circ}\text{C}$  and will extend for a period of 2-3 months to

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assure sufficient outgassing for measurement of a difference in penetration. To provide an oxide-free surface on the steel, all of the cleaning operations and pickling will be done in an argon atmosphere. The samples will be rinsed in oxygen-free water and transferred to the vacuum oven in an argon filled container.

## II. Diffusion Experiments

- (1) Samples: Samples for this series of experiments will be fabricated from 304 ELC stainless steel bar stock. Exact dimensions to be determined by the pressure fittings obtainable. Possible dimensions: 3/4" OD, 1/2" ID, wall thickness 0.125", length approximately 3 inches. These samples will be given the same cleaning and pickling surface treatments as described in the section "Outgassing Experiments". They will then be cryogenically loaded with tritium to furnish a pressure of 2 atmospheres at room temperature.

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(2) Tests:

The loaded samples will be placed in a vacuum oven and diffusion experiments carried out at 100°C for a suitable period of time (1-2 months).

- (3) Diffusion measurements will be made on sections cut from the samples, using the standard counting analyses (duplicate samples) as well as with autoradiographic techniques.

Progress to date: November 15, 1965

1. Vacuum oven obtained for use in outgassing and diffusion tests
2. 304 L Bar stock, ordered, for preparation of diffusion samples
3. Pressure fittings ordered, (6 ordered) for use in diffusion tests
4. Valves for connections, on hand
5. Drawings for connections, etc., in progress
6. Argon atmosphere, arranged (use of plastic glove box, argon lines from J. Frye)

Tests on outgassing phase can start as soon as Argon box is set up, probably week of November 29, 1965.

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