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INTRODUCTION

The new prestripper tank, originally planned for installation this spring, would dissipate 417 kW of rf power on its side walls. Approximately 10 feet in diameter and 20 feet long, this cavity was to be cooled by water circulated through extruded aluminum cooling tubes fastened to its outside walls. (Figures 1 and 2) These tubes were heated during installation and clamped tightly while elongated. A heat-conducting paste filled any voids between the tank wall and the tube. This paper discusses some of the installation procedures, test results and advantages of using this type of cooling.

DETAILS

The cooling tubes of 6063-T1 aluminum, shown in Fig. 3, were extruded by a local vendor in 34 foot lengths with the following physical characteristics: 0.344 in^2 cross-sectional area, 0.413 lb/ft weight, a yield strength of approximately 8000 psi, and an average coefficient of thermal expansion of $13 \times 10^{-6}/^{o}F$.

The prestripper's outside diameter of 123 in called for a cooling tube with an installed length of approximately 389 inches. Each tube, prebent to an 8-ft diameter was placed around the tank, measured and cut to length. Both ends were then tapped for a 1/2-13 NC thread. In addition, threads were tapped into the crowned surface of each tube close to the ends. A heat-conducting paste was placed on the tank wall, and then the tube, wound somewhat helically around the tank, was fastened to a length of predrilled barstock which had been previously welded to the tank's surface. See Fig. 4. Fittings were threaded into the side of the tube at each end, and the tube was heated by circulating steam through it from a standard steam cleaner. When the tube had elongated approximately 5/8 in, it was drawn tightly to the tank wall by using an impact wrench on its end fasteners. The steam supply was valved off, and cold water briefly circulated through the tube. The tube yielded as it shrank, resulting in a radial pressure on the filler of approximately 45 psi. Excess paste was cleaned from the tank surface, and the brass fittings used to admit steam to the tube were exchanged for nylon "Fast-N-Tite" fittings epoxied into the tube wall.

In areas where the cooling tubes had to be interrupted, they were terminated in small channel-shaped sections welded to the tank as shown in Fig. 5. A copper tube between nylon fittings provided an uninterrupted flow from one tube to the other. The end screws that held the tubes to the tank were stainless steel. These screws were liberally coated with an epoxy that acted both as a thread sealant and an electrolysis preventive coating.

FILLER MATERIAL

Conductivity tests were made of various heat-conducting fillers to see which one would best fill the gap between the cooling tube and the tank wall. The results are shown in Fig. 6 for the following fillers: 1) Devcon Corporation's steel in paste form, steel power and synthetic resin; 2) Devcon's Liquid Aluminum, a pulverized aluminum and synthetic resin; 3) a homemade mixture of Emerson and Cuming's Eccobond 45/15, and powdered aluminum; 4) Emerson and Cuming's Eccobond 285/24 HV; 5) their Eccobond 2850-FT; 6) their Eccobond 99; 7) and Dow Corning's Heat Sink Compound No. 340.

This last one was chosen for the following reasons: a) it was the only one that remained in paste form; this feature eliminated the danger of a crack developing in the filler, which in turn would cause a large temperature difference between tank wall and tube; b) it had next to the best thermal conductivity, i.e., $K = 1.086 \times 10^{-2} \frac{watts}{in.-^{o}F}$, the Eccobond 99 being slightly higher; c) it was relatively inexpensive, $30/10 lb pail, was easily placed with a caulking gun, and was not too troublesome to clean from tools and tank surface.

Rough, preliminary tests were made by circulating hot water through tubes on either side of a cooled tube. At a heat density of 12.5 watts/linear inch of cooled tube, the temperature difference between tank wall and tube was approximately 6°F with an average (calculated) filler thickness of 5-mils. With 3-1/2 gpm of cooling water flowing through cooling tubes spaced 4-3/16 in apart, on the average, the hot spot temperature of the inner tank wall could be held to 130°F under maximum operating conditions.

COSTS AND ADVANTAGES

The die was priced at $475; and the tubing was extruded for 34 cents per foot. 56 turns were placed on the tank, each turn requiring approximately 3 man-hours for installation. Total cost for the installation approximated $2500, exclusive of the additional manifolding, hoses, fittings, etc., that were required.

In addition to its simplicity, neat appearance, and low installation cost there are other advantages associated with this method of cooling. Relatively inexperienced operators can install the tubing; and in the event of damage, a tube can easily be replaced in short time.

*This work was done under the auspices of the U. S. Atomic Energy Commission.

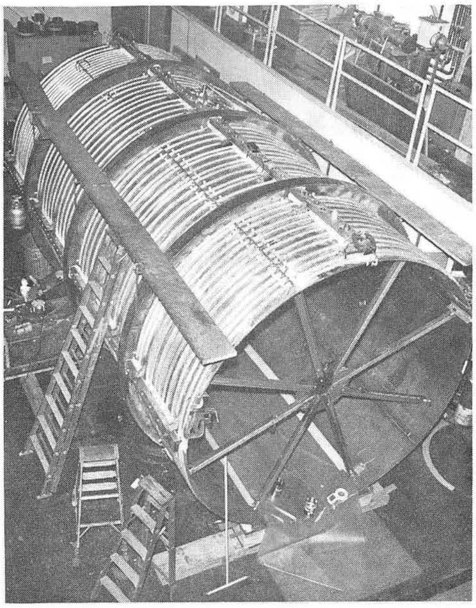

Fig. 1 Prestripper shell with cooling tubes.

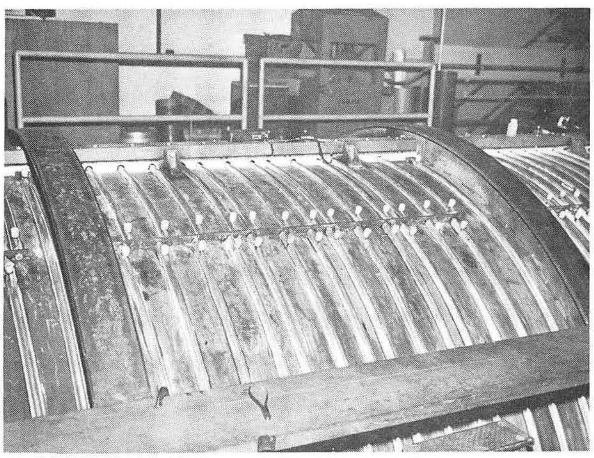

Fig. 2 Prestripper shell with cooling tubes.

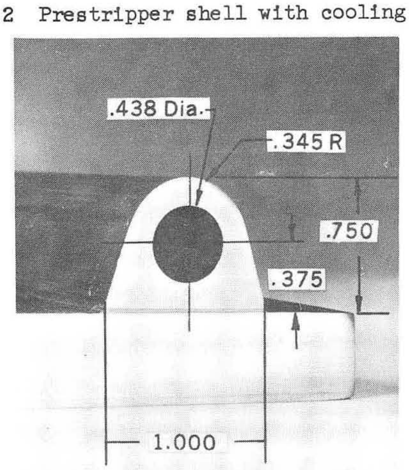

Fig. 3 Extruded cooling tube dimensions.

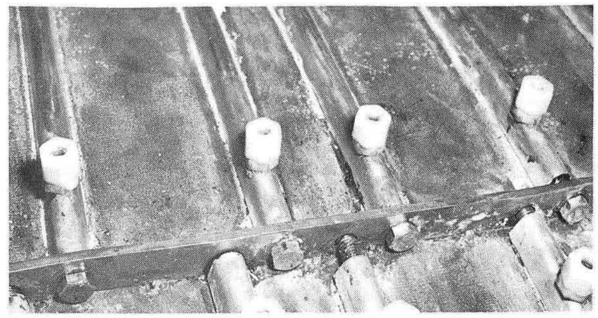

Fig. 4 Cooling tube connection detail.

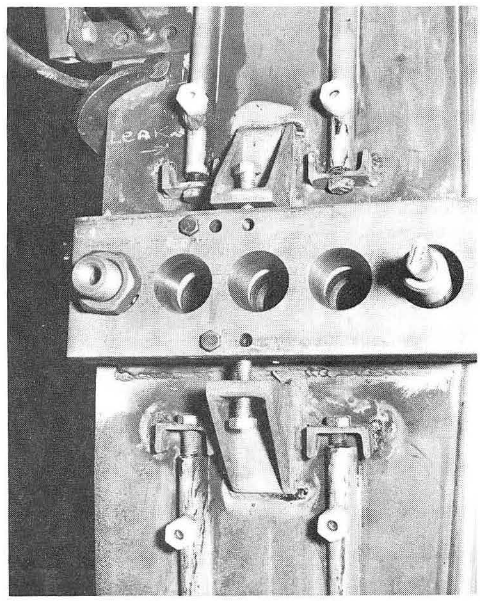

Fig. 5 Interrupted cooling tube connection details.

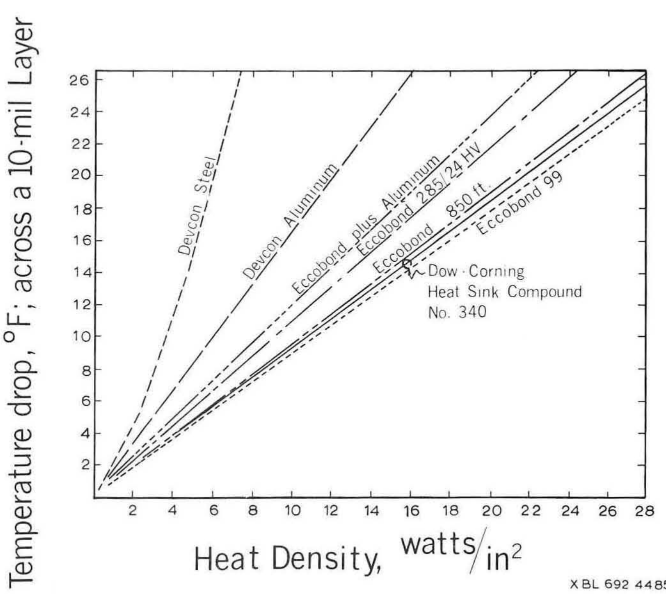

Fig. 6 Filler material temperature drop.

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