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W. M. Mathis
Manager, Metal Preparation Section
MANUFACTURING DEPARTMENT

ACCEPTANCE OF HOT PRESSED "C" ALLOY SLUGS

Fabrication of hot pressed "C" alloy slugs commenced December 29, 1954. About 2000 slugs were canned in the period January through March. Some slugs in each box of 54 were known to have been canned outside of the process limits; canning yields were low due to obvious cases of incomplete can-core bonding.

Destructive examination of slugs from both this initial period of production and the ensuing production indicated the need for a more rigorous criterion with regards to bonding than specified in the HPA Canning Process. The characteristics of the slugs produced now appear to be defined to the extent that a meaningful separation of canned slugs for bond quality can now be made.

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It is recommended that all of the hot pressed "C" alloy slugs canned to date be ultrasonic bond tested with the equipment standardized to register 110 $\pm$ 10 counts on the standard slug* and that all slugs on which the equipment does not record any counts (other than the background counts) be accepted for shipment to the piles. Slugs passing this more rigorous bond test appear to be of better quality than the hot pressed "J" alloy slugs that survived irradiation in C pile.** A revised specification (Specification 12.0, HPA Canning Process) will be issued immediately to specify this test procedure for all future production.

It is estimated that about 25-30 per cent of the January-March production will be rejected at the recommended test level. Rejection of about 10-15 per cent of the later production, when much better control of the process was achieved, is estimated.

A summarized description of hot pressed "C" slug bond quality investigations is attached.

*As specified in Specification 12.0, HPA Canning Process.

**Fabricated under PT-313-105-35-M.

VR Cooper
Manager - Fuel Technology
ENGINEERING DEPARTMENT

VR Cooper:ACC:jf

Attachment

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QUALITY OF HOT PRESS CANNED "C" SLUGS

During the initial production of hot pressed "C" alloy slugs early this year some deviations from the process standards were noted. Since there were a large number of blistered slugs (a visually detectable unbonded condition) as well as ultrasonic bond rejects, and since the effects of the deviations from process standards were not accurately known, the quality of the remaining slugs was in doubt. (The ultrasonic bond tester does not distinguish between weak attachments and a true metallurgical bond. There was the possibility that many slugs with marginal bonding were being accepted using the established bond testing procedure). An investigation was undertaken in cooperation with Process Sub-Section personnel to determine the quality of slugs canned during January as compared to those canned during March through June when much better control was achieved.

To compare the slugs canned in January with the slugs canned March to June, 51 selected slugs were destructively examined. The samples were selected by count number (relative amount of unbond area) with the ultrasonic bond tester set at a high sensitivity. Slugs at comparable count rates from both groups, including 33 "no count" slugs, had their unbonded areas (if any) outlined and the jackets removed by chiseling where possible. Most of the slugs having an unbonded area detectable by the bond tester had large weakly-bonded areas surrounding the ultrasonically established unbonded area. The slugs on which no counts were recorded had a few small areas of moderate bond strength. The "weakly-bonded" areas are believed to be bonded only with beta aluminum oxide, which was found on similar appearing pieces during the initial hot press work for "J" slug canning in the spring of 1954. The areas of moderate bond strength are believed to be partially an oxide and partially a true metallurgical bond.

During January and up to April 26, the slugs were tested for the presence of individual unbonded areas greater than approximately one square centimeter. A test was run on slugs that had previously passed this test in an effort to segregate those slugs having a total integrated count corresponding to more than one square centimeter of unbonded area. (The equipment was adjusted so that a standard slug with approximately one square centimeter unbond area gave a reading of about 100 counts.) Several slugs with more than the one square centimeter of unbonded can wall were found at this more sensitive setting. All of the slugs canned since April 26 have been inspected using this method. Slugs having some, but fewer than 100, counts were marked with the count number and sent to storage with the slugs on which no counts were obtained. During this test, it was noted that defects in the aluminum-uranium slug core were being counted as well as unbond areas at the can-core junction. By appropriate adjustment of the ultrasonic tester it was possible to reduce or eliminate the count from core defects. The equipment should be so adjusted in the future.

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The per cent bond rejects and number of slugs tested by lot are shown in Figure 1. The per cent bond rejects has been reduced from between 20-50 per cent to less than 10 per cent since the start of production. This was brought about through changes in processing, improved component inspection, and better control of the processing variables.

It is recommended that all of the slugs now on hand that have not been tested using a total count basis for acceptance be re-tested. The slugs on which no counts are recorded should be sent to the pile. It is estimated about 27 per cent of the January and 12 per cent of the March through May production now in storage will not pass the recommended test level. Any slug that has a count should be sorted out, marked with the total count number, and grouped in special lots for further examination.

Slugs have been selected for destructive examination in the Metallurgical Laboratory again based on the size of the ultrasonically detectable unbonded area -- to determine the physical characteristics of the "weakly-bonded" and detectable unbond areas. These samples have not been completed to date. Heat transfer studies are also being made to estimate in-pile effects of various types and sizes of unbond areas. This work must necessarily be completed prior to consideration of a relaxation of the proposed "no count" acceptance level.

E. A. Weakley
Fuel Assembly
Pile Technology Section
ENGINEERING DEPARTMENT

E. A. Weakley:jf

Figure 1: Ultrasonic Bond Test Results for Hot Pressed "C" Slugs

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