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PROGRAM FOR DEVELOPING URANIUM FABRICATION PROCESSES

HANFORD

42813

I. ROLLING DEVELOPMENT PROGRAM

Introduction

Evaluation of rods used in the program for the development of a rolling process for Fernald has re-emphasized the possibility that a randomly-oriented fine-grained structure may be attained by alpha-phase rolling alone. It was anticipated by Hanford personnel, early in this program, that such a structure might be attained in Hanford diameter rods by variations in the shaped pass sequence used in producing the small diameter rods at Battelle. These possibilities were discussed in document number HW-20683.

Discussion

Samples of uranium rods taken from the fourth rolling at the Lackawanna plant of Bethlehem Steel, document number HW-22474, were sent to Hanford and were examined for structural characteristics (see report of M. J. Sanderson in the January Technical Activities Report, Uranium Metallurgy). As Sanderson reports, the results of the examination of these samples indicate the possibility that randomly-oriented fine-grained uranium may be obtained by rolling in the high alpha-phase, 1180 to 1200°F. Rolling at such high temperatures has not heretofore been considered possible because of the difficulty of controlling the temperatures of the uranium billets, and rods. The salt bath preheat which has been used in the uranium rolling development program permits much closer temperature control than preheating mediums used previously. The fact that the salt clings to the rods during rolling prevents surface oxidation and requires that the billets be preheated to a higher temperature. The salt coating also inhibits oxidation of portions of the billet which have pyrophoric tendencies.

~~RESTRICTED DATA~~

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The test, described below, has been proposed to and accepted by R. J. Smith of Production in the New York Operations Office of the AEC. The test is designed to determine whether it is feasible to develop a structure in uranium that will permit slugs to be alpha-phase canned without a beta-phase heat treatment. It is particularly important that this test be conducted in January because it is planned to roll about 30 tons of uranium for Hanford, using the experimental facilities at Watervliet and Lackawanna, early in February to provide for an increase in the Hanford rod inventory.

### Rolling Test Program

The experimental phase of the test may be summarized as follows:

1. Rough twenty-four, 550 lb. Mallinckrodt billets to 2.4 inch diameter bars at 1150-1180°F at Allegheny-Ludlum, Watervliet, New York, January 19. Six inch samples will be cut from the ends of two or three of these bars for metallurgical examination at Hanford.
2. Finish roll the twenty-four bars, preheated in salt, at the Lackawanna, New York mill of the Bethlehem Steel Company.
  - a. Establish mill speeds required to maintain preheat temperatures in the uniform reduction pass sequence to produce 1.40 inch diameter rods.
  - b. Roll four billets at each of the following temperatures: 1200, 1175, 1150, 1100, and 1050°F, obtaining as complete data as possible on each bar.
  - c. Cut 10 inch samples from the front and rear end of each bar and ship to Hanford via Air Express.
3. Evaluate each sample with respect to
  - a. Orientation
  - b. Coefficients of Expansion
  - c. Yield and ultimate strengths
  - d. Dimensional uniformity
  - e. Grainsize
4. The data obtained in the above steps will be analyzed to determine (a) whether it appears that the techniques employed are sufficient to produce randomly oriented fine grained uranium by rolling alone and (b) the conditions for the rolling of the 30 tons of uranium at Watervliet and Lackawanna in February.
5. The February rolling will be closely followed by a representative from Hanford.
6. The thirty tons of rods rolled in February will be shipped to Hanford to be used in a 313-105 series production test.

It appears that it may be desirable to duplicate steps one through four of the above test, with the inclusion of a beta-heat treatment of the roughed rods between steps one and two. Heat treatment at this point will assure that the texture of the rods will be randomized prior to finish rolling, the smaller reduction in cross section of the randomized rod is expected to result in a lower preferred orientation in the final rod.

## II. HEAT TREATMENT OF URANIUM

Arrangements have been made to beta heat treat four tons of Simonds rolled uranium rods at the Lackawanna mill of Bethlehem Steel on January 27. The conditions proposed for the heat treatment of these rods, outlined in document number HW-23040, are reproduced below. Data obtained subsequent to the issuance of document number HW-23040 indicate that without agitation the immersion time should be six minutes. That change is incorporated in the following specifications.

### 1. RODS:

- a. Amount: Four tons.
- b. Surfaces: Good surfaces except for one or two rods which will be observed to determine whether the salt bath treatment affects the defects present.
- c. Length: Eight to thirteen feet.
- d. Diameter: 1.41 inches nominal.

### 2. SALT BATH:

- a. Composition:  $\text{Li}_2\text{CO}_3$  and  $\text{K}_2\text{CO}_3$
- b. Temperature:  $720-730^\circ\text{C}$ . The bath will be checked to assure that the temperature is uniform throughout.
- c. Support in Bath: Rods should not rest on bottom of molten salt containers, but should rest on supports at 2-3 foot intervals.
- d. Technique for Heating: If rods are treated more than one at a time they will be bundled with spacers.
- e. Time: 6 minutes in bath. Salt should recover to at least  $720^\circ\text{C}$  within this time.
- f. Quench: In flowing water.
- g. Log: A careful log of the heat treating conditions for each rod will be maintained by the Hanford representative observing the operation.

### 3. STRAIGHTENING:

It is preferable to straighten the rods at the mill where the heat treating is done.

## 4. MACHINING:

All rods will be shipped to Hanford to be machined unless the NYOO desires to have American Machine and Foundry machine the 1000 slugs for Hanford tests. If having Am & F do such educational work will provide needed information, special instructions will be prepared covering dimensions, handling of scrap, and cutting and identification of samples needed for studies at Hanford. The rods from which the slugs for Sylvania tests will be made are to be shipped to Hanford.

It is proposed that the treated rods be used in warm pressing canning tests at Sylvania and in preparation of slugs machined and canned by the lead dip process for pile exposure. This proposed test will be similar to Production Test 313-105-3-M, "Fabrication and Irradiation of Salt Bath Heat Treated Uranium Slugs" (document number HW-22770) except that the uranium will be treated as rods instead of as slugs.

W. T. Kattner

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