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HW--28282

DE92 007668

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REMOVAL OF THE COMPOUND LAYER

FROM DECANNED HANFORD URANIUM

SLUGS BY THE USE OF SODIUM HYDROXIDE

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May 15, 1953

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INTRODUCTION

About twenty-five to thirty per cent of the uranium slugs canned in the Metal Preparation Section do not meet specifications and are rejected. These rejected slugs are recovered by a chemical process and prepared for re-canning. The canning operation provides a coating of metal composed principally of elemental aluminum and silicon with traces of copper and tin, which bonds the aluminum can to the slug. The elements in intimate contact with the slug combine chemically with the uranium to form the tenacious compound layer.

The current recovery process consists essentially of a sodium hydroxide-sodium nitrate bath for chemically removing the aluminum can and the bonding medium, followed by hydrofluoric acid and nitric acid baths to remove the remaining compound layer and to pickle the slugs before they are returned to the process canning line.

Recent studies have indicated the possibility of using a more economical means of recovery. This includes the mechanical removal of the aluminum can and most of the bonding medium, followed by a chemical removal of the residual compound layer by a solution of sodium hydroxide.

OBJECTIVE

A laboratory scale investigation was made to determine whether a solution of sodium hydroxide would remove the compound layer from de-canned, triple-dipped and lead-dipped uranium slugs. X

SUMMARY AND CONCLUSIONS

Small scale experiments indicate that a 50% caustic solution readily removes the compound layer from de-canned, triple-dipped and lead-dipped uranium slugs. Full scale tests of this recovery method should be made to decide its process feasibility. X

DISCUSSION

Manufacturing Engineering recommended in a letter, "A Proposal for the Investigation of Change in the Slug Recovery Process", dated April 17, 1953 that the feasibility of replacing the hydrofluoric and nitric acids by a sodium hydroxide solution be investigated. This proposal was prompted by experimental results and theory relating to the ability of a sodium hydroxide solution to remove the various elements and compounds comprising the compound layer on slugs, and the consequent large gains which would result if this chemical agent could be adopted for use in recovering rejected slugs.

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Discussion (Continued)

Previous experiments showed that the compound layer on non-uranium slugs could be removed by caustic treatment. It was thought that some combination of concentration of sodium hydroxide and time of treatment would remove this compound layer from uranium slugs, even though some elements, notably silicon, may have compounded with the uranium. Preliminary investigation confirms this idea.

Variation of concentration and duration of treatment led to the use of 50 per cent sodium hydroxide at its boiling point for a period of two hours. This treatment on triple-dipped slugs results in a complete removal of the compound layer. (See Figure 1). Slugs so treated are satisfactorily canned after being processed through the regular slug pickling bath. (See Figure 2). The compound layer on lead-dipped slugs is removed by the same procedure in less than two hours. Although concentrations of about 25 per cent sodium hydroxide produce a reasonably clean slug, higher concentrations are required to insure the removal of uranium silicide, which appears to be the compound most resistant to the caustic treatment.

A concentration of 50 per cent sodium hydroxide is available commercially and can be used directly from storage tanks, thus eliminating the need for intermediate mixing tanks. Also, after several charges of slugs are cleaned, the sodium hydroxide solution may be neutralized by nitric acid from other processes. This neutralization affords a possible method for recovering the uranium dissolved by either the acid or the caustic.

Results of the dissolution tests are in agreement with those of an earlier report by Hyman, Makins and Winner, of the Manhattan Project, which shows that bare uranium slugs dissolve at a rate less than 0.2 per cent by weight per hour in 50 per cent sodium hydroxide.

The experiments for removing the compound layer by the use of sodium hydroxide were made with four and eight-inch Hanford uranium slugs from both the triple-dip and lead-dip canning processes. These slugs were de-canned prior to processing in the caustic solution. The slugs were supported on stainless steel rods in the bottom of a 12" x 20" x 8" tank constructed from steel plate. The solution level was maintained at approximately one inch above the slugs and was boiled constantly to insure continuous movement of the liquid around the surface of each slug. The water boiled off was replaced from time to time to maintain the bath concentration.

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CONCLUSIONS AND RECOMMENDATIONS

Experimental results indicate that the process for recovering slugs may be made more economical, simpler and safer. When used in conjunction with a mechanical can stripper, the sodium hydroxide recovery may yield a method of reducing the time cycle and of increasing the capacity of this operation. Hazards of handling and using hydrofluoric and nitric acids would be eliminated. Substantial savings (about \$50,000) in expenditure for program "X" equipment may be realized. (See Table).

It is recommended that a full-scale process test be made by the Process Sub-Section to decide the feasibility of using sodium hydroxide as proposed.

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Figure 1. Sections of de-canned uranium slugs (X75) showing the effectiveness of sodium hydroxide treatment for removing the compound layer.

Figure 2. Sections of acceptably canned uranium slugs (X75) showing that canning properties of recovered slugs treated by sodium hydroxide are comparable to slugs recovered by the present process,

FLOW CHART OF PRESENT PROCESS

FLOW CHART OF PROPOSED PROCESS

TABLE COMPARING PRESENT & PROPOSED METHODS

	PRESENT	PROPOSED
Approximate production capacity/shift (using existing equip.)	500 slugs	900 slugs
Cycle time	7 hours	3 1/4 hours
Hydrofluoric acid *	yes	no
Nitric acid **	yes	no
Sodium nitrate	yes	no
Water rinse tanks	2	1
Caustic mixing tank	yes	no
Disposition of used caustic	discarded	neut. acid
Material cost/1000 slugs recovered	\$57	\$30
Direct labor cost/1000 slugs recovered	\$44	\$24
Estimated capital investment necessary to increase facilities for present method to operate at the Program "X" level of production	\$75,000	\$25,000 (Best available est.)

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- * Highly damaging to human tissue and corrosive to equipment. Requires special handling and storage.
- **Unusually corrosive to equipment when combined with hydrofluoric acid.

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