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CONCLUSIONS FROM FEBRUARY 20TH ROVER MEETING

F. L. Culler, Jr.

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Summary

1. J. C. Bresee will serve as over-all coordinator of the Rover process investigation, including liaison with Brookhaven.

2. Several potential processes must be studied at various levels of priority during the next few months. These are listed below in order of priority, together with significant data on each:

a. Grind-Leach - Because of the requirements for fluoride concentrations in excess of 0.2 N plus nitric acid, plastic-lined or plastic equipment will probably be required. A serious development problem will be solid-liquid separations, which may lead to a direct extraction process.

b. Oxidation-Volatility - This process will be studied at ORNL and Brookhaven. A batch two step reaction will be studied at ORNL, while a batch or continuous, fluid bed, two or three step reaction will be studied at BNL. Heat and material balance flowsheets must be prepared for this process to compare with revised Grind-Leach flowsheets.

c. 90% HNO_3 - Work on this aqueous process will continue, but at a lower priority than the Grind-Leach process.

d. Combustion - Dissolution - Laboratory studies will be completed, and preliminary design studies will be performed to compare this process with Combustion - Volatility.

e. Chloride Volatility and Nitrofluor - These processes will be studied, at ORNL and BNL, at the present man-power and will be reviewed in six months.

Discussion

Chemical and engineering development of a process for uranium recovery from irradiated Rover fuels must be completed this calendar year. The following conclusions from our February 20th meeting with representatives from Idaho and Brookhaven should be used as guides for the development program.

1. Of the potential aqueous methods the one that was selected for intensive development effort is the Grind-Leach process. Available process and corrosion data indicate that plastic-lined equipment will probably be necessary through the dissolution step. Plastic equipment

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will probably also be required for solvent extraction if aluminum is not added to complex fluoride. Work on chemical disintegration with 90+% HNO_3 will be continued but with a lower priority. Laboratory studies of aqueous dissolution of combustion ash are nearing completion. After they are completed, the assumption that combustion-aqueous dissolution has no advantages over combustion-volatility will be checked by a separate engineering flowsheet study.

One of the most difficult problems of the Grind-Leach process is the handling of niobium solutions or precipitates. If niobium is to be separated from uranium before solvent extraction, chemical data are needed on reagents and conditions which will produce crystalline niobium compounds of low solubility. Filtration or centrifugation of gelatinous precipitates may be avoided by direct solvent extraction of uranium from the slurry leach liquor. Alternatively, niobium may be kept in solution until uranium is extracted. For this alternate, data are needed on new solvent extraction reagents.

Engineering scale-up studies must be performed on the difficult solid-liquid separation steps. Batch leacher capacity and slurry transfer problems must be investigated. In Design and Unit Operations, fuel shipment, unloading, and size reduction must be studied (and coordinated with the Nevada test program). Solvent extraction tests on a significant scale must be carried out with actual leach liquors.

2. The second process which will be studied intensively is the Oxidation-Volatility process. A cooperative program will be established with Brookhaven to obtain design data rapidly, since this process probably is farther from satisfactory development than the aqueous processes.

The process will be carried out in either two or three steps. In the three-step process, hydrofluorination of Nb_2O_5 to volatile NbF_5 is assumed. G. I. Cathers will study this reaction at ORNL, and chemical and engineering research on hydrofluorination will be carried out at Brookhaven when they are equipped for it.

Process development will follow two paths. A batch two-step process will be studied at ORNL and a fluid-bed two or three step process will be studied at BNL. Both BNL and ORNL will investigate the physical

chemistry of the separation of NbF_5 and UF_6, which will apply to either path.

Laboratory studies will evaluate the potential advantages of catalysts to reduce the temperature and/or increase the rate of combustion. Unit Operations will determine the necessary combination of burner design and operating conditions to guarantee that explosive mixtures of carbon monoxide and oxygen cannot be formed in the burner and off-gas system. The analysis will also be applied to the BNL fluid bed reactor. Chemical research on fission product volatility and engineering analysis of off-gas treatment will be required for each step.

Chemical flowsheets are needed together with heat and material balances for the various Oxidation-Volatility process paths. J. C. Bresee will coordinate the necessary work at BNL and ORNL to prepare the flowsheets. He will also revise the preliminary flowsheets in ORNL-CF-61-11-51 for the Grind-Leach and 90+% HNO_3 processes and issue a report containing all the flowsheets as a guide to process development and design. Progress reports on ORNL process development will be issued in accordance with my memorandum dated March 6, 1962.

3. Potential processes less advanced than the two main-line processes, such as Chloride Volatility and Nitrofluor, will continue to be studied at approximately their present level of effort. They will be reviewed in approximately six months to determine the feasibility of considering them for plant design.

4. Depleted-uranium, lined, prototype fuel of the Kiwi B-1B type will be required for almost all phases of the ORNL and BNL program. In a recent memorandum each section and BNL have estimated their requirements for the next nine months.[1] J. C. Bresee will arrange for the procurement of the necessary fuel from Y-12 with the approval of Washington AEC.

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[1] Letter to F. L. Culler, Jr. from J. C. Bresee, entitled "Availability of Depleted-uranium Rover Prototype Fuel," dated March 15, 1962.