HW-GTS-557

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Chemical Work Needed on Bismuth Phosphate Process Preparatory to Hanford Operation No. 3 of 4 copies, Series B

(List prepared by Chemistry Section C-1 (N-422)
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The following list is designed to outline some of the information which should be obtained preparatory to setting the exact conditions for operation of the bismuth phosphate process at Site W. The list includes problems which will require all types of investigation including fundamental research, process develpment, semiworks and Site X plant operation.

1. Metal dissolving step.
   A. Effect of proposed coating materials (Al, Sn, Zn, Si?) on yields and decontamination factors.
      1. If harmful effects are encountered (such as interference by metastannic acid formed from Sn when HNO_3 is used) can the dissolving procedure be changed, as for instance by use of NaOH?

   B. Behavior of fission products such as Cb in metal dissolving step. (Including a more precise determination of Pu: E. P. ratios from pile material).

   C. Determination of amount of Pu oxidized in metal dissolving step when Pu is present at relatively high concentrations in the metal.

II. Reduction step preceding extraction
   A. Alternate reducing agents including U^{-4}.

III. Extraction step
   A. Maximum allowable HNO_3 concentration from metal dissolving step; including the possibility of counteracting high acidity by the use of Na_2SO_4.

   B. Possibility of carrying with bismuth arsenate. (To afford better decontamination, allow the use of higher HNO_3 conc., etc.)

   C. Improved decontamination of certain species in extraction step by altering method of precipitation, time of digestion, etc.

IV. Decontamination steps
   A. Use of scavengers and of multiple by-product precipitations.

   B. Use of holdback carriers

   C. Use of reprecipitation

   D. Use of bismuth arsenate as carrier.

   E. Effect of HNO_3 conc., H_3PO_4 conc., total amounts of carrier, rate of precipitation, and time and temperature of digestion on decontamination.

   F. Alternate oxidizing and reducing agents including Co^{-4}, $(OOOH)_2$ U^{-4}.

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V. Bulk reduction step

A. Determination of decontamination factors in the bulk reduction step.
Effect of lanthanum fluoride by-product precipitation of decontamination.

B. Alternate reducing agents including Fe^{-2}, $(OOOH)_2$.

VI. Concentration and isolation

A. Further tests of metathesis procedures
1. KOH metathesis in centrifuge.
2. KOH metathesis in tanks.
3. K_2CO_3 metathesis.

B. Peroxide method
1. Determination of solubility of plutonous peroxide as a function of HNO_3 conc.
2. Determination of solubility of plutonous nitrate as a function of HNO_3 concentration
3. Determination of water holdup of plutonous peroxide precipitates.
4. Determination of rate of solution of plutonous peroxide.

C. Alternate concentration methods including dissolving $BiPO_4$ from last canyon step in HCl and precipitating plutonous peroxide, plutonous fluoride or other pure plutonium compound.

D. Methods for concentration of Pu from less active batches produced in trial runs in canyon.

VII. General

A. Tests at Site W conditions
As progressively larger amounts of plutonium become available the whole process as a unit should be tested with Site W concentrations of plutonium and fission products, on as large a scale as possible. Equipment as nearly comparable to Site W equipment as possible should be used. Active material with times of bombardment and cooling equivalent to that at Site W should be used.

B. Oxidation before extraction.
If fission product concentrations are high enough to cause difficulty by direct precipitation in the present flow sheet process or if difficulty is encountered with the coating materials an initial oxidation and decontamination step may be desirable.

C. Mechanism of carrying
1. X-ray studies of $BiPO_4$ - plutonium phosphate crystals.
2. Determination of ratio of Bi:Pu in phosphate precipitates formed from solutions where the Pu conc. is greater than the Bi conc.

D. Study of rates of solution of bismuth phosphate and plutonium phosphate precipitates.

E. Systematic test of all variables in process to determine limits of safety.

F. Development of method of separating Pu and Np for use if short periods of cooling must be used.

G. Determination of species and yields from fissioning of Pu.

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