PREPARATION OF SELF-CLEANING ^{232}U TRACER

1. SCOPE

1.1. This is a procedure for preparing a ^{232}U tracer from which ^{228}Th and its daughters will be continuously removed using a $BaSO_4$ precipitate. Once prepared, the tracer can be vortex mixed to suspend the $BaSO_4$ and centrifuged, yielding a clean ^{232}U solution suitable for yield monitoring in uranium isotope determination by alpha spectrometry.

1.2. This method does not address all aspects of safety, quality control, calibration or instrument set-up. However, enough detail is given for a trained radiochemist to achieve accurate and precise results for the analysis of the analyte(s) from the appropriate matrix, when incorporating the appropriate agency or laboratory safety, quality and laboratory control standards.

2. SUMMARY

2.1. This method is for the preparation of 1 liter of ^{232}U standard solution. Other volumes of solution can be prepared by using the same ratio of reagents.

3. APPARATUS

- Bottle, plastic, 1L
- Centrifuge tubes, 50mL
- Erlenmeyer flask, glass, 500mL
- Hot plate
- Metal tongs
- Volumetric flask, 1L

4. REAGENTS

Barium chloride dihydrate, $BaCl_2 \cdot 2H_2O$
Deionized water
Hydrogen peroxide (30%), concentrate H_2O_2
Nitric acid (70%), concentrated HNO_3
Potassium sulfate anhydrous, K_2SO_4
Sodium sulfate anhydrous, Na_2SO_4
Sulfuric acid (96%), concentrated H_2SO_4
^{232}U certified standard solution

5. PROCEDURE

5.1. Weigh 45 grams of K_2SO_4 and 20 grams of Na_2SO_4 into a 500 mL glass Erlenmeyer flask.

5.2. Add the amount of aqueous ^{232}U reference standard that will produce the desired activity concentration for 1L of total solution volume.

5.3. Carefully add 20mL of concentrated sulfuric acid.

5.4. Heat the mixture on a hotplate at medium setting.H_2SO_4 fumes will form once water from the ^{232}U standard has evaporated. Continue heating until a thick sulfate melt is formed from which very little fumes are evolved.

5.5. Remove the Erlenmeyer flask from the hot plate using metal tongs and allow the melt to cool.

5.6. Dissolve the solid in 250mL of deionized water + 32mL concentrated HNO_3. If necessary, heat mixture to complete dissolution of the solids.

5.7. Add 3mL of 30% H_2O_2.

5.8. Carefully swirl to mix.

5.9. Dissolve 0.30g of $BaCl_2 \cdot 2H_2O$ in 20mL of deionized water.

5.10. Slowly add the barium chloride solution to the ^{232}U in the volumetric flask, while heating and mixing. A $BaSO_4$ precipitate will

form. ^{228}Th and its daughters will be removed by the precipitate. ^{232}U will remain in solution.

5.11. Cool to room temperature.

5.12. Transfer solution and precipitate to a 1L glass volumetric flask. Use deionized water to rinse and completely recover any residual precipitate from the Erlenmeyer flask. Add these rinses to the volumetric flask.

5.13. Dilute to 1L with deionized water.

5.14. Mix well and transfer solution and precipitate to a 1L plastic bottle for storage.

5.15. For daily use:

5.15.1. Mix standard in 1L bottle to suspend the precipitate.

5.15.2. Transfer 20-30mL aliquot (or volume needed) into 50mL centrifuge tube.

5.15.3. Cap centrifuge tube and vortex mix for 1-2 minutes.

5.15.4. Centrifuge for 5 minutes.

5.15.5. Remove aliquot to trace uranium samples, while taking care to avoid the $BaSO_4$ precipitate at the bottom of the centrifuge tube.

6. References

1) Claude W. Sill, “Purification of Radioactive Tracers for Use in High Sensitivity Alpha Spectrometry,” Analytical Chemistry, 46(11), 1426-1431 (1974).