

## C H L O R I N E      C A R R I E R S

Since the Oxford meeting in August, water work in Oxford has mainly been directed to the development of more sensitive methods for the measurement of Thorium, together with investigations into the process of adsorption on Hydrous Titanium Oxide and the standardising of production methods for making H Ti O.

Leaving aside the prohibitively expensive I C P mass spectrometer measurements, the practical limit for the measurement of Thorium contamination using silicon diode alpha counters remains at about  $5.10E-4$  Bq., i.e. about 100 ng. of  $^{232}\text{Th}$ . Using 12.5 kg. samples of salts dissolved in water and then exposed to various adsorbers, we obtain a detection level of 1 part in  $10E+11$ , at least one order less sensitive than that ultimately required in the chosen chlorine carrier, whether it be NaCl or  $\text{MgCl}_2$ .

The method developed by Richard Taplin (Norm), using delayed beta - alpha coincidence to detect  $^{212}\text{Bi}$ , provides an improvement of at least one order over the simple alpha counter measurements and makes it possible to proceed with the NaCl or  $\text{MgCl}_2$  work on purification using sensitive and reliable measurements of Thorium concentrations.

The double 5 - Tonne tank system has now been completed and will enable seeded ultra-filtration extraction work to proceed on a much larger scale than hitherto. It is proposed initially to use this plant to pursue the concentration method of repeated seeded ultra-filtration with acid elution so as to establish the accuracy and reliability of Thorium assay measurements in water supplied by the new reverse osmosis plant. This can then be followed by purification work using 1 tonne quantities of NaCl or  $\text{MgCl}_2$ . Using two sequential stages of seeded UF, followed by acid elution and assuming an extraction efficiency of at least 70% for each stage, it should be possible to concentrate the Thorium into a volume of about 15 ml, holding 50% of the original activity. If the initial contamination is at a level of 1 part in  $10E+12$ , this would give an activity in the final sample of about 2 mBq. Such a quantity would provide adequate spectral identification and allow for measurements by both beta - alpha coincidence and direct alpha counting to better than 10% accuracy.

Since the last meeting, work with the 1 - Tonne tanks has proceeded, rather more slowly than hoped, on the purification and contamination assay of NaCl and  $\text{MgCl}_2$ . This involved dissolving 12.5 kg of NaCl or  $\text{MgCl}_2$  in about 600 l. of high purity (Millipore) water, and then passing the solution through two Seakem  $\text{MnO}_2$  / acrylic filters in series. Each filter contained about 25 gm (dry) of Seakem. After each run, the Seakem was extracted, dried, and sent to J-X. Wang at Guelph, for assay. The results were as follows.

Filter 1.

Filter 2.

Pair 1.

224 Ra

54 +/- 10

24 +/- 13

*J-X Wang*

The 224 Ra figures are corrected for the date of filtration.  
The 226 Ra activity for Pair 6 was so high as to distort the 224 counts.

>From these results we may conclude that the activity in the Millipore water was somewhat less, but comparable with that measured at the start of the NaCl runs. Pair 6, however, show an activity from the Uranium chain at a level of 3000 ng/g. of MgCl<sub>2</sub>. This is two orders higher than the value obtained by John Barton from a similar sample using gamma counting.

His reported activities were :-

K (ppm) 3 +/-9 , U (ppb) 2 +/-3 , Th (ppb) 25 +/-10 .

Measurement by Guelph (Jagam) of a sample of MgCl<sub>2</sub> from the same supply gave approx 15 ppb of Th. It would seem unlikely that during this measurement Jagam would not have noticed such a high level of Uranium activity.

Consequently, we conclude that this high U activity must have been a consequence of either extreme inhomogeneity in the MgCl<sub>2</sub> supply, or, more probably, contamination.

The two measurements of 226 Ra in run 6 do confirm the efficiency of MnO<sub>2</sub> extraction of Radium, giving a decontamination factor of a little more than 20.

The Thorium levels in this run are acceptable, being somewhat lower, but similar to those obtaining in the NaCl series of measurements.

It is proposed to complete these MgCl<sub>2</sub> measurements with one more MnO<sub>2</sub> pass being made during the week 6th-12th Dec. The 1 Tonne tanks will then be cleaned and re-filled with water from the new R.O. system. We can then continue with a series of adsorption runs using either the Merck anhydrous MgCl<sub>2</sub> or the Salt Union undoped PDV NaCl. We hope to carry out Seakem filtrations in alternation with seeded UF using HTiO. By increasing the concentration of salt dissolved to 50 kg per 500 l. of solution we should be able to improve the accuracy of our measurements and gain information of value in development of the 5 - Tonne unit which should start to be used early in 1994.

99% purified  
20-40%  
Kg MgCl<sub>2</sub>

One outstanding problem in the purification process for our chlorine carrier arises from the difficulty in drying aqueous solutions of MgCl<sub>2</sub>. Assuming that a satisfactory purification routine can be developed through our water based experiments, we could then presumably develop the routine for the initial purification of the chlorine carrier using D<sub>2</sub>O. However, when the time comes to return the D<sub>2</sub>O it would be necessary to extract the MgCl<sub>2</sub> from the D<sub>2</sub>O and this appears at first to present some difficulties. If these cannot be easily resolved, perhaps a stronger case for the use of NaCl as our chlorine carrier exists. It would be of value in pursuing the purification work if a final decision could be made soon as to which of the possible chlorine carriers is to be used.