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CRL Monthly Report on Acrylic Radioactivity.
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a) Alpha Spectrometry Section: (contact Milton)

Since the CRL Sept meeting 8 kg of Rohm material have been vaporized and separation of the Th, U and Ra isotopes are about to begin. It was noted that the Ra spectrum from one of the samples reported at the Sept meeting contained a 224Ra peak indicating concentrations of this short lived isotope much higher than would have been expected from the 228Th concentration measured in the Th spectrum. This could not be due to disequilibrium but must be from 232U contamination, 232U is used in the laboratory as a tracer and it must have gotten into the Ra stream but not the Th stream. The conclusions of the report tabled at the Sept meeting are unchanged.

b) Vaporization and TIMS Section: (contact Earle)

i) Kevlar Rope - 380 ppt Th
A 58 g sample of kevlar rope was vaporized and analysed by mass spectroscopy. Due to the large quantities of other solids in the sample the solution following the vaporization was passed through an anion exchange column to isolate the Th and U. The level of Th and U was found to be 380 ppt and 210 ppt respectively. The Th value is consistent with NAA measurements at Guelph but the U value is twice their limit.

ii) Guelph Shop Acrylic - 11.6 ppt Th
A 400 g sample of shop acrylic measured at Guelph by NAA to contain less than 2 ppt Th (see SNO6 in the report at the CRL Sept meeting) was vaporized and measured by TIMS to contain 11.6 ppt Th. Recently Guelph has found that with better statistics these 68% confidence limit numbers may be misleading. Samples initially considered to be less than 2 ppt are now, in fact, more like 5 ppt. In addition, the yield from their Al standard appears to depend on its location with respect to the acrylic. (See the Guelph section of this report). Cross checking of samples will continue.

iii) Polycast "candle" - 10, 16, 27, 32 ppt Th
Four samples of Polycast acrylic taken from the "candle" distributed by Peter Doe have been measured and shown to contain 10, 16, 27 and 32 ppt Th. In all cases the U level was about 25% of this concentration. These Th levels are significantly higher than the 5 ppt Th reported by Guelph from an adjacent piece of the same sheet. The differences may be due in part to the ratio of surface to the total acrylic mass in the two techniques. We are currently seeing some evidence that the Th may be concentrated on the surfaces of the acrylic. The Guelph irradiated samples will be sent to CRL for TIMS.

iv) Rohm for alpha counting - 4.8 ppt Th
A quantity of Rohm material has been vaporized for disequilibrium measurements. The 232Th concentration by TIMS is 4.8 ppt.

v) Polycast Monomer - 1.3, 1.5, 3.6, and 2.8 ppt Th
Quantities of inhibited liquid Polycast monomer (each around 0.8 litre) have been evaporated and the Th and U in the residue measured by TIMS. The levels of Th may depend on the plant location of the sample. Samples taken from the delivery truck (2.8 ppt Th), the underground storage tank (3.6 ppt) and the mixing vat (1.5 & 1.3 ppt) have been measured.

c) Neutron Activation Section (contact Bonvin)

Results:
Reactor operations at CRL release a few times a week high levels of Ar-41, and therefore dramatically alter the sensitivity of the Ge-well detector measuring neutron activated acrylic samples. A standard ambiant radiation monitor has been installed and is being used to automatically stop data collection when Ar-41 is detected. Accordingly the background in the 312 KeV region has been reduced to 1.2 counts/hour/kev.

Data on Polycast material (12 samples), irradiated during September 1990 are presented in Table 1. For comparison mass spec results on Polycast material (described in another section of this report) are also presented. The monomer samples for NAA were uninhibited 30g samples taken from various locations in the Polycast plant. The acrylic samples were from the large sheet of Polycast "candle" material distributed by Peter Doe and taxed by the GST (Guelph Sno Team) to have 5 ppt. The core and the surface samples were from earlier Polycast material on hand at CRL and were prepared by laser cutting at NRC.

	N.A.A.		Mass. Spec.
	ppt Th	ppt Th	ppt Th
momoner (truck)	1.9 (0.8)	6.3 (1.2)	2.8
monomer (tank)	2.4 (0.8)	38. (4.)	3.6
monomer (mix-room)	3. (1.)	1.9 (0.8)	1.5, 1.3
acrylic, "candle"	20. (8.)	23. (6.)	32, 27, 16, 10

core	4.6 (1.3)	3.4 (1.1)
surface	16. (3.)	10. (4.)

Table 1.
Th levels (stat. error) in Polycast samples measured by NAA or Mass Spec.

These NAA results are preliminary since we are still studying the reliability of the Th monitors used during the irradiations (cf. "the Guelph depletion effect") and we would like to get better confidence in the fitting routines used to determine the net peak area.

Observations:

1. The sensitivity of NAA is now around 1 ppt thanks to the lower background.

2. Four out of six monomer samples show a low Th level (2-3 ppt). The higher values for the two other samples may be due to external contamination.

3. Th levels in core acrylic and in monomer are similar.

4. The levels of Th in the surface and core components of the acrylic are different in agreement with previous evidence (see September 90 report) of an inhomogeneous distribution of Th.

5. Th measurements by NAA and by Mass Spec. give compatible results.

Discussion:

1. The good agreement between Mass Spec. and NAA data as well as recent results from Los Alamos on spiked acrylic (high recovery efficiency after vaporisation and precise Th determination by NAA) reinforce our confidence that both methods are adequate to determine ppt levels of Th in acrylic samples.

2. The following scenario may describe the observed Th levels in Polycast acrylic:

* The monomer and the core of acrylic samples have 2-4 ppt of Th.
* Random contamination during either the manufacturing of acrylic and/or the handling prior to measurements contribute (in a major way) to the higher Th concentrations observed in acrylic. This contamination is randomly distributed on or near the surface.