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Alan R. Smith
Donna L. Hurley

RADIOACTIVITIES IN KEVLAR AND VECTRAN FILAMENTS: 1994 SNO SAMPLES

One sample of VECTRAN filament and one sample of KEVLAR filament (the two major candidates for the SNO detector-support ropes) were received at the LBL Low Background Facility in late 1993, for radiometric analysis at our Oroville Facility with the MERLIN II gamma-spectrometer system. (A similar pair of samples was analysed at Oroville in early 1993.) The new VECTRAN sample was produced by exactly the same process as the one analysed in 1993. The new KEVLAR sample was produced with use of a "lubricant" (the normal manufacturing procedure), in contrast to the 1993 sample which was produced without use of any "lubricant". Additional material from these same lots of VECTRAN and KEVLAR were sent to the SNO Sudbury low background facility for similar analyses, which results we expect will also be presented at this meeting (April 1994).

Both filament samples were re-wound from their original spools into "standard" LBL sample formats: a two-piece assembly that nearly fills the available space inside the MERLIN II shield. The larger piece is a 7-in OD by 4" ID annulus that is 8" long, wound on a spool of thin polyethylene sheet that has been joined by heat-welding. The smaller piece is a 7" diam by 2" thick disc of the filament alone without any support form. The resulting samples each weighed more than 4000 grams.

BKG values we use for this analysis represent about 100000 minutes of counting time. This BKG spectrum is a composite of 4 true BKG runs and 4 runs on samples which showed no excess above actual BKG for any of the peaks used in the results reported here. These BKG values are:

| | PEAK (KEV) | C/MIN |
|-----------|------------|---------------|
| Thorium | 238 | .0464+- .0010 |
| | 583 | .0123+- .0005 |
| | 911 | .0101+- .0004 |
| | 2614 | .0070+- .0003 |
| Uranium | 295 | .0136+- .0007 |
| | 352 | .0258+- .0007 |
| | 609 | .0208+- .0006 |
| | 1764 | .0058+- .0003 |
| Potassium | 1461 | .0079+- .0003 |

RESULTS

Mass concentration values for thorium, uranium and potassium in the VECTRAN and KEVLAR samples are listed below, where Th and U are expressed in ppt and K is expressed in ppm. NET count rates above (or below) the BKG values are given, along with the gross rates OBSERVED in each peak. The last row for Th and U shows weighted averages for concentrations obtained by combining results from all 4 of the individual peaks.

The listed U-values may contain an additional uncertainty that is connected with a relatively low rate of air exchange in the Oroville Power Plant during much of the time these measurements were in progress: the Rn-purge system may not have been able to provide adequate protection under these unusual conditions.

VECTRAN: 4028 gram sample 25327 min count time

| | PEAK | OBS. C/MIN | NET C/MIN | CONC. |
|----|--------|---------------|----------------|---------------|
| Th | 238 | .0465+- .0022 | .0001+- .0024 | 6+-159 |
| | 583 | .0150+- .0011 | .0027+- .0012 | 513+-228 |
| | 911 | .0115+- .0010 | .0014+- .0011 | 444+-349 |
| | 2614 | .0070+- .0006 | .0000+- .0007 | 000+-312 |
| | AVG(4) | | | 178+-114 ppt |
| U | 295 | .0134+- .0015 | -.0002+- .0016 | - 9+- 75 |
| | 352 | .0220+- .0015 | -.0038+- .0016 | -102+- 75 |
| | 609 | .0224+- .0012 | .0016+- .0013 | 53+- 43 |
| | 1764 | .0055+- .0005 | +.0003+- .0006 | - 53+-107 |
| | AVG(4) | | | 4+- 32 ppt |
| K | 1461 | .7245+- .0054 | .7166+- .0054 | 73.5+-0.5 ppm |

KEVLAR: 4320 gram sample 25540 min count time

| | PEAK | OBS. C/MIN | NET C/MIN | CONC. |
|----|--------|---------------|----------------|--------------|
| Th | 238 | .0493+- .0020 | .0029+- .0022 | 179+-136 |
| | 583 | .0112+- .0010 | -.0011+- .0011 | -195+-195 |
| | 911 | .0137+- .0009 | .0036+- .0010 | 1065+-296 |
| | 2614 | .0064+- .0006 | -.0006+- .0007 | -249+-291 |
| | AVG(4) | | | 133+- 98 ppt |
| U | 295 | .0206+- .0016 | .0070+- .0017 | 307+- 75 |
| | 352 | .0334+- .0017 | .0076+- .0018 | 190+- 45 |
| | 609 | .0278+- .0013 | .0070+- .0014 | 216+- 43 |
| | 1764 | .0076+- .0006 | .0018+- .0007 | 299+-116 |
| | AVG(4) | | | 223+- 28 ppt |
| K | 1461 | .0853+- .0019 | .0783+- .0019 | 7.5+-0.2 ppm |

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CALIBRATION CONSTANTS OBTAINED FROM VERMICULITE SAMPLE

The vermiculite (expanded mica) sample is also a two-piece assembly, having the same shape and volume as the "rope" samples. The vermiculite sample weighs 710 grams; it contains 2.6 ppm U, 4.9 ppm Th, and 4.6% K by weight. These assays were done with the LBF S7 NaI(Tl) scintillation crystal gamma-spectrometer system, a system whose calibrations have been maintained continuously since 1967. The calibrations are based on USAEC New Brunswick Laboratory standard materials which contain known quantities of U-ore and Th-ore, on CP grade KCL, and on an IAEA Cs-137 calibration source.

Detector "calibration constants" were obtained from the Vermiculite sample for the peaks used to determine radionuclide concentrations, and are expressed in the following terms. Uranium series members are given in terms of the quantity of uranium that would present at secular equilibrium; thorium series members are expressed in the same way. Potassium is given as the quantity of elemental potassium present for the normal isotopic ratio. All these values are expressed in terms of c/min per gram of uranium, thorium, or potassium.

| | | |
|-----------|----------|--------------|
| Thorium | 238 KeV | 3744 c/min-g |
| | 583 KeV | 1307 c/min-g |
| | 911 KeV | 782 c/min-g |
| | 2614 KeV | 557 c/min-g |
| Uranium | 295 KeV | 5270 c/min-g |
| | 352 KeV | 9243 c/min-g |
| | 609 KeV | 7519 c/min-g |
| | 1764 KeV | 1395 c/min-g |
| Potassium | 1461 KeV | 2.42 c/min-g |