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Radioactivities of Silicon Carbide Abrasives

Two samples of silicon carbide abrasive grit have been analysed for uranium, thorium, and potassium (U,Th,K) with the S7 NaI(Tl) scintillation crystal gamma-spectrometer. While this method does not reveal whether equiilibrium exists in the U-series and Th-series, it does give reliable assessment of the high energy gamma-ray emission from both series, in the following context:

U-series: the U-concentration that would be in equilibrium with the measured gammas which belong to short-lived daughters of Ra-226 (1620 yr halflife).

Th-series: The Th-concentration that would be in equilibrium with the measured gammas which belong to short-lived daughters of Th-228 (1.9 yr halflife).

For all practical purposes, the U-series high-energy gamma emission will be constant for the lifetime of any apparatus now being designed. The Th-series high-energy gamma emission may not remain constant, depending upon the nature of (any) disequilibrium. Several possibilities exist:

1) Th-232 and Th-228 are retained, but Ra-228 is removed. If our analysis is at a time after processing that is short compared to the Th-228 halflife, the high-energy gamma emission will decrease about a factor of 2, after which it will increase to the early value in about 20 years.

2) Th-228 is retained, but Th-232 and Ra-228 are not present. This strange circumstance requires a two step chemical processing, and is observed in some aluminum samples. The high-energy gamma emission will continue to decrease from its measured value, with a 1.9 year halflife.

3) Ra-228 is retained, but both isotopes of thorium are removed. The high-energy gamma emission will change from its measured value, depending upon how much time has elapsed since chemical separation. Ingrowth of Th-228 controls the increase of HE gammas for early times after processing, while decay of Ra-228 controls the decrease of HE gammas beyond about 10 years after processing time. If our measurement is made witin a few months of the chemical separation, the increase of HE gammas can be quite large.

Results of the NaI(Tl) measurements are:

SiC, Grade 240	U(ppm)	=	0.182 +-0.006
	Th(ppm)	=	0.82 +-0.02
	K(pct)	=	0.0023+-0.0008
SiC, Grade 600	U(ppm)	=	1.12 +-0.01
	Th(ppm)	=	5.66 +-0.05
	K(pct)	=	0.0035+-0.0019

These two samples exhibit a wide range of radionuclide content for this material. It is doubtful the values are associated with the grit size, but rather with differences in the radioactive content of feed materials from batch to batch, or with differences among production furnaces. (This is only an opinion.)

The radioactivity in Grade 600 SiC is equivalent to a uranium content of about 1/3 pCi/gram and a thorium content of about 1/2 pCi/gram. Such (relatively) high radioactivities may carry too great a risk for the intended use of these abrasives - - polishing pieces of the acryllic vessel. Perhaps alternatives should be explored, or perhaps cleaner SiC can be found. There is probably no guidance for the latter course of action - - simply obtain a bunch of samples (and pray before and during counting).

Since the acryllic is so soft, finding an alternative material seems the more promising avenue (to me). What about good clean quartz, suitably crushed and sieved? There are millions of tons of relatively clean quartz sand (Ottawa sand), used extensively for sandblasting; we have analysed such sands in the past, finding U and Th content at about 0.1 ppm each. Fused silica can be obtained with U and Th content in the few ppb range. Other choices surely exist.