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Preparation of ²²⁶Ra sources from solid samples for alpha spectrometry in less
than one hour.

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Abstract:

Determination of ²²⁶Ra by alpha spectrometry offers many advantages such as high sensitivity, selectivity and direct relation between the emitted alpha particle and the parent nucleus. However, it has also a serious limitation in that it requires radiochemical processing of analysed samples. The procedures are often lengthy and must be carried out by skilful personnel. Accuracy of data obtained by radiochemical methods of analysis depends heavily on the completeness of sample dissolution and equilibration with tracers. Total destruction of silicates entails application of aggressive chemicals such as HF and H₂SO₄ which create serious health hazard.

The method developed by us is free of all these inconveniences. Its originality is based on our discovery that a melt of silicates with lithium metaborate forms suspension of mixed barium and radium sulphate upon mixing with solution containing sulphate ions. The suspension collected on a membrane filter is suitable for alpha spectrometry without any additional treatment.

Below is given an abbreviated version of the method. The full version will be made available in the Journal of Radioanalytical and Nuclear Chemistry.

Procedure: mix 0.2 to 0.3 g of ashed material with 1 g of anhydrous LiBO₂ and add a measured amount of ¹³³Ba tracer. Evaporate to dryness and heat with a gas burner until a transparent melt is obtained. Cool, add a pinch of NaI and heat until the melt takes on a spherical form. Transfer it, while in a liquid state, to a baker with 50 ml of 5 % Li₂SO₄ in 0.75 M sulfuric acid. The liquid should be vigorously stirred when the melt is poured in the solution. Continue stirring until the melt dissolves completely. Pass the solution through a filter with porosity 0.1 μm. Wash it briefly with distilled water before removing from the holder. Wash the walls of the filtration chimney with alkaline solution of EDTA, collect the washes in the original baker, add 0.1 mg of Ba²⁺, combine with the original filtrate and add immediately 50 μg of BaSO₄ in form of microcrystalline suspension. Add an equimolar amount of CuSO₄ to bind the EDTA and perform a second filtration. Determine activity of ¹³³Ba on each filter, as well as in the filtrate, and make sure they sum up to 100 %.

As the behaviour of barium does not correspond exactly to the behaviour of radium in the applied scheme, the ¹³³Ba cannot be used as yield monitor for ²²⁶Ra. However, applying double precipitation, the combined recovery of ¹³³Ba on both filters runs above 90 % in most cases. Since radium always precipitates more completely than barium, it is evident that its recovery falls somewhere between the recovery of barium and 100 %. A mid-point between these two values is a reasonable estimate of the true value for radium recovery.