Quantitative analysis of thorium-containing materials using an Industrial XRF analyzer

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Thorium (Th) as nuclear fuel is clean and safe and offers significant advantages over uranium. The technology for several types of thorium reactors is proven but still must be developed on a commercial scale. In the case of commercialization of thorium nuclear reactor thorium raw materials will be on demand. With this, mining and processing companies producing Th and rare earth elements will require prompt and reliable methods and instrumentation for Th quantitative on-line analysis.

Potential applicability of X-ray fluorescence conveyor analyzer CON-X series is discussed for Th quantitative or semi-quantitative on-line measurement in several types of Th-bearing materials. Laboratory study of several minerals (zircon sands and limestone as unconventional Th resources; monazite concentrate as Th associated resources and uranium ore residues after extraction as a waste product) was performed and analyzer was tested for on-line quantitative measurements of Th contents along with other major and minor components.

Th concentration range in zircon sand is 50-350 ppm; its detection limit at this level is estimated at 25-50 ppm in 5 minute measurements depending on the type of material. On-site test of the CON-X analyzer for continuous analysis of thorium traces along with other elements in zircon sand showed that accuracy of Th measurements is within 20% relative. When Th content is higher than 1% as in the concentrate of monazite ore (5-8% ThO_2) accuracy of Th determination is within 1% relative.

Although preliminary on-site test is recommended in order to address system feasibility at a large scale, provided results show that industrial conveyor XRF analyzer CON-X series can be effectively used for analytical control of mining and processing streams of Th-bearing materials.