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## NORM characterization using laboratory measurements: An Italian case study

NORM characterization is a main topic in Industrial operations: it is essential for any subsequent evaluation, such as radioprotection measures to adopt, identification of appropriate treatments, waste management and disposal, etc.

A case study, named in Italian language as Palte Fosfatiche (Phosphate Muds), is taken under consideration, for its peculiarities: this material is the only obtained as a by-product from the refinement of phosphoric acid intended for human use (not for fertilizer production, as more usual). This specific process produces a fine-grained material, rich of heavy elements, such as Uranium (U), heavy metals in general, and, in some cases, Barium (Ba), which result of main interest both for radiometric and chemical aspects.

In particular, the relatively high concentration of Barium in the phosphate muds, makes difficult the low energy gamma spectrometry measurement, not only because its high atomic number, but mainly for the intense self-absorption effect due to the resonance of X-rays peaks at about 32 and 36 keV. Such relevant issues for the efficiency calibration in gamma spectrometry, are crucial to obtain a good activity measurement of radionuclides of major interest, such as Pb-210 (46.5 keV), U-234 (53.3 keV), Th-234 (63.3 keV), Th-230 (67.7 keV).

Chemical characterization, through EDXRF Spectrometer, and radiochemical measurements were used, respectively: i) to know the approximate chemical composition of muds and ii) to independently fix the activity concentration value for Pb-210 (radiochemical methods have been also used for experimental determination of Po-210, which results not in equilibrium with Pb-210).

The experience gained with this work leads to conclusion that a multidisciplinary approach is required in order to implement the best setup for efficiency calibration, numerically obtained by means of Genie2000/LabSOCS software package, and to get consistent results for radionuclides identification and related concentrations.

This case study highlights the importance of interdisciplinary approach to fix basic aspects of NORM knowledge. Chemical and radiological characterizations, in fact, are joined aspects of the same topic and, for a best optimization of NORM management, it is essential that both are considered and matched between.

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