NORM by-products from Drinking Water Treatment Plants: considerations for agricultural use.

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Abstract

The content of naturally occurring radionuclides, mainly uranium and radium, in water used for human consumption can surpass the gross alpha threshold, 0.1 mBq/L, and the Total Indicative Dose (TID) threshold, 0.1 mSv/y. The occurrence of this is due to great extent to geological reasons. In these cases, the traditional working proceedings of Drinking Water Treatment Plants (DWTP) are not able to reduce the radionuclide content, and the water is not apt to be consumed by humans. We developed modifications to these proceedings that were able to successfully remove the uranium and/or radium contents of the water, thus reducing the TID and the water becoming drinkable. This has been carried out in several operating DWTP.

The radionuclides removed from the water are accumulated into the sludges generated in the same process. The radionuclide content in the sludges can surpass the 0.5 kBq/kg UE clearance level, and up to 12 kBq/kg d.w. The association of uranium and radium to the sludges can affect the later use of this by-product, being its use as fertilizer one of the most common. This association was determined by using sequential speciation procedures. The uranium and radium associated to sludges can be found in: the exchangeable extracted with NH_4OAc at pH at pH 7; in the carbonated fraction, extracted with sodium acetate 1M at pH 5; in the easily reducible fraction, extracted with $NH_2OH{\cdot}HCl$ 0.5M at pH 2; and in the moderately reducible fraction, extracted with ammonium oxalate 0.2M at pH 3. The order of importance of these fractions depended on the origin of the input water used in the DWTP, i.e. the content of the major inorganic ions dissolved. The radiological impact of the use of these sludges as fertilizers was estimated by means of experiences of wheat plantlets grown under controlled laboratory conditions.