

"Radionuclides in sludge from wastewater treatment plants: recycling and re-use"

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Abstract

Given the problems both with scarcity and quality of water, use of water treatment plants has significantly increased over the last few years in many countries. Consequently, large quantities of solid waste or sludge are generated every year which can be re-used for different applications. This solid waste may contain all kinds of pollutants, including significant levels of radioactivity.

A screening study of the presence of radionuclides at eleven Spanish wastewater treatment plants (WWTPs) and one located in the Midwest of the United States was carried out. The Spanish WWTPs were located in the north east and north west of Spain and they were chosen by taking into account the fact that plants were in different geological areas and that they used different treatment processes.

The range of measured activities for gamma-emitted radionuclides in Spanish sludge samples were from 12 to 132 Bq/kg for ²²⁶Ra, between 11 and 77 Bq/kg for ²²⁸Ra, from 130 to 480 Bq/kg for ⁴⁰K and between 75 and 520 Bq/kg for ⁷Be. In some samples small amounts of ¹³⁷Cs, an artificial radionuclide from nuclear testing fallout, were detected with a maximum value of 2.6 Bq/kg. The highest concentrations of natural gamma isotopes were for sludge from WWTPs located in north-west Spain because granitic formations are prevalent in this zone.

In the sludge from Waukesha WWTP (USA) the main contribution to natural gamma radioisotopes was from ²²⁸Ra with the value of 1090 ± 130 Bq/kg and by ²²⁶Ra with 880 ± 50 Bq/kg.

Sludge can be recycled and re-used in a variety of ways that are both environmentally beneficial and sustainable. The common practice of dispersing sewage sludge onto agricultural land can lead to the accumulation of radionuclides in

soil and can eventually lead to their uptake into crops. Sludge is also disposed of in sanitary landfills, discharged into sewers or incorporated into building materials. Sludge from the studied WWTPs is mainly used in composting production or in agriculture without being treated. The concentration (kBq/kg) in sludge from WWTPs was evaluated as NORM and, as the main uses of the sludge are as fertilizer, their potential hazard was studied by using indices employed in the radiological assessment of soil such as the gamma index.

Although results from the total inventory of the sludge samples analyzed were below the reference values (with the exception of the Waukesha sample), the fact that some samples values were slightly below the reference ones should be taken into account and also that these data were obtained from an individual sampling campaign. More exhaustive studies should be carried out in order to evaluate whether there is temporal variation or stability in the measured activities.
