Water treatment plants fed by Cambrian-Vendian aquifer as NORM producers in Estonia

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Abstract

Directive 2013/51/EURATOM sets indicative dose 0,1 mSv/a as parametric value for effective dose from consumption of drinking water. Consumers in many regions in North Estonia get their drinking water from ground water aquifer Cambrian-Vendian (Cm-V). Cm-V aquifer contains naturally elevated activity concentrations of Ra-226 and Ra-228. Approximately 91% of all consumers (approx. 190 000 consumers) of Cm-V fed water works are expected to receive effective doses above 0.1 mSv/a. This has forced water works to seek water treatment technologies that can reduce radium concentrations in drinking water. In 2012, first large scale facility specifically designed to remove Ra-226 and Ra-228 isotopes, was commissioned at Viimsi.

In order to meet the conditions for drinking water quality in addition to elevated radium concentration, water works need to reduce high concentrations of Fe and Mn in ground water. It is well known that Ra co-precipitation may occur during Fe and Mn treatment and it can be expected that build-up of NORM may take place even in treatment plants not specifically designed to radium removal. First survey was made in 2010 concluding that build-up of NORM in filtration beds and sludge take place in some of the Cm-V aquifer fed treatment plants.

NORM generation from water treatment plants was first acknowledged by the authorities in 2013, when we reported first results on the accumulation of Ra-226 and Ra-228 at Viimsi water treatment plant. In 2015, a survey was made, comprising 18 treatment plants fed by Cm-V ground water, which concluded that majority of plants (approx.70% of treatment plants included in the study), accumulate Ra isotopes in filtration bed to a level classified as NORM. Concentrations of Ra-226 and Ra-228 as well build-up of Th-228 in filter beds were found to vary between 1–40 kBg/kg. Approximately 350 tons of NORM was identified. It was found that treatment plants do not have the capability to control the accumulation, irrespectively whether the plant is designed for removal of Ra isotopes or not. It was concluded that depending on the replacement frequency, 30-60 tons of filtration bed material is to be disposed as NORM waste annually by Cm-V based treatment plants.

National policy does not foresee disposal options for NORM as a low level radioactive waste and is guiding NORM generators to seek options for clearance. However, there is neither NORM management experience nor practice established yet. An overview of the studies performed since 2012 will be given. The studies characterized water treatment processes with respect to the behaviour of Rn-222, Ra-226, Ra-228 and Th-228, identified accumulation in the filter beds and production of NORM by the Cm-V fed drinking water industry. An overview of NORM waste management options as well radiation safety assessments for the NORM waste disposal will be given.

In connection to that, authorities have raised a question whether removal of Ra isotopes from drinking water is justified due to NORM generation in the treatment process. To answer this question, aiding tools to perform optimization process taking into account risk assessments for consumers of drinking water and the practice for NORM management need to be developed. An overview on recent developments will be presented.