Assessment of the Impact of Naturally-Occurring Radioactive Materials (NORM) in the water treatment cycle

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INTRODUCTION

Natural radioactive elements such as uranium, thorium, and radium exist naturally in water, soil and rocks, and their decay products (radium-226 and radon-222) and potassium-40 as well. The activity concentrations of the radionuclides in rocks and soil commonly found in nature are generally low.

Natural radionuclides can appear in a gaseous form (e.g. radon-222), dissolved in water (e.g. radium-226) and solid materials (e.g. uranium-238). In many cases, the decay products of uranium-238 and thorium-232, particularly radon-222, accumulate in indoor environments, resulting in an existing exposure situation. Radon-222 and its radioactive progeny are a significant source of human exposure to ionizing radiation through inhalation and represent the most important contributing component to the effective dose from natural sources.

Some level of radioactivity may be present in water supplies due to natural processes or from the disposal of radioactive materials or from some industrial activities. In these cases, a treatment process is needed to purify water, specifically for water safety and quality parameters. In other cases, even if the radiological issues are not the focus of the treatment, the process can accumulate radionuclides and, consequently originate an additional radiological exposure.

Therefore, groundwater filtration which is included in the water treatment cycle, was identified as an Industrial NORM practice (Annex VI) in the European Union Council Directive 2013/59/Euratom. As water is treated to remove impurities, radionuclides may coagulate as sediment and sludge and also build up in filters, tanks and pipes at treatment plants. The generated waste streams are treatment residuals. Most of this waste is disposed in landfills and storage ponds. This study aims to shed light on this particular issue and try to reduce the residuals of radionuclides in water treatment plant facilities.

OBJECTIVES

The work focuses on the assessment and removal of the natural radioactivity present in the water cycle treatment processes. Two major objectives are considered:

To **understand** the nature and potential impact of residual radioactivity associated with the water supply cycle. This developed work will allow achieving this objective through a predictive model of the potential concentrations of radioactivity in residuals and filters at the system, including dose estimation and quantitative risk assessment (occupational, public, environment) in maintenance and cleaning activities and handling, storage, and disposal operations;

To **study** an alternative photocatalytic/catalytic treatment system consisting of porous microspheres with immobilized catalysts (TiO_2, amines, carbon, etc.) able to remove the radionuclides upstream of residuals disposal [1].

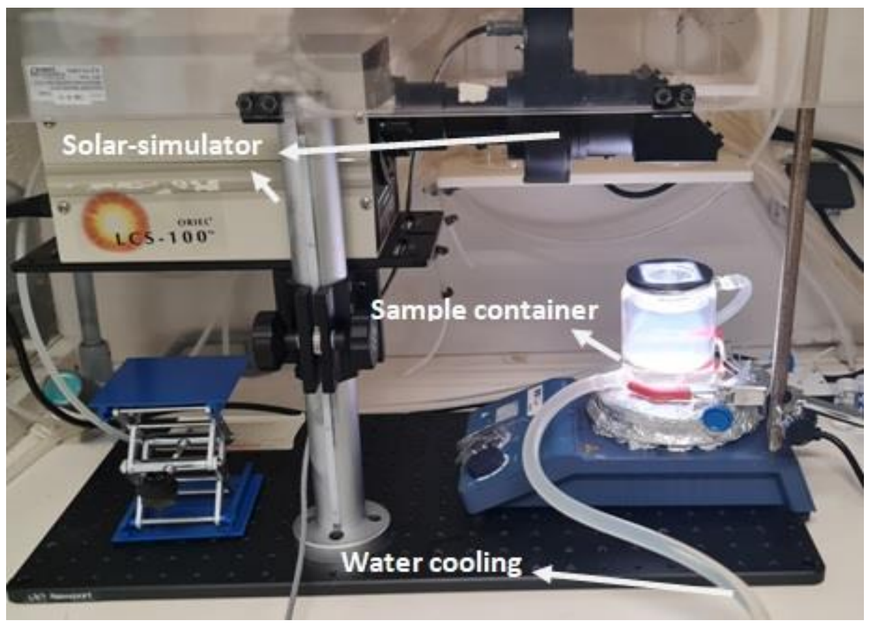

Fig.1: Experimental layout.

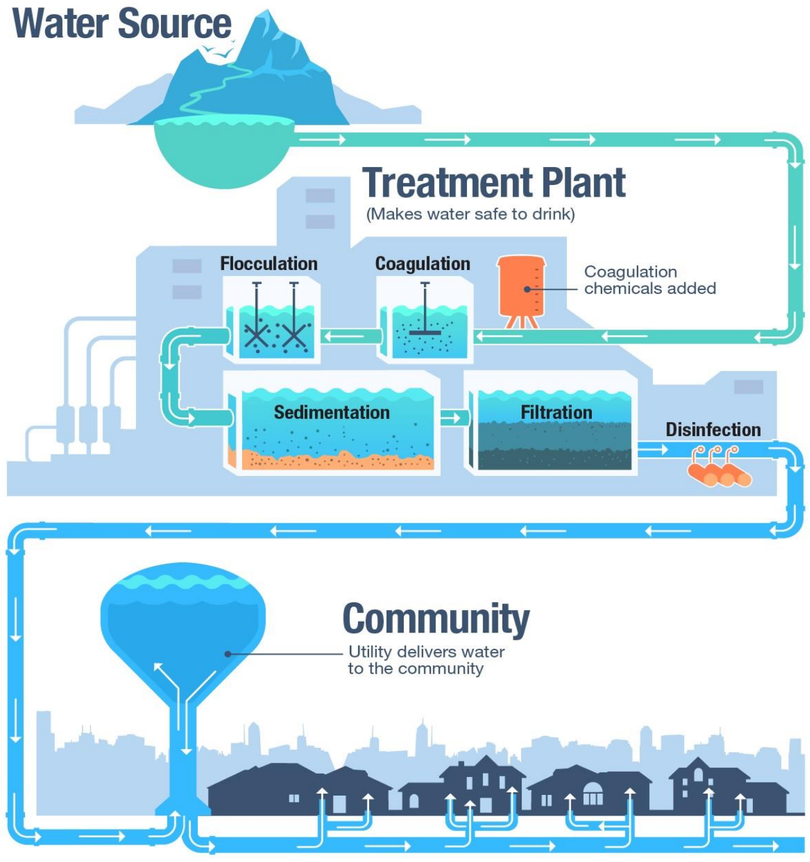

Fig.2: Water treatment process [2].

CONCLUSION

This work is under development, however, calculated doses will be used to identify the relevant task in terms of exposure for a given facility and the significant exposure pathways for each generic task of the project.

Water treatment facilities is one of the industrial sectors involving naturally occurring radioactive material therefore, it is necessary to conduct a radiation safety assessment.

A new treatment process will be tested in the raw water based on a photocatalytic/catalytic system with porous microspheres, to test the possibility to reduce or remove the traces of the accumulated naturally occurring radioactive materials[3].

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