Environmental Science

http://www.aimspress.com/journal/environmental

AIMS Environmental Science, 10 (1): 125–128.
DOI: 10.3934/environsci.2023007
Received: 04 January 2023
Accepted: 12 January 2023
Published: 13 January 2023

Editorial

Radioactive waste management and disposal – introduction to the special issue

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In this special issue of AIMS Environmental Science, present trends of radioactive waste management are reviewed. In spite of nuclear energy production, radionuclides have many other important applications in medicine and industrial fields. The sustainability of all radionuclides applications depends on the proper management of radioactive wastes. The characteristics of these wastes can be very different depending on the previous application. Thus, we can find solid or liquid wastes with ranges of radioactivity from low/medium ($< 3.7 \times 10^8$ Bq) to high ($10^4 – 10^6$ TBq/m^3). Nowadays, management of low/medium activity wastes is well established and mainly consists of the following basic stages:

a) Prevention and minimization. Reduction of waste volume and activity are basic principles for environmental impact and cost decrease. In this line, short half-life radionuclides must replace long half-life ones [1], and wastes must be segregated according to solid/liquid state, radionuclide content, level of activity and half-life of radionuclides [2].
b) Storage for decay. When it is possible, storage of radioactive wastes is used to reduce the level of activity before discharge or transport to a disposal facility.
c) Discharge after decay. Some radioactive liquid wastes (as the ones produced in some medical applications) can be discharge to sewer after storage for decay [3], if other release criteria such as radiological, chemical and biological ones are met.
d) Concentrate and contain. When option of delay and decay is not practical due to the level of activity and/or the length of half-lives, radioactive waste must be concentrated by a conditioning process to reduce volume and then confine the radionuclides to prevent their dispersion in the environment [4]. After this, concentrated wastes are collected in suitable containers and buried in authorized sites.

This Special Issue aims to contribute with papers on research and innovation in the field of radioactive waste treatment, both medium-low and high activity, covering topics as diverse as those related to the most advanced management procedures, which involve the systematization and implementation of integral management systems [2,5]; as well as the implementation of methods for predicting and monitoring the radiological incidence [6,7] of waste and/or its environmental impact [8,9], using dose calculation and associated risk assessment software [10,11]; or the application of specific treatments for the declassification of waste such as volume reduction prior to its disposal [12–14], among which the application of nanomaterials stands out [15].

On the other hand, an important field of research is the structures and materials that allow the long-term storage of high activity radioactive materials, both in the nuclear facilities themselves and in the final storage sites. In this sense, there is room for studies on the degradation of the containers used for storage [16]; as well as research on the application of new materials, among which those that include nanoparticles should be noted [17].

Among the sectors of origin of the waste to be managed, the scope of the special issue covers waste from the nuclear industry (spent fuel storage and reprocessing), as well as waste from industry or medical applications. On the other hand, the radiological incidence and the management of NORM Naturally Occurring Radioactive Materials (NORMs) are also considered, in spite of not being strictly waste, since they can have a significant radiological impact. As it is the case of TENORM materials (Technologically Enhanced NORMs), which are those radioactive materials of natural origin whose exposure potential has increased compared to the situation unaltered by human technological activity. Among the TENORMs, the case of phosphate sludges coming from the phosphoric acid production industry is especially relevant since it is a very important environmental problem [18,19] for which a definitive solution has not yet been found.

Finally, among the most current trends in the field of radioactive waste, it is worth highlighting the application of biological treatments [20] such as the sequestration of radionuclides through the use of bacteria that have the capacity to adsorb them specifically; and bioremediation, through the which radioactive compounds are transformed into non-radioactive ones by the metabolic action of microorganisms. In this sense, promising results are being achieved in the sequestration of uranium [21], Sr-90 and Ra-226 [22], as well as Tc-99 [23].

Through all these relevant topics, it is hoped that this special issue contributes to make visible and promote adequate management of all radioactive waste, which allows its application in conditions of sustainability.

Conflict of interest

Author declares no conflicts of interest in this paper.

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