Preparation Of Radium And Other Spent Sealed Sources Containing Long-Lived Radionuclides To Long-Term Storage

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ABSTRACT

At present time management of radioactive waste containing long-lived a radionuclides, is one of the most serious problems. The complexity of the management this kind of waste is due to extended half-life of these radionuclides. Hence it is difficult to predict not only long-term behaviour of packages with waste, but also conditions of containing geological medium. The spent sources containing long-lived radionuclides are not suitable for disposal in shallow ground repositories. They must be temporary stored in special engineered structures. Long terms storage of these sources require application of additional measures for diminishing of risk of incidents with them.

INTRODUCTION

Among spent sources used in scientific researches, medicine and industry, the greatest problem is represented the management of spent sources containing ^{226}Ra

The sources ^{226}Ra are one from the oldest kinds of radioactive waste. Their production was begun in the early of 20-th century and was terminated in extremity of 60-th years due to emerging of sources cheaper and safe in management. In connection with high reactionary ability of radium, the solubility of its salts and heavily leakages during the decay the majority of spent sources with radium represent a great potential danger to the environment.

The sources ^{226}Ra are stored directly in protective containers in special reinforced concrete repositories equipped by ventilation systems for evacuation of ^{222}Rn. Such method of storage does not correspond to modern requests of safety, and besides, as the practice shows, does not exclude unauthorized access or loss of sources.

PREPARATION OF SPENT SEALED SOURCES TO LONG-TERM STORAGE.

For preparation of spent sources to long-term storage two approaches are used:

Conditioning separate sources permitting to resolve the problem of the outflow ^{222}Rn to create an additional barrier and to protect against a contingency storage of sources.

Conditioning sources permitting to create additional isolating barriers excluding possibility of unauthorized access to sources and to create package suitable for final disposal in geological repositories.

In Russia for conditioning separate sources the method of inclusion in a metal matrix inside capsules from a stainless steel is used. The geometric sizes of capsules are selected with allowance for sources emplacement and internal cameras of standard containers for storage of sources.

Maximum to reduce temperature effect on sources three are used beforehand prepared capsules from a stainless steel and low melting alloys on the base of lead.

At the stage of preparation in the capsule for source the melt is filled up and with the help of special form the internal concavity for source is formed. This special form is inserted into the capsule with a liquid melt, and after hardening the latter is extracted.

The source is put into the prepared thus capsule by the manipulator and then the capsule is filled up by a small portion of melt, after that the capsule is closed by a lid. There is a drainage orifice in the lid intended for evacuation of melt surpluses from the capsule. The melt fills the drainage orifices in the lid, and after cooling fixes it, hindering unauthorized opening of the capsule.

This method of separate sources conditioning has some essential advantages against the method of capsulation by welding.

First the minimum temperature loads are supplied as the alloys have low melting temperature (in limits 100°C) and the main part of high temperature operations is executed without participation of sources.

Fig. 1. Corrosion-proof capsule, prepared for conditioning of sources (at the left) and the ready capsule (on the right)

Second, there are two additional barriers having high corrosion stability.

Third, the high ability of leaden alloys to plastic deformation enables to avoid origin of internal voltages in a matrix created in overpressure, without violation of matrix wholeness. An essential argument is also, that this method is simple and does not require with what or special equipment.

For preparation of long-lived spent sources to long-term storage on the centralized sites in Russia the technology supposing a storage conditioned of long-lived sources, in reinforce concrete containers was developed.

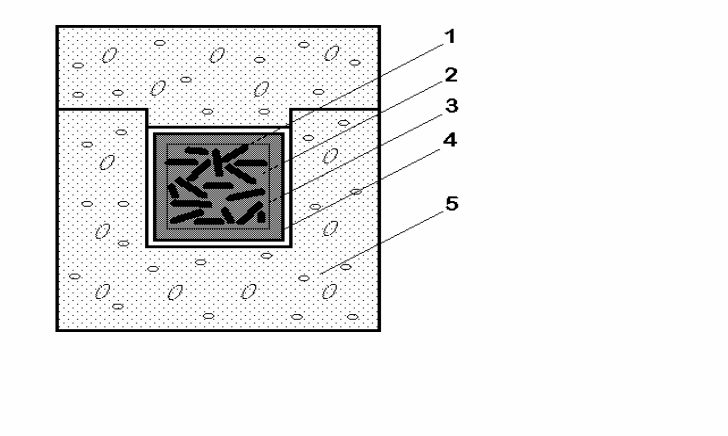

Fig. 2. A long-term safe storage of the spent sources with long-lived radionuclide. 1 - spent sources, 2 - metal matrix, 3 - basket, 4 - capsule, 5 - concrete container.

The isolation of sources from an environment is carried out by including them in a metal matrix from a low melting temperature alloy. The metal matrix prevents leakage of radionuclides from depressurized sources in an environment and reduces level of radiation. For conditioning neutron sources use alloys with the additives of cadmium and inserts in containers from hydrogen containing materials such as polyethylene. If necessary extractions of the spent sources a metal matrix may be melted.

The container protects sources from mechanical effects during of handlings and storage, ensures increase of physical guard level and reduces a level of radiation up to established by the acting norms of radiation safety. The conditioned spent sources in concrete containers place for a long-term storage in typical repositories for solid radioactive waste.

In summary it would be worth to mark, that in Russia and other countries, despite of significant achievements in the field of radioactive waste conditioning the problem of long-lived waste final disposal is not solved yet.

LITERATURE

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