

SNETP Forum

IRE-SOLVE PROCESS: AN INVENTIVE SOLUTION TO ADDRESS THE PRE-DISPOSAL OF SPENT ION-EXCHANGE RESINS



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Background



Thousands of cubic meters of spent, organic, ion-exchange resins (SIERs) are yearly produced from the operation of nuclear power plants all over the world. The increasing accumulation of such a waste at the storage sites is becoming an urgent issue. The direct conditioning of SIERs in cement



Prior Art

TREATMENT

EVAPORATION

The resulting liquor is very acidic and rich of sulphates and borates. This undergoes an evaporation process to concentrate it and the contaminants into a **sludge**.

matrices with a limited loading factor (~10 wt.%) yielded high volumes of the waste forms. Moreover, their scarce long-term durability due to the challenging nature of the waste, resulting into flammability, swelling, dispersivity and leachability of radionuclides, hindered the compliance with the waste acceptance criteria (WAC) of a repository.

CONDITIONING

The sludge is generally mixed with cement paste and cured.

Issues of compatibility between the sludge and the matrix hold back the implementation of the process at industrial scale.

iRE-SOLVE: integrated pRE-diSpOsaL of radioactiVE organic waste

TREATMENT

Advanced Fenton-like wet oxidation of SIERs at ambient pressure and temperature < 100 °C. H_2O_2 is used as oxidant. Iron and aluminosilicatecontaining **industrial by-products**, precursors of the conditioning matrix are used as catalyst for the first time.

DECONTAMINATION

The obtained liquor is decontaminated by adding some of the materials constituting the conditioning matrix, like the activator and the chabazite-rich tuff.

Lower content of sulphates and borates in the residue allows good compatibility with the following conditioning matrix, and higher waste loading factors (LFs).

CONDITIONING

The residue, containing contamination and part of the matrix constituents is added to the remaining part of the Alkali-Activated Material (AAM) formulation to prepare a grout. The waste form undergoes a period of curing in molds, preferably of 28 days.







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Treatment of up to 100 g of mixed SIERs loaded with B and stable Cs, Sr, Co, Ni, Gd. C content reduction > 95%

Quick decontamination (> 98%) by: basic solution up to pH 10-12 to precipitate the contaminants, except Cs and B. zeolitic tuff to cage Cs The yields were backed up with ¹³⁷Cs, ²²⁶Ra, ⁶³Ni, and ²⁴¹Am.

RESIDUE to be conditioned ISIN. Guida Tecnica n. 33 Criteri Di Sicurezza per la Gestione Dei Rifiuti Radioattivi Luglio; 2022.

	Rc of specimens with LF ~12 wt.% (MPa)	
	Direct conditioning in AAM	8 ± 1
WASTE FORM up to 35 wt.% of loading factor	Treatment and Evaporation in AAM	15 ± 2
	iRE-SOLVE process in AAM	21 ± 2

Future perspectives

- Life cycle assessment and life cycle costing analysis of the process.
 - Development of a simpler and more performing conditioning matrix.
- Looking for a **joint collaborative research** with a business partner for an **industrial scale** application.

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Intellectual Property



loading factor

European patent application (n° EP24156036, 6th February 2024)