

GEOPOLYMER MATRIX FACING WASTE ACCEPTANCE CRITERIA IN FRANCE

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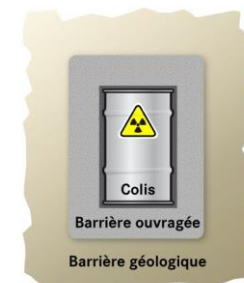
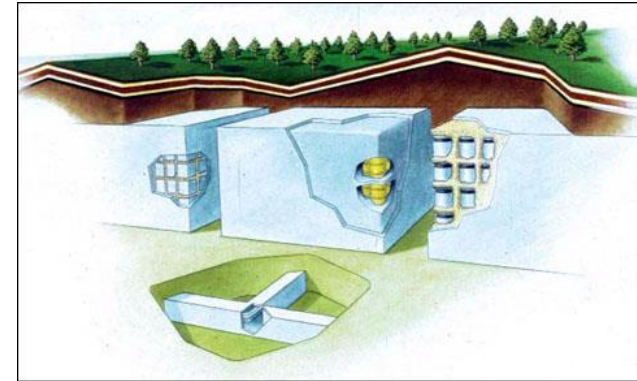
PREDIS WP5 webinar 30/03/2021
Innovations in liquid organic waste treatment and conditioning

Disposal concepts

Waste disposal concepts adapted to each type of waste must sequester radioactive materials from the environment until their radioactivity has decayed to an acceptable level

Repository safety is based on **three components**:

1. the **packages** containing the waste
2. the **repository** structures containing the conditioned packages
3. the **geology** of the site making up a permanent natural barrier



Principles of waste conditioning

Purposes of conditioning

- Ensure safe storage
- Enable transport and handling
- Ensure safe disposal
- ☞ For safety reasons, Andra disposes of **ONLY SOLID or SOLIDIFIED WASTE.**
- Waste is placed in a solid, stable, monolithic and confining form
- Waste is immobilised by embedding, encapsulation, or chemical incorporation into a matrix
- ☞ A package = matrix + buffer

Low and Intermediate Level Short-Lived waste (LIL-SLW)

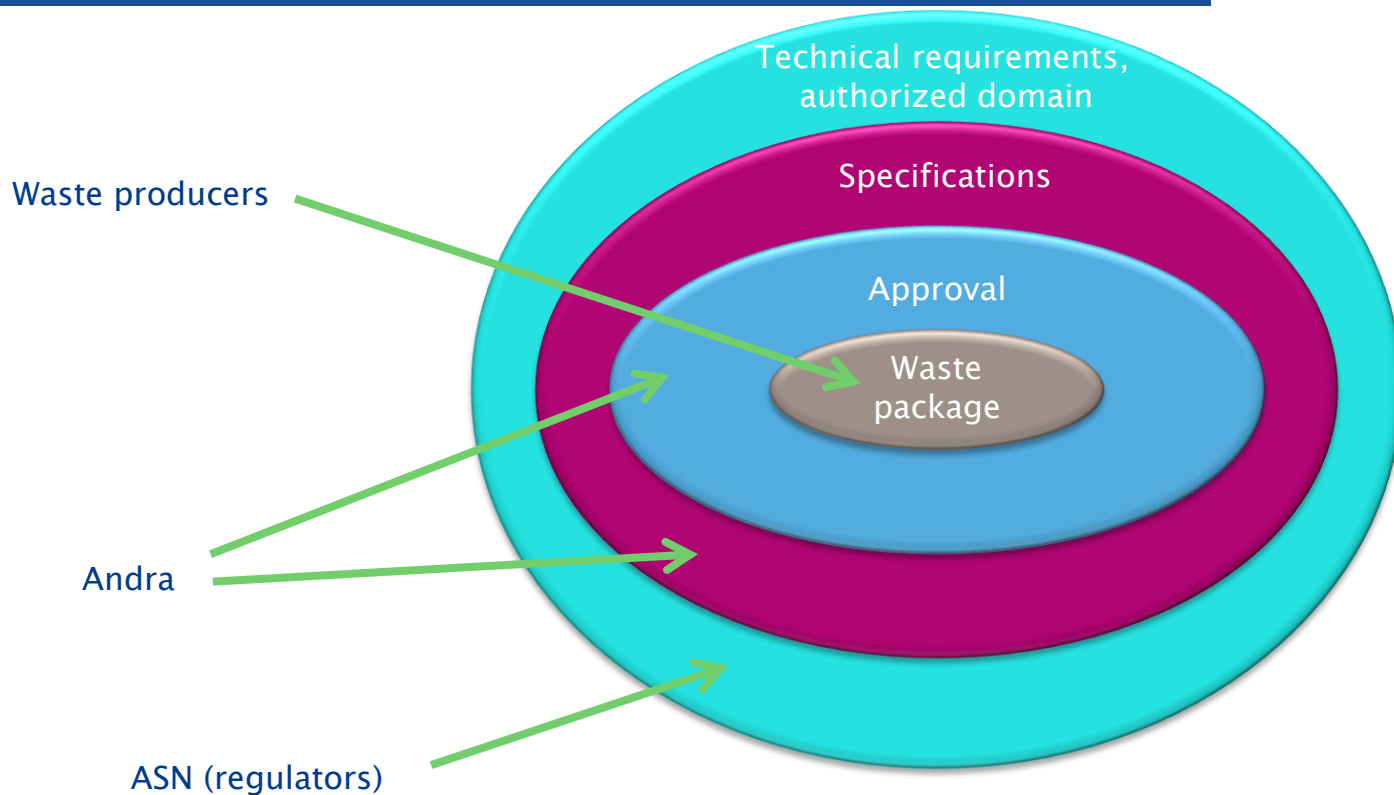
It is conditioned in a metal or concrete container and then encapsulated in concrete.

There is a specific type of package for the volume, radioactivity and nature of the waste: casks or drums made of metal or concrete

Encapsulation stabilises the waste and renders it inert: mortar, resin or bitumen



The Aube disposal facility (CSA): acceptance of waste packages



What's about new conditioning

For specific waste, cement encapsulation is not available

- Reactive metals
- Oils...

Development of new matrix by the waste producers

- Geopolymers
- Nochars
- Specific Cements....

How to manage the approval and specifications of this kind of new conditioning?

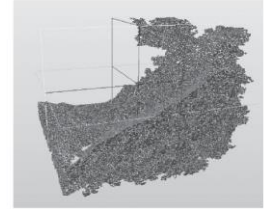
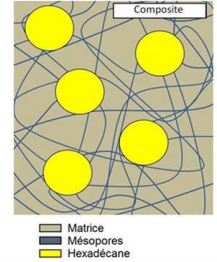


Approval and specification questions for geopolymer/oil composite

Organic/inorganic composite materials made by adding organic liquids into geopolymer matrices

Biphasic structure

- Separate oil droplets, connected by the mesoporal network
- Matrix : Geopolymer Skeleton



Main Approval and Specification questions :

- Presence of organic liquid trapped in the composite in the form of micro-droplets = Deviation from the permitted standard
➔ To be discussed with Regulators
- Before regulators acceptance, we have to demonstrate the composite stability under storage conditions

Cantarel, V.; Lambertin, D.; Poulesquen, A.; Leroux, F.; Renaudin, G.; Frizon, F. (2018) *Geopolymer assembly by emulsion templating. Emulsion stability and hardening mechanisms*. In : *Ceramics International*, vol. 44, n° 9.
Panel, B.; Davy, C. A. A.; Adler, P. M.; Hauss, G.; Bertin, M.; Cantarel, V.; Lambertin, D. (2020) *Water permeability of geopolymers emulsified with oil*. In : *Cement and Concrete Research*, vol. 135.

Approval and specification questions for geopolymer/oil composite

Which standard specifications are applicable to the Geopolymer matrix?

- resistance to leaching under cementitious water
- Integrity performance of the containment shell
 - swelling of the composite
 - chemical compatibility with other disposal components (metal or cement box)
- resistance to irradiation, etc.

What are the new/additional characterisation needs for these new system?

- Liquid immobilization sustainability during the surveillance phase (50 + 300 years)
 - Geopolymer matrix stability
 - Pore structure evolution and oil immobilization associated
- Assessment of initial and degradation complexant

Main R&D challenge : Liquid immobilization sustainability on the time scale of storage

Guaranty of none liquid release over 350 years under disposal conditions

Skeleton evolution under time and cementitious water leaching

- New phases? Stability of the structure (skeleton and porosity network)
- Interest of comparisons with archaeological analogues?

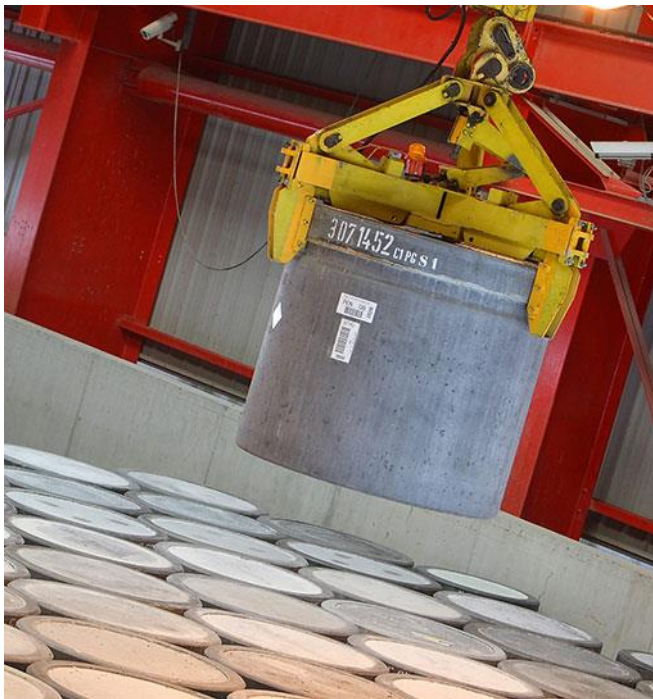
Pore structure distribution under time and cementitious water leaching

- Mesoporal network stability?
- Influence of Na/K substitution
- Stability of the connectivity between organic liquid network and meso-poral network?

Permeability of the composite with cementitious water and risk of oil leaching under time

Evolution of skeleton and porosity distribution under irradiation

- representativeness of properties on the time scale of the lab versus storage ?
- how to extrapolate the data obtained on a 350-year scale ?



Thank you
for your
attention