

Orano has over 40 years of commercial high-level waste vitrification experience, producing up to 1,100 glass canisters per year with significant waste loading—approximately 1 curie per gram of glass.

For over 12 years, Orano has used cold-crucible induction melter (CCIM) technology to overcome the limitations of current high-level waste (HLW) vitrification technologies in France. The CCIM process uses an induction melter with water-cooled walls that create a protective glass layer. It was developed to be used for new or unique corrosive effluent compositions impossible to treat with other technologies and to produce new waste containment matrices with higher waste loading.

This modular technology can process a wide range of HLW (e.g., effluents resulting from decontamination and decommissioning (D&D) operations, legacy waste, fission products). With higher waste loading it reduces the number of HLW canisters produced.

Advantages

The cooling of the crucible forms a solidified layer of glass that protects the equipment from the corrosive melt, which results in:

- Increased lifetime of the melter
- After the draining pour, the remaining glass is easily detachable and does not adhere to the melter structure
- After removal of the remaining glass the melter is clean and corrosion-free

The CCIM allows the temperature to be increased:

- Higher temperature allows faster waste digestion by the glass
- New robust waste containment matrices reachable with high waste loading
- High throughputs and continuous feeding

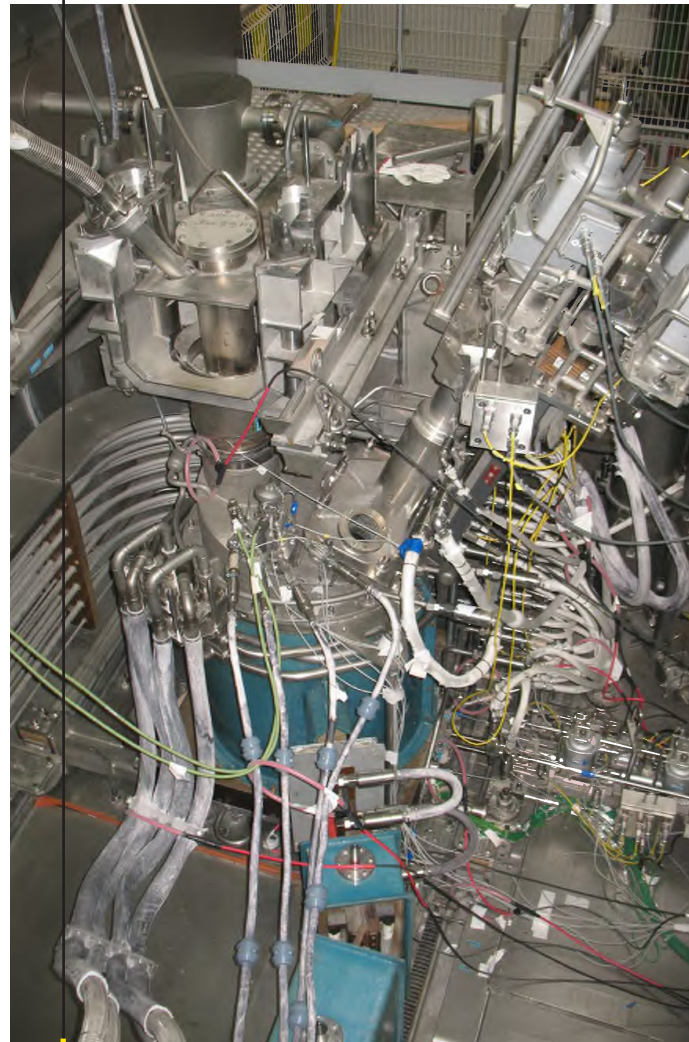
CCIM's modular and removable design ensures that:

- Most of the elements of the CCIM are remotely-removable and can be separately replaced

- Maintenance and replacement of elements can be performed with moderate sized maintenance tools

Contamination is kept at a low level due to the solid glass layer that protects the surface of the melter, which simplifies maintenance.

The vitrification of the whole inventory of the highly corrosive UMo legacy fission products was achieved with the CCIM utilized at the La Hague plant. The CCIM was also used to vitrify effluents from the La Hague UP2-400 facility D&D operations.



Top view of CCIM Scale 1 pilot at Orano R&D center identical to the one in operation at La Hague vitrification plant



CCIM hot cell at La Hague R7 vitrification facility

Process Integration

- The CCIM process was installed during operation inside an existing hot cell of the La Hague vitrification facility

Process operation

- The CCIM can process liquid or solid waste feed
- The CCIM melter is fed continuously to pour the melted glass in canisters and the unique off-gas treatment unit recycles particulate material and purifies the gas streams
- A high rate of waste incorporation is achieved

The CCIM was developed with a compact and modular design, resulting in simpler and more compact equipment that is easy to maintain.

CCIM Scale 1 pilot at Marcoule

The CCIM platform at the Marcoule site in France is self-contained and comprises all the systems and components to test new glass formulations and perform industrial scale continuous pilot demonstration runs. The platform includes a melter feed system, an industrial scale CCIM, a glass pouring station, a complete off-gas treatment system, and all related auxiliary equipment, including the control system.

CCIM Scale 1 pilot at La Hague

The La Hague Beaumont-Hague Research Hall, Orano's R&D center, is a Scale 1 inactive pilot of the operational facility used for operation and maintenance improvements as well as operator training.

CCIM in industrial operation at La Hague vitrification plant

CCIM industrial deployment has produced positive results:

- CCIM has been in commercial operation for over 12 years
- Produced high throughput up to around 135 kg/h/m² with continuous feeding
- Resilience to corrosion
- Major demonstrations of maintainability have been performed
- Over one thousand glass containers produced by the end of 2021

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