

PLASMA TREATMENT OF RADWASTE

BELGOPROCESS offers extensive experience in plasma treatment of radwaste. We combine our expertise in plasma and flue gas treatment systems with design and engineering expertise and our operational experience in processing nuclear waste to offer safe, cost-effective and durable solutions for the challenging problems regarding treatment of problematic wastes.



Low and intermediate level radioactive waste is often mixed with hazardous waste and various non-combustibles. Historically, these wastes have been treated by separating the combustibles from the non-combustibles and processing them separately through incineration, super-compaction, cementation and other encapsulating technologies. However, this approach is costly and increases the risk of personnel exposure.

BELGOPROCESS offers a proven plasma treatment technology that uses a high-temperature plasma processing technique with operating features that eliminate the personnel exposure and costs associated with sorting, characterizing and handling his waste and gives a final product that meets most stringent acceptance criteria for final storage.

PLASMA TECHNOLOGY

Plasma is a highly desirable heat source for treatment of problematic radioactive waste. Plasma treatment uses an electric arc to generate temperatures in the gas stream that can achieve several thousand degrees centigrade causing the rupture of molecular structures of materials into their constituent atoms. Its high temperature range of 5 000 to 10 000 °C can treat the radioactive waste as is.

The non-combustible and other inorganic materials are melted into a glassy slag containing most of the radioactive isotopes, and subsequently transferred into an external drum and cooled. The organic materials are vaporized into a syngas and afterwards oxidized in an afterburner. The unwanted gaseous by-products of the combustion process are reduced to an acceptable level by using a proven dry scrub flue gas system, based on that of the BELGOPROCESS CILVA incinerator for radioactive waste.

MULTIPLE BENEFITS

Plasma technology offers a number of benefits and has a wider range of applicability compared to conventional methods of incineration:

- Applicable to solid organic and inorganic waste, including asbestos, and also to other waste types such as drummed spent resins and liquid waste
- One single process can treat the waste as generated (no prior treatment); this implies less dose uptake and risk for contamination
- The final waste form is robust, free of organic material, and suitable for long term storage and disposal
- High volume reduction factor that minimizes the overall costs of waste storage and final disposal:
 - VRF~6 waste containing mostly metals and debris
 - VRF~15 drummed mixed waste
 - VRF~80 primarily organic waste
- The heat source is a plasma, which produces less flue gasses and greenhouse gas CO₂

In addition, as plasma technology can recondition previously conditioned waste packages that no longer meet the present acceptance criteria for final disposal, it offers a solution to the growing demand for improved quality of final waste forms. Therefore, even historical conditioned waste in a bituminous or concrete matrix, which doesn't meet current acceptance criteria for conditioned waste can be retreated in a plasma facility, resulting in a conditioned product that does meet these criteria.





WIDE APPLICABILITY

Technology	Waste type						
	Organic liquids	Inorganic liquids	Organic solids	Inorganic solids	Mixed (in) organic solids	Mixed (in) organic liquids	Spent resins
Calcination	NA	A	NA	NA	NA	NA	NA
High temperature incineration	A	A	A	NA*	A*	A	A
Incineration	A	A	A	NA*	A*	A	A
Melting	NA	NA	NA	A	NA	NA	NA
Plasma	A	A	A	A	A	A	A
Pyrolysis	A	NA	A**	A**	A**	A	A
Synroc	NA	NA	A	A	A	NA	NA
Thermo-chemical treatment	NA	NA	A	A	A	NA	A
Vitrification	NA	A	A**	A**	A**	NA	A

A = technology applicable to waste type

NA = technology not applicable to waste type

LA = technology has limited applicability

* = Small pieces of inorganic acceptable without causing damage or plugging the system

** = Applicable only for the granular powder form of this waste type

PROVEN TECHNOLOGY

A first full-scale plasma system at the ZWILAG facility in Switzerland became operational beginning of 2004 and has been operating successfully. Two campaigns per year of about 10 weeks are organized to treat the waste. During each campaign about 500 drums or 100 tons are treated. The Joint Venture IBERDROLA - BELGOPROCESS, with MONTAIR as a main subcontractor, has built a plasma melting facility for the Kozloduy Nuclear Power Plant in Bulgaria. The facility started operations mid 2018.

AN OPTIMAL SOLUTION FOR LOW LEVEL RADIOACTIVE WASTE MINIMIZATION

As the plasma technology offers a single process solution for the treatment of radioactive and problematic chemical waste, there is no need for costly sorting or pre-treatment infrastructures or separate treatment facilities for non-burnable wastes. In addition, due to its high volume reduction factor, plasma technology significantly reduces storage and disposal costs. ALARA principles are also applied. There is no need to open waste packages, which eliminates the risk for contamination to operational staff and limits dose exposure.

The final waste form is a glassy slag that is free from any organic material and liquid/sludge and is very suitable for long-term storage and disposal due to the physical-chemical and mechanical stabilization of the waste.

KOZLODUY FACILITY

- Building size: 30 x 10 x 15 m
- Fixed furnace with tilt design
- 500 kW non-transferred arc plasma torch
- Primary treatment chamber temperature: 1100 - 1500°C
- Continuous feed system (2-stage shredder)
- Waste:
 - o Historical and operational solid, liquid waste, spent ion exchange resins
 - o Typical radioactivity: 5E5 Bq/kg
- Throughput: 65 kg/h - 250 tons per year (40 operational weeks)
- Off-gas system based on Belgoprocess CILVA facility
- VRF:
 - o Untreated waste (bags): ~80
 - o Precompacted waste (200 liter drums): ~20
 - o Supercompacted waste (pellets): ~2

BELGOPROCESS

offers integrated nuclear waste management and de-commissioning services, driven by safety and backed by hands-on industrial experience. The company is an expert in minimizing the amount of radioactive waste produced and maximizing release of decontaminated material while optimizing operational costs.

BELGOPROCESS' activities are performed within a company-wide quality assurance system certified as being in conformity with ISO 9001, ISO 14001, ISO 17025 and OHSAS 18001.

BELGOPROCESS

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