

Vitrification of the incineration residues

A. BORDERES

Europlasma, Parc d'Activités du Magne, 135 rue Pierre Ramond, 33160 Saint-Médard en Jalles

1. Forward

What is vitrification ?

Far more than a stabilising process, vitrification, is a process that uses very high temperatures, which modify the state of the residue. The end product is then transformed into a type of glass that is innocuous for the environment and can be re-use. The vitrification process is an alternative to cold stabilisation followed by disposal in a landfill. The vitrified end-product obtained is now a valuable source of secondary raw materials, with applications particularly in the construction and road building industries.

In ecological terms, fly ash vitrification offers major advantages as regards the quality and long-term behaviour of the products obtained. It also guarantees that the dioxins and furans initially present in fly ash is totally destroyed.

The development of the vitrification alternative was made possible when the Greater Bordeaux Metropolitan Community (GBMC), via SO.CO.GEST. (Community management services), initially awarded the contract for the design, construction and experimentation of a pilot industrial facility for ash vitrification at the domestic waste Waste-To-Energy Facility in Cenon, to a temporary consortium of companies (consisting of Europlasma CT. Environnement - Novergie Sud-Ouest) for which Europlasma is the principal contractor.

2. Presentation of the vitrification unit

The Europlasma plasma-torch vitrification process – the first application in Europe of this type - has been in operation since February 1997 at the Bordeaux Municipal Solid Waste (MSW) Waste-To-Energy Facility located at Cenon.

The MSW Waste-to-Energy Facility of Cenon treats each year 120 000 tons of MSW and 18 000 tons of sludge.

A wet-type system is used to purify the exhaust gas produced by the Waste-To-Energy Facility, with the dust removed by electrostatic filters and then neutralised by washing. It produces 2 500 tons of ash each year.

The vitrification process has been developed with the view to allowing maximum integration of the vitrification unit with the Waste-To-Energy Facility. The unit was sized such that it could treat the site's total fly ash output. So, the vitrification Unit treats approximately 10 tons of fly ash per day.

3. Description of the vitrification facility

3.1. The vitrification reactor (furnace)

The fly ash is injected continuously in the vitrification melting reactor.

In the central part of the reactor, a plasma torch produces a flow of plasma (very hot air) which generates thermo-chemical reactions. So, the ash is melting at a temperature of over 1450°C. The residence time of the ash inside the bath is controlled to ensure that there are no incompletely-melted materials, and that the end-product is perfectly homogeneous. In this way, the vitrification process produces a high quality slag.

After passing through a resting zone, the end-product is expelled via a flow outlet into a cooling and conditioning unit, which is adapted to the final use of the product.

It is to be noticed that the vitrification process by plasma torch is not a combustion or burning process.

3.2. The plasma system

Plasma is sometimes referred as the "fourth state of matter" because it is a special form of gaseous matter that conducts energy. Indeed, plasma is a gas that has been ionized. It is produced by heating a gas through an electric arc created between two electrodes. A gas used in this way provides a source of energy that is reliable over time. This is the basic principle of the plasma torch.

The plasma torch used in the Cenon facility is a blown-arc (non-transferred), tube-type torch that uses air as plasmagenic gas. This torch consists of two cooled electrodes joined by an air injection chamber. The maximum power of the torch is 700 KW.

3.3. The effluent treatment system

The exhaust gas produced in the vitrification reactor, after being pre-processed, is re-injected into the facility's main exhaust gas processing unit. The water used to pre-process the vitrification gas is directly re-injected into the facility's water treatment unit. In addition to the technical trade-offs, whose aim is to limit both the capital expenditure and to achieve acceptable treatment costs, this integration also produces significant savings in terms of the number of operators required to run the vitrification unit.

4. Prospects

The initial results obtained at the Cenon facility in operation since February 1997 and equipped with the plasma vitrification process designed by Europlasma have proven the validity of the initiative implemented by Greater Bordeaux Metropolitan Community. This initiative aims to enhance the value of domestic waste disposal through generating energy and producing re-usable materials. As a result of the above, the vitrification unit in Bordeaux will be able to run as an industrial plant 24 hours per day, 7 days per week. Moreover, the Bordeaux Metropolitan technical services opted to use the end product for applications such as urban materials and fittings (e.g. paving blocks, slabs, public benches, etc.).

5. Conclusion

Vitrification is now a technology that has been proven under industrial conditions. It is considered as the best alternative for the elimination of toxic waste, and it provides local authorities and industrialists with the means to control the entire waste elimination process because:

- It eliminates incineration-related problems caused by toxic by-products
- It destroys the dioxins and furans contained in fly ash
- The glassy end-product is no longer hazardous
- It saves storage capacity for other type of hazardous waste, which cannot be treated.

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