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DESIGN AND CONSTRUCTION OF A DEMONSTRATION PLASMA GASIFICATION / VITRIFICATION UNIT FOR WASTE TREATMENT

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EXTENDED ABSTARCT

According to the European Environmental policy and strategy hazardous waste constitutes one of the waste streams that should be dealt with special priority. A variety of techniques and methods can be used in order to ensure hazardous waste effective management. This paper deals with plasma technology, which is an innovative thermal method for hazardous and non-hazardous waste treatment, and in particular, with the design, construction and operation of a pilot plasma waste treatment unit.

Thermal plasmas have the potential to play an important role in a variety of chemical processes. Compared to most gases even at elevated temperatures and pressures, the chemical reactivity that is characteristic of these plasmas is far greater. Plasma gasification / vitrification is a technologically advanced and environmentally friendly process of disposing of waste materials, converting them to commercially usable by-products.

In the framework of a LIFE - Environment project, a pilot plasma gasification / vitrification system was designed, constructed and installed in Greece in order to examine the efficiency of this innovative technology in treating industrial waste. The pilot plant, which was designed to treat up to 50 kg waste per hour, has two main sections: (i) the furnace and its related equipment and (ii) the off-gas treatment system, including the secondary combustion chamber (SCC), quench and scrubber.

In this work, detailed data concerning the construction and operation of the plasma unit is presented. Waste is fed to the electric arc furnace from a feed hopper, through a rotary air lock. In the furnace, the inorganic portion of the waste melts and is tapped periodically in a slag mold, to produce solid slag blocks, or in water, to produce slag granules. The organic portion of waste is converted to synthesis gas, by the addition of metered amounts of air and steam. This synthesis gas is then fed to the secondary combustion chamber, where it is combusted with air to form carbon dioxide and water. The temperature in the SCC is maintained at 1100°C using propane burners. The combustion gases leaving the SCC are cooled down rapidly in the quench vessel by atomized water. The combustion gases are passed through a packed bed scrubber where the acid components of gas (such as HCl and SO_2) are neutralized by a caustic soda solution. Part of the water being re-circulated in the scrubber is sent to drain after filtration through a bag filter. The gases through the whole system are pulled through an induced draft blower, which maintains all equipment under a negative pressure.

Key words: plasma technology, gasification / vitrification process, waste management, hazardous waste, synthesis gas, slag.