

National Technical University of Athens School of Electrical and Computer Engineering Inter – Departmental Postgraduate Course "Energy Production and Management"

ABSTRACT OF POSTGRADUATE STUDY:

« EQUILIBRIUM MODEL DEVELOPMENT FOR SOLID WASTE PLASMA GASIFICATION AND TECHNICAL-ECONOMIC STUDY »

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ABSTRACT

Plasma gasification technology has been demonstrated in recent studies as one of the most effective and environmentally friendly methods for solid waste treatment and energy utilization. This study focuses on the thermodynamic analysis of plasma gasification technology, which includes prediction of the produced synthesis gas and energy calculations.

To that purpose, an equilibrium plasma gasification model, called GasSim, is developed here by using recent thermodynamic data. The model also has the capability of energy calculations that are required for the optimization of such processes. This is demonstrated by the presentation of the effect of the most important process parameters on the energetic performance of the process.

The thermodynamic data that are required for development of the equilibrium gasification model are the Gibbs energies of formation at 298 K, the enthalpies of formation at 298 K and the temperature dependent heat capacities cp, which are required to evaluate the change of the equilibrium constants with temperature.

In process analysis studies, the study of each operational parameters effect is required in order to decide which is the optimum scenario for high energy efficiency to be achieved. In this work, parametric analysis has been conducted for a characteristic waste material. Three parameters are considered: feed moisture content, oxygen and gasification temperature and their effect on the synthesis gas composition. The objective of the process analysis is to identify the conditions that optimize the production of electrical energy (net electricity), which is equal to the electrical energy produced from the gas engine minus the electrical energy consumed in the reactor.

Finally, the economic evaluation of the plasma gasification process is made using the optimization results for the sizing of the equipment. The economic analysis of this process is made by estimating the fixed installation cost and the annual operating cost in order to assess the viability of the investment plan.

Plasma gasification offers an attractive and environmentally sound option for the treatment and energy utilization of solid wastes. This study demonstrates the energy utilization potential of solid waste treatment using an integrated process involving plasma gasification, pre-drying and electric energy production.