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PLASMA ARC MELTERS FOR CONVERSION OF WASTE TO VALUE-ADDED PRODUCTS

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ABSTRACT

Materials recovery facilities (MRFs) and waste-to-energy (WTE) systems are making significant contributions to reducing the need for landfill disposal by producing useful products. The purpose of this paper is to examine the effects and costs when using plasma arc melters in the thermal treatment process. Plasma arc melters can decrease offgas volume, pyrolize organics, reduce equipment size, separate materials, and generate a homogeneous, stable, solid residue. However, they use electricity for power and may be more expensive to operate. The differences between plasma torch and arc melters is discussed and a typical melter system presented. Various recycling or product output options are discussed based on the composition of the input waste stream composition. An economic comparison between different systems includes both capital and operating costs.

INTRODUCTION

Municipal Solid Waste (MSW) management has evolved from simple dumping in landfills and the oceans to improved classified landfills and a number of methods to recycle or produce value added products from the waste material. Improved landfills include barriers to separate the leached products from the environment and to meet stiffer landfill regulations. Some landfills are configured to route the methane gas resulting from decomposition to units for cogeneration purposes. Sorting and recycling newspapers, various plastics, and different colored glass has joined the recycling of metal as an economical practice in MRFs.

The initial attempts to incinerate solid waste are often met with public resistance because of the lack of control of the combustion products, inadequate air pollution control, and the accompanying offensive odor from the input waste. The early waste to energy plants used several methods to produce and recycle the energy. The water-walled incinerators were used to provide steam for district heating or to steam turbines, but many of these suffered from the same community problems as incinerators. Attempts to use the combustion gas products directly in gas turbines went through the learning process of how well the particulates and acid forming gases must be separated out to give acceptable maintenance periods. Some processes converted commercial solid waste in a dry process to briquettes to be added to the coal in stoker-fed power plants. Early practices have led to the present successful WTE plants that burn the solid waste to generate steam for turbine-generator production of electricity. The latest trend appears to be to combine the MRF on the front end of a WTE plant for an increase in overall recycling efficiency (Hilts, 1994).

There are a number of other processes in development that can be used for converting MSW, as well as hazardous wastes, into recyclable products with either a drastic reduction in volume or an elimination of an "ultimate" waste. An ultimate waste is defined here as that which would need to be placed in a repository or landfill. The Molten Metal Technologies (MMT) system is an induction-heated molten metal bath in which the waste material is passed through the molten metal under a baffle, becoming transformed into simple gaseous or vapor compounds and reformed on the other side of the baffle (MMT, 1993). Some constituents remain in the bath or rise to the top as slag. The composition of the slag and metal bath can apparently be (and must be) controlled to produce the desired products. The process is capable of some sophisticated partitioning, but has yet to be demonstrated in practice, and is probably size limited for MSW application.

Another method uses plasma arc processes, to be discussed below, with commercially available equipment that ranges in size from 10 kW (10 kg/h) to 250 MW (250 tonnes/h). This method has the advantage of more than 50 years of development in the related scrap melting, steel smelting, mineral wool making industries, and their auxiliary equipment industries.

This paper discusses the use of plasma arc melters in systems for treating MSW, including a discussion of different types of plasma arc melters (PAM^{tm}), types of PAM^{tm} waste treatment systems, various