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### TECHNICAL AND ECONOMIC IMPACTS OF PRE-SHREDDING THE MSW FEED TO MOVING GRATE WTE BOILERS

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#### ABSTRACT

Chemical rate and heat transfer theory indicates that the combustion performance and productivity of a moving grate waste-to-energy boiler should be enhanced by means of pre-shredding of the MSW, thus reducing the average particle size, homogenizing the feed, and increasing its bulk density by an estimated 30%. However, the capital, operating and maintenance costs of the shredding equipment should be low enough so that existing or new WTE facilities consider pre-shredding of the MSW. In cases where MSW is transported to a central WTE from a number of Waste Transfer Stations (WTS), pre-shredding may take place at the WTS, thus increasing density and decreasing transportation costs. This is a mechanical engineering study that examined the evolution and present state of shredding equipment since 1994 when the last WTE shredder in the U.S. was installed at the SEMASS facility. The quantitative benefits realized through the pre-processing of MSW by means of modern shredding equipment are evaluated both for the traditional high speed hammermills and the new generation of low-rpm, high-torque shredders. The combustion characteristics of shredded MSW were analyzed and compared to those of the “as-received” material that is presently combusted in mass burn WTEs. The emphasis of the project has been on equipment that can be integrated in the traditional flowsheet of a WTE and serviced readily. The most important criterion in the final design will be that the economic and energy benefits of pre-shredding be clearly greater than the conventional operation of combusting as received MSW.

#### INTRODUCTION

Municipal solid waste is a mixed stream of widely varying composition and particle size that is continuously generated by

our society. Its management and disposal in an environmentally sound manner is a difficult task and has seen large improvements over the past decades. Incineration of MSW as a means of reducing its volume and facilitating disposal has been a common waste management technique for centuries, yet the majority of incinerators in the U.S. did not recover the heat of combustion generated via MSW incineration, until the mid seventies. At this time, 88 Waste to Energy plants in the U.S. and over 600 worldwide are a clean and safe way of disposing MSW and also recovering energy, in the form of electricity and heat, and metals.

One of the reasons that there have not been WTE facilities in the U.S. for several years is the very high capital cost of new plants. It is believed that one way of increasing the specific productivity of such plants, and thus reducing their size and capital cost, may be by pre-shredding of the MSW, thus homogenizing and increasing the density of the feed to the grate. This study evaluates the potential benefits that pre-shredding may have on MSW management, both by means of combustion with energy recovery and of landfilling in regulation landfills.

Most of the present WTE facilities are based on the combustion of “as received” MSW, commonly referred to as “mass burn” or “stoker” combustion. Refuse Derived Fuel (RDF) is a less widely used form of MSW in WTE facilities. In the U.S., an estimated 6 million tons of MSW are used as the fuel of RDF WTE facilities, i.e. 23% of the total MSW combusted in the U.S. The RDF fuel is MSW that has undergone treatment to remove non-combustibles, with shredding being the first step in the pre-processing of MSW to RDF. In RDF plants, shredding is followed by some sorting and recovery of non-combustible materials such as glass, ferrous and non-ferrous metals. However, the recovery of non-ferrous