

**AN INVESTIGATION INTO THE SYNGAS PRODUCTION FROM MUNICIPAL  
SOLID WASTE (MSW) GASIFICATION UNDER VARIOUS PRESSURES AND  
CO<sub>2</sub> CONCENTRATION ATMOSPHERES**

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**ABSTRACT**

The Municipal Solid Waste (MSW) gasification process is a promising candidate for both MSW disposal and syngas production. The MSW gasification process has been characterized thermo-gravimetrically under various experimental atmospheres in order to understand syngas production and char burnout. This preliminary data shows that with any concentration of carbon dioxide in the atmosphere the residual char is reduced about 20% of the original mass (in an inert atmosphere) to about 5%, corresponding to a significant amount of carbon monoxide production (0.7% of CO was produced from a 20mg sample with 100ml/min of purge gas at 825°C).

Two main steps of thermal degradation have been observed. The first thermal degradation step occurs at temperatures between 280~350°C and consists mainly of the decomposition of the biomass component into light C<sub>1-3</sub>-hydrocarbons. The second thermal degradation step occurs between 380~450°C and is mainly attributed to polymer components, such as plastics and rubber, in MSW. The polymer component in MSW gave off significant amount of benzene derivatives such as styrene. In order to identify the optimal operating regime for MSW gasification, a series of tests covering a range of temperatures (280~700°C), pressures (30~45 Bar), and atmospheres (100% N<sub>2</sub>, 0~20%CO<sub>2</sub>+Bal. N<sub>2</sub> with/without steam) have been done and the results are presented here.

**1. INTRODUCTION**

As the world looks to manage solid waste and reduce greenhouse gases, an integrated approach to waste management should be considered. In 2006, 251 million tons of MSW was generated in the U.S. 138.2 million tons of this waste (55.1% of total generation) was landfilled and more than

31 million tons (12.4% of total) of materials were combusted with energy recovery[1, 2]. In 2003 Waste-to-Energy (WtE) facilities converted MSW into 440 trillion BTU of usable energy, which was approximately 0.4% of total U.S. demand. While Combustion techniques are widespread and well known throughout the WtE industry, gasification is a promising alternative technology, which may be attractive in that the products other than heat and energy are produced.

The gasification process transfers some of the heating value of the solid fuel to a gaseous energy carrier, due to the advantages of a gas over a solid fuel[3]. For example, gases are easy to clean, transport and to combust efficiently with less excess air and less lower levels of some types of pollutants[4]. Many studies have been carried out on gasification of various feedstocks from biomass[5, 6] and coal[4, 7-12]. Recently, according to tremendous consumption of polymer (plastics & rubbers), the gasification is appearing as an interesting solution for utilization of plastic and rubbery wastes even though there has not been much work done at the pilot scale. For example, Sumitomo Metals in Japan successfully produced dioxin-free and high calorie purified gas via Poly-Vinyl Chloride (PVC) gasification[12].

Due to the heterogeneous MSW matrix, however, only limited information on MSW gasification is available even though the gasification process for each components of MSW has been investigated[13-15]. Indeed, MSW is composed of ~60% biomass or biomass derived components including yard trimmings, wood, food scraps, and paper, which can be an advantage in terms of carbon credit. Thus, MSW conversion via gasification or combustion should be encouraged as part of a strategy for CO<sub>2</sub> abatement.

The objective of this work is to investigate the MSW gasification process, and enhance the syngas production using CO<sub>2</sub> as a feedstock[16]. Thus, MSW samples have been investigated thermo-gravimetrically under various CO<sub>2</sub> concentrations. In order to extend this understanding to a more