

## Energy Recovery from Municipal Solid Wastes by Gasification

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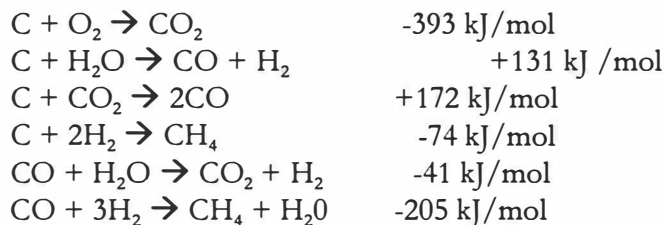
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### Abstract

Recovery of energy from MSW by combustion in Waste-to-Energy (WTE) plants reduces landfilling and air/water emissions, and also lessens dependence on fossil fuels for power generation. The objective of this study was to assess the potential of gasification processes as an alternative to the combustion of MSW. Gasification uses a relatively small amount of oxygen or water vapor to convert the organic compounds into a combustible gas. Its advantages are a much lower volume of process gas per unit of MSW and thus smaller volume of gas control equipment; also, gasification generates a fuel gas that can be integrated with combined cycle turbines or reciprocating engines, thus converting fuel energy to electricity more efficiently than the steam boilers used in combustion of MSW. The disadvantages are the need to pre-process the MSW to a Refuse Derived Fuel (RDF) and the formation of tars that may foul the downstream gas cleaning and energy conversion systems. This paper presents two prominent gasification processes and compares their energy characteristics with a mass burn WTE and a suspension firing WTE that uses shredded WTE. The results showed potential energy and capital cost advantages for gasification. However, long-term operating results from industrial plants are needed for gasification to become a practical alternative to combustion.

### The Gasification Process

Gasification is a thermochemical process that consists of two stages: In the first, pyrolysis releases the volatile components of the organic compounds at temperatures below 600°C (1112°F) and results in a char consisting of fixed carbon and the inorganic compounds in the feed. In the second stage, the carbon in the char is reacted with steam, air, or pure oxygen. Gasification with steam (“reforming”) results in a hydrogen and carbon dioxide rich “synthetic” gas (syngas). Gasification with air produces a high-N<sub>2</sub>, low Btu fuel gas and with oxygen a high Btu mixture of carbon monoxide and hydrogen. The exothermic reaction between carbon and oxygen provides the thermal energy required to drive the pyrolysis and char gasification reactions. The basic gasification reactions are either endothermic or exothermic and their rates depend on temperature, pressure and oxygen concentration:



Wood-fired *downdraft gasifiers* (Figure 1) have been used for a long time to power the engines of buses and other vehicles. The fuel and air supply are introduced at the top and the gases flow through the combustion bed. A gas suitable for an internal combustion engine. Downdraft gasifiers are not suitable for waste treatment because they require a low ash fuel to prevent clogging.