Scrap Tires in Waste-to-Energy Plants: Treatment and Emission Control

Eilhann Kwon & Marco J. Castaldi

Department of Earth and Environmental Engineering [HKSM]

Columbia University in the City of New York, NY, 10027

The conversion of Municipal Solid Waste (MSW) to energy in Waste-to-Energy (WTE) facilities has been recognized as one of the means of effective waste management. The process concentrates the combustible components of MSW, and results in a fuel such as a waste tire with higher value. A series of Thermo-Gravimetric Analysis (TGA) coupled to Gas Chromatography/Mass Spectroscopy (GC/MS) has been done under various heating rates and atmospheres in order to understand and investigate the decomposition of waste tires via combustion and gasification/pyrolysis. The major objective of this work is to develop a mechanistic understanding of waste tire decomposition from starting constituents to final products.

One of the most significant findings was the observation of a plateau in the reaction at high temperature with oxygen that divided the thermal degradation into a primary and secondary reaction mechanism. The primary mechanism induced devolatilization while the secondary reaction mechanism induced a combustion reaction whose rate was proportional to the oxygen

concentration. Direct evidence of this was the identification of epoxide chemical species using GC/MS analysis of produced gases.

Chemical releases from the thermal degradation of SBR, IR, and a waste tire have been measured with a GC/MS at heating rate 10C˚/min and 20C˚/min in various atmospheres. Chemical analysis of a waste tire using a GC/MS ensures that attribution of the thermal degradation products arising from SBR and IR is significant and measurably distinguishable. A significant amount of benzene derivatives were observed leading to conditions that was favorable for generating Polycyclic Aromatic Hydrocarbons (PAHs). Thus, benzene derivatives were investigated intensively along with their structural isomers, which lead to a mechanistic understanding of PAH formation.

Finally an attempt to approach more realistic test condition was made using a flow-through reactor for pyrolysis of real waste tire. Significant Volatile Organic Carbons (VOCs) including benzene derivatives, PAHs, and Hetero N-containing PAHs were observed. This study provides new data for the overall development and validation of detailed reaction mechanisms that can describe the thermal degradation of waste tire.