Waste to Energy (WTE) effort in the Combustion and Catalysis Laboratory (CCL) at Columbia University under the direction of Marco J. Castaldi, assistant professor in the Earth & Environmental Engineering Department. Contact: mc2352@columbia.edu or 212-854-6390.

**Waste to Energy (WTE)** – This effort is focused on understanding the many aspects of waste to energy technologies as well as developing novel approaches toward waste to energy. In addition, detailed research is ongoing that strives to understand the different phenomena occurring in WTE combustion and gasification systems. For example, kinetic reaction rates and mechanisms are being elucidated for waste components under various conditions. The conditions being investigated range from current operating systems to more forward looking advanced designs that target maximizing efficiency and material recovery while minimizing adverse environmental impacts. The waste components include, but are not limited to, waste tires, municipal solid waste (MSW), medical wastes, combined MSW and sewage sludge, hazardous wastes as well as co-feeding fossil fuel with waste components.

**Results to date**

Decomposition steps for SBR are shown. First there is breakage between the ligand and butadiene backbone which results in some hydrogen liberation. The backbone can continue to be hydrogenated to various extents leading to the mixture of C\(_4\)'s which were observed in GC analysis. The styrene ligand can undergo various transformations leading to the substituted aromatics observed in the TGA effluent.

To provide a guide for the development of the decomposition mechanism shown above, gas analysis of the reactor effluent is done using GC/MS. A representative plot is shown to the left, which provides information on the evolution of various chemical species over different temperature ranges. Among the substituted aromatics, concentrations of toluene and ethyl benzene are dominant. Indicating gas phase addition reactions occurring where light hydrocarbons are combining with the aromatic ligand released from the SBR base. This shift in maximum concentration with temperature is also observed in the formation of higher order PAH species.
To better understand the likelihood of a proposed decomposition mechanism based on the data, Thermo-chemical calculations are done. The figure below shows the energy of formation going from reactant SBR to various product or intermediate species. This figure shows the most likely pathway for SBR decomposition is to go through a butadiene intermediate followed by hydrogenation. If an aromatic ligand is released during the decomposition, the likely product species would be toluene, as evidenced by the lower heat of formation.

References:


