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SJSU Undergraduate Research Grants

Thermal Decomposition of Polypropylene

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Abstract

The accumulation of plastic wastes has become a globally threatening problem the world community has to face. Many ways to deal with the plastic wastes are already in use but none offer an ideal solution.

At the core of our research, we want to explore the impact that commonly used food items have on the thermal properties of polypropylene (PP) during decomposition. This will aid in more efficient ways to utilize recycling routes and find solutions to commercial, residential, and industrial applications.

Scoping studies suggest common food items have an impact on the thermal properties of polypropylene.

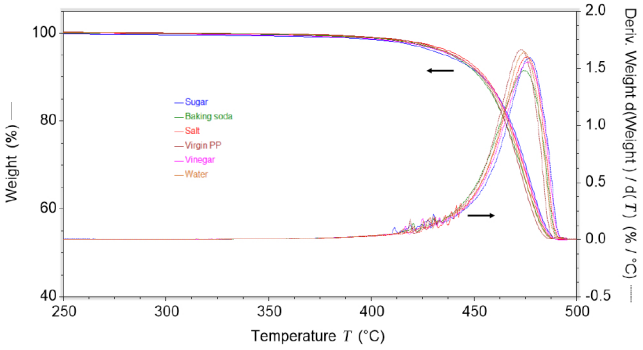
Project Activities or Findings

Scope: Samples of polypropylene were soaked in the following solutions, representing 'contaminants' from food waste:

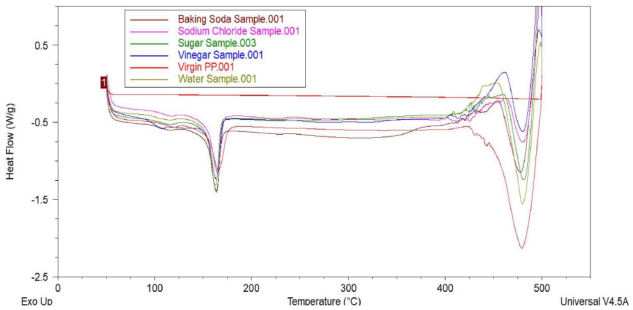
- 10% Sodium Chloride
- 10% Sugar
- 10% Baking Soda
- Vinegar
- Water
- Control group: Virgin polypropylene

Procedure: The plastics were soaked for 14 days and then decomposed in a thermogravimetric analyzer (TGA) and a differential scanning calorimeter (DSC). The samples were wiped dry and heated up from 50 ℃ to 500 ℃ with a heating rate of 20 ℃/minute.

TGA Data – Thermal Decomposition



DSC Data – Phase Transitions



Research Questions

Initially, we wanted to answer the following:

- How do thermal properties of plastics change when contaminated with common food waste solutions?
- Is there an optimal temperature to treat contaminated plastics (PP)?

Through scoping studies, we began to add research questions:

- If less energy is required to achieve a similar deformation, does this impact the potential energy recovered from decomposition of PP?
- How can this energy demand be minimized?
- How does the treatment affect the compounds on a molecular level to justify the change?

Ongoing and Future Work

Preliminary results suggest that soaking polypropylene in 'contaminant' solutions may decrease energy requirement to achieve the same level of thermal decomposition of the material (compared to the virgin sample).

Further work includes:

- Expand the research to other commonly used plastics
- Continue our design of experiment approach
- Document findings

This work will be submitted to the American Institute of Chemical Engineers Annual Conference held in San Francisco, CA in November 2020.
Preliminary work has also been used to apply for external funding from the Environmental Research and Education Foundation.

PP 5 Recyling image from "Chemistry may have solutions to our plastic trash problem," online publication <https://cen.acs.org/environment/pollution/Chemistry-solutions-plastic-trash-problem/96/i25>