CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Cathy Kenderski

Project Number

S0610

Project Title

Using Hydrolysis to Facilitate the Chemical Degradation of PET Plastic

Abstract

Objectives

The ocean is home to 8 million tons of plastic, which contains polymers that are too large to degrade. Thus, I sought out to find a method of chemically degrading plastic using hydrolysis.

Methods

22 grams of PET plastic were heated to various temperatures in 55 mL of ethylene glycol and 12 grams of sodium hydroxide. Sulfuric acid was added in order to react with the alkaline solution and create terephthalic acid in the form of a white precipitate. The precipitate was removed from the remaining liquid and was drained of water. Excess waste liquid was boiled to procure ethylene glycol for future use. This experiment was repeated 3 times at 180, 160, or 140 degrees Celsius.

Results

In order to test that the product of the hydrolysis reaction was terepthalic acid, I tested for specific chemical properties of the chemical. For ethylene glycol, I tested whether the liquid had an exact boiling point of 197° C, which was proven true. Terephthalic acid was confirmed through analysis of qualitative properties, such as its white color and lack of odor. However, existence of terephthalic acid had already been verified through the creation of a precipitate. I also found that performing the experiment at 180° C dissolved the plastic in 20 minutes, which was the most efficient of the 3 temperatures. 160° C dissolved the plastic in 25 minutes, while 140° C dissolved the plastic in half an hour.

Conclusions

I was successful in transforming PET plastic into its main component: terephthalic acid. This raw material could be used in the creation of new plastic, which provides the scientific community with an efficient method of recycling plastic. This method can also be applied to ocean cleanup efforts.

Summary Statement

I used a hydrolysis reaction to cleave the chemical bonds in PET plastic, ultimately degrading plastic and creating a method of converting plastic into terephthalic acid monomers.

Help Received

While my science teacher gave me access to our school's fume hood, all experimentation and research was my own and performed independently.