Developing an Economic Identification Method for Plastics of Unknown Origin

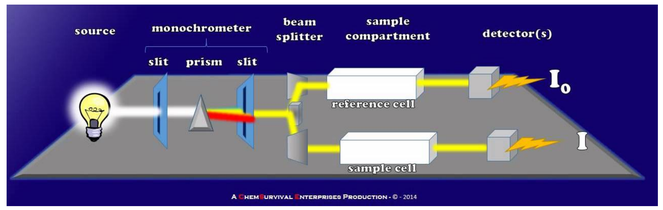
Matthew Adner; Dr. Peter Faletra, Dr. Kelly Salmon
New Hampshire Academy of Science

Abstract

Plastics have become a critical pollutant in the world's oceans and landfills. It is estimated that more than 8 million tons of plastic enter into the ocean every year. Given the prevalence of plastic, there is a need and pressure to do research on the effect of its presence in the environment. A challenge that accompanies research on plastic pollution is that there are many different types of plastics that are hard to distinguish from one another. Current methods of detection use Fourier Transform Infrared Spectroscopy. This, however, is very costly and presents a significant barrier to entry for any group seeking to study plastics. Using a regular spectrophotometer, I have developed a promising approach for plastic identification. Using this new method, I was able to successfully distinguish Polyvinylchloride (PVC) from Polyethylene Terephthalate (PETE). These two plastics are commonly used in water piping (PVC) and in disposable water bottles (PETE). These initial results are promising as they show that it may be possible to develop a and cost-effective system for identifying a broad variety of plastics.

Background

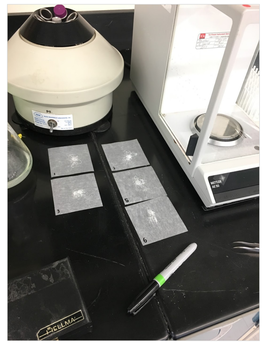
Plastic is a huge environmental problem, and while solutions exist to help control the impact of plastic, many of these solutions depend on being able to identify the type of plastic being used (for example, *Methodology Used for the Detection and Identification of Microplastics—A Critical Appraisal* by Martin G. J. Löder and Gunnar Gerdts). There already exists a method of identifying plastics- this is called FTIR, or Fourier Transfer Infrared Spectroscopy. The drawback to the FTIR method is that it requires machines that are very expensive and can cost up to several hundred thousand dollars. This means that using FTIR to identify plastic types is not an option for most labs, however it is still necessary. **My goal with this research is to develop a cheaper way to identify plastic types using a standard spectrophotometer.**



The spectrophotometer first filters light through a prism then directs it though a slit so that only specific wave length passes through the sample. The light is measured as it passes through the sample, and the spectrophotometer records the percent transmittance and and absorption.

Methods and Materials

Plastic sample



Plastics and scale

Spectrophotometer

Results

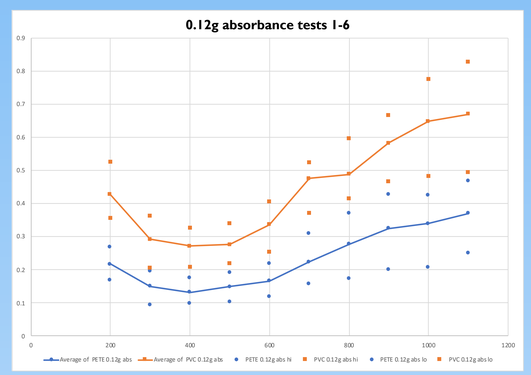


Figure 1. Results from tests 1-6 for Wavelength absorption profile for PETE and PVC showing average values across the six trials as well as minimum and maximum values across the trials.

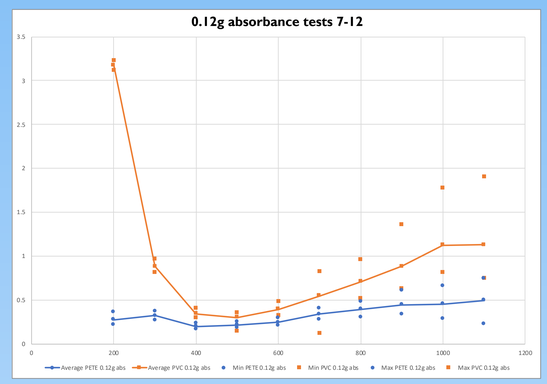


Figure 2. Results from tests 7-12 for Wavelength absorption profile for PETE and PVC showing average values across the six trials as well as minimum and maximum values across the trials.

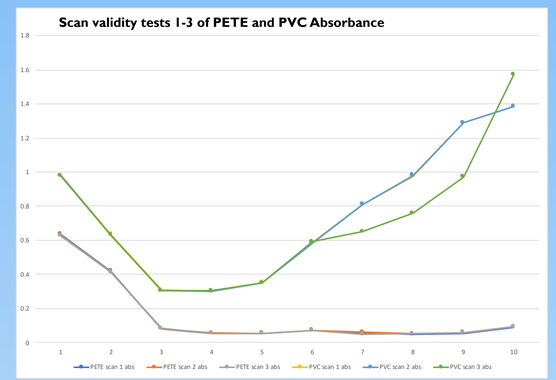


Figure 3. Results from tests for Wavelength absorption profile for PETE and PVC showing that they scan consistently.

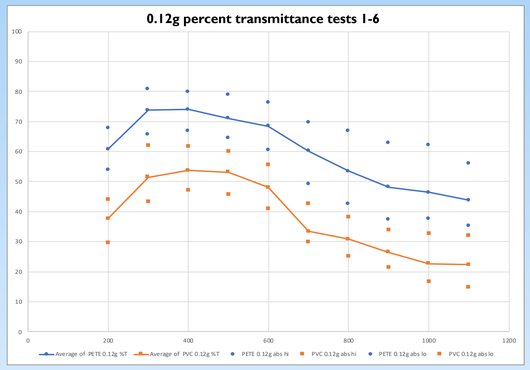


Figure 4. Results from tests 1-6 for Wavelength %T profile for PETE and PVC showing average values across the six trials as well as minimum and maximum values across the trials.

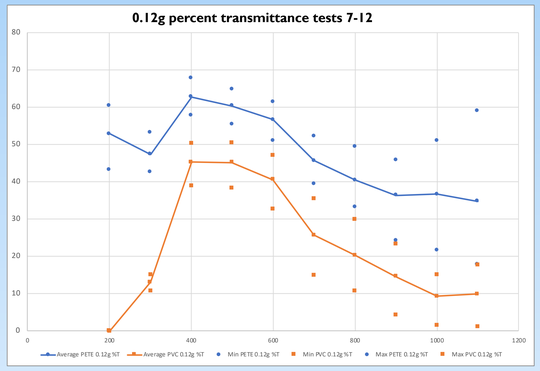


Figure 5. Results from tests 7-12 for Wavelength absorption profile for PETE and PVC showing average values across the six trials as well as minimum and maximum values across the trials.

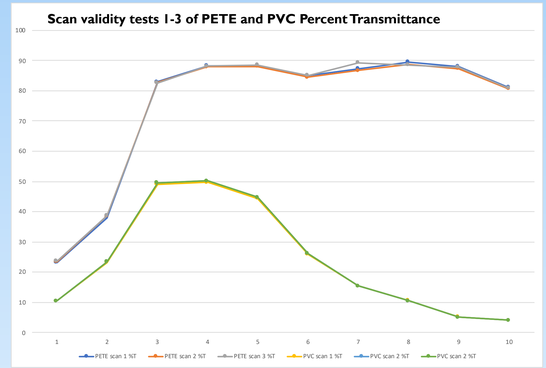


Figure 6. Results from tests for Wavelength %T profile for PETE and PVC showing that they scan consistently.

Going Forward

Going forward I plan to try to expand on my work by attempting to identify other plastics with the same method used to identify these plastics. I plan to also test combinations of plastics and try to modify the fluid the plastics are suspended in to keep plastics suspended longer with the end goal of getting more consistent results.

Acknowledgements

I would like to thank everyone who helped me with my research and preparation. I would like to specifically thank Peter and Elaine Faletra as well as Dr. Salmon for helping me with my experimental design and helping me conduct my research. I would like to thank everyone who at the NHAS stem lab who assisted in the research or gave helpful second opinions.