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Department of Chemistry and Biochemistry

Bringing Photodegradation of Plastics into the "Green Age"

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ABSTRACT: With the growing issue of plastic pollution found in e-waste around the world, many methods of management have surged to deal with this alarming rate of growth. One recent example is the use of photochemical degradation as a way of breaking down complex polymers such as those found in the category 7 of the resin code. While photodegradation of these polymers has seen significant findings over the years, it remains economically costly, and limited to the laboratory scale. This project introduces the science behind photodegradation of plastics in category 7 and shares significant findings from previous studies; furthermore, it shows the preliminary findings of our own implementation of gravity-light as a potential "greener" alternative to typical photochemical methodologies.

Introduction

Plastic, *"polymer,"* pollution is a complex and drastic problem with well-known environmental consequences. Many methods have been developed to deal with various polymers, such as polyethylene; however, polymers within Category 7 (C7) have not been significantly addressed. Plastics in C7 contain complex polymers such as nylon, acrylic, fiberglass, styrene and polycarbonates (PC), to name a few. Research on photochemical reactions of C7 plastics has made progress for dealing with PC; however, these methods are still far from efficient.

Photodegradation of PC

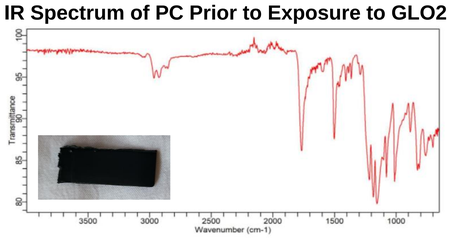
Plastic photodegradation occurs upon extended exposure to light which slowly degrades it, a visual cue for this in PCs is the progressive color change towards yellow. The absorbed light causes covalent bonds within PC to break resulting in photo-oxidation or photo-Fries reactions, depending on the exposure parameters. These reactions cause the physical attributes of the PC to be diminished.

Method and Results

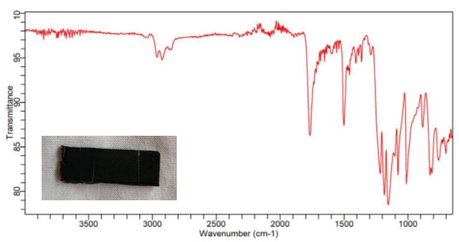
Typically, laboratory photochemical reactions are performed with high powered lamps in order to provide enough energy to drive the reaction forward. However, this study focuses on bringing photochemical reactions into the "*Green Age.*" Here, we introduce an alternative light source which is the GLO2 Gravity Light.

The preliminary Infrared analysis of PC exposed to light from the GLO2 are shown below:

IR Spectrum of PC Prior to Exposure to GLO2



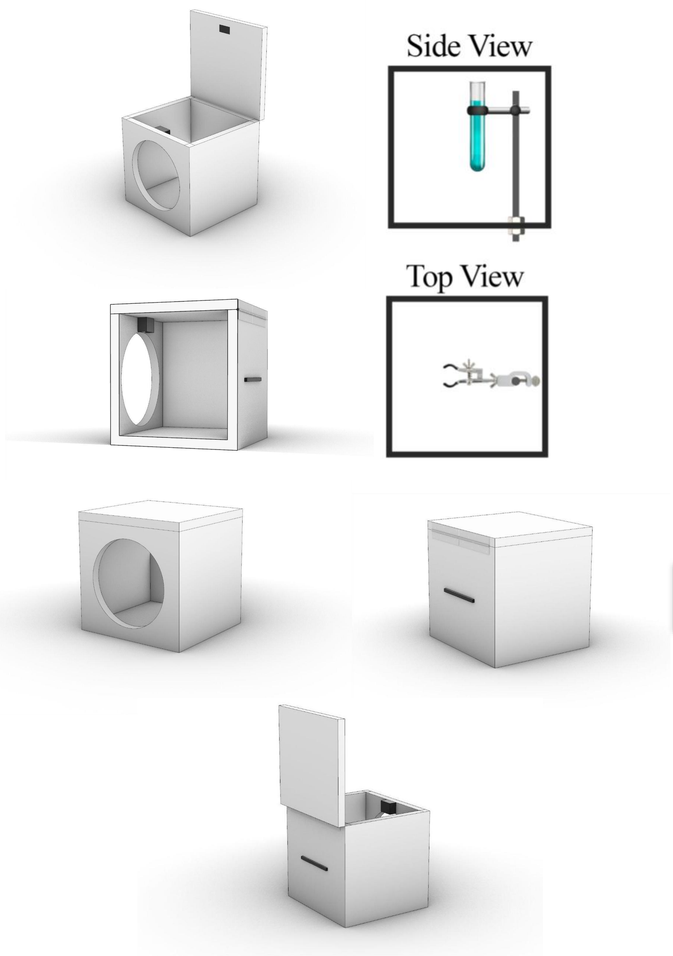
IR Spectrum of PC After 24 Hrs. of Exposure



Discussion and Current Work

After 24 hours of simple exposure under the GLO2, it was apparent that no significant change occurred within the sample.

While this result serves as baseline, the construction of a photoreactor chamber in order to help focus the light on the desired sample is in progress. See the full design below.



Conclusion and Future Work

The photoreactor is just the first step in improving the GLO2's efficiency. There are still many other forms of enhancement to achieve the desired photoreaction including the use of lenses to select wavelength of light and/or help further focusing; the use of green solvents or catalysts that can be applied directly on the PC surface to help its susceptibility to light; and different methods of PC preparation such as grinding the sample to increase the exposed surface area.

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