Conversion of Waste Plastic from Water Systems to a Fuel Oil

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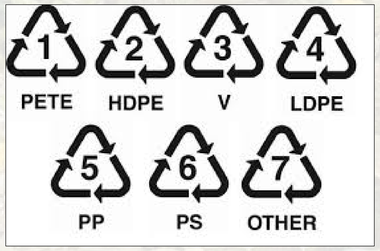
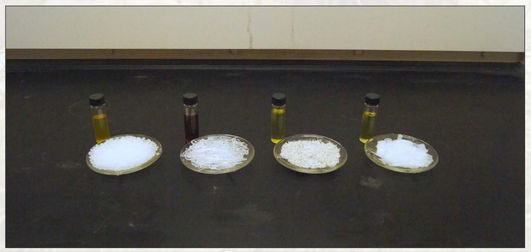
INTRODUCTION

- Waste plastic is accumulating at an exponential rate, with roughly 300 million tons of plastic produced globally each year.
- Only about 10 percent of the plastic produced annually is recycled.
- Projections for 2050 predict that up to 1,600 million metric tons (MMT) will enter our oceans, nearly a 120 fold increase from today.
- This waste plastic is taking its toll on both human and environmental well being, and measures must be take to reduce, reuse, and recycle plastic.



PROCESS

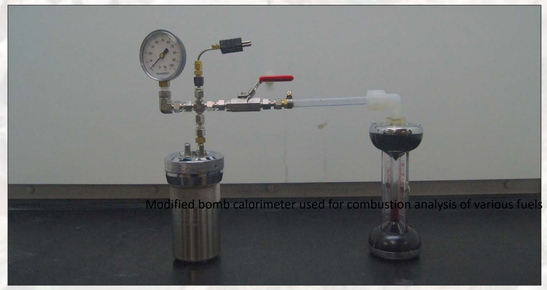
- The University of Kentucky Appropriate Technology and Sustainability Team (UKATS) has developed a process able to convert waste plastics into a fuel oil.
- This process is compatible with plastics 2,4,5,6.
- The four usable plastic types all float in salt water, making the separation from water systems easier.
- The resulting fuel oil has a chemical composition similar to diesel fuel.



(left to right): PP, PS, LDPE, HDPE

EXPERIMENTAL METHOD

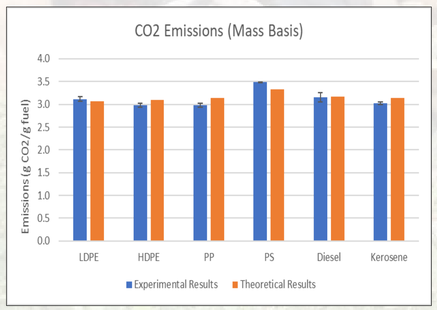
- The UKATS team uses a type of slow pyrolysis to efficiently convert waste plastic into a usable fuel oil.
- The pyrolysis process takes place in a stainless steel reactor operating between 450 and 500 degrees Celsius.
- In this temperature range, hydrocarbon chains that compose the given plastics will break and become gaseous.
- The resulting gases are cooled and condensed in a bucket of water.
- The resulting fuel oil is less dense than water and collects on the surface. To separate, just pour the top layer of fuel out of the bucket and filter before use.

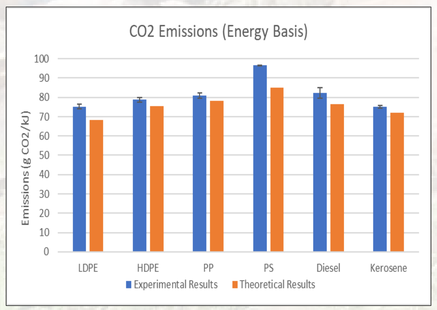


Modified bomb calorimeter used for combustion analysis of various fuels

RESULTS

- The resulting fuel oil yields a cleaner, more efficient product while having the potential to reduce the amount of plastic polluting our water.
- Compared to “Ultra-Low Sulfur” diesel fuel from the pump, the UKATS fuel oil
  - Is more calorific
  - Emits less Carbon Dioxide
  - Completely free of sulfur
- Roughly, 1 kg of plastic produces 1 L of fuel oil.





FUTURE QUESTIONS AND GOALS

In 2018, the UKATS research team will be going to Uganda in a partnership with Makerere University to gather data from the field.

- What is the most efficient combination of variables to conduct the process?
- Can we create a continuous process to increase efficiency over batch-based processes?
- What is the energy input/output of the process?
- How does a mixture of plastic effect the end product?

Large scale reactor in use

SUSTAINABILITY GOALS

Reduce the amount of waste plastic in water systems while being

- Socially viable
- Economically prosperous
- Environmentally responsible

Be able to establish a small-scale, local economy of pickers, producers, and sellers in under-developed regions with major water systems.

Acknowledgements

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