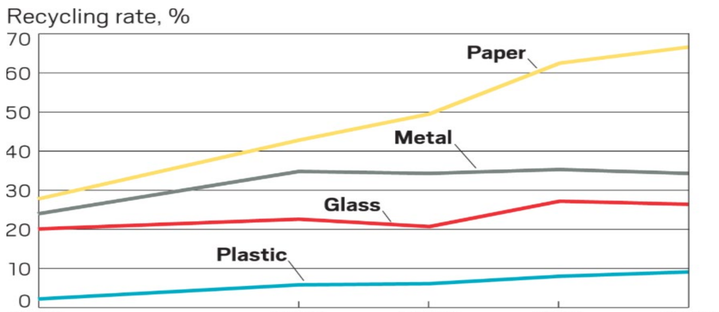
Current and Future Methods of Plastic Recycling

Christina Bowen
School of Science, Mathematics, and Technology
Ohio Northern University, 525 S. Main St., Ada, OH 45810 USA

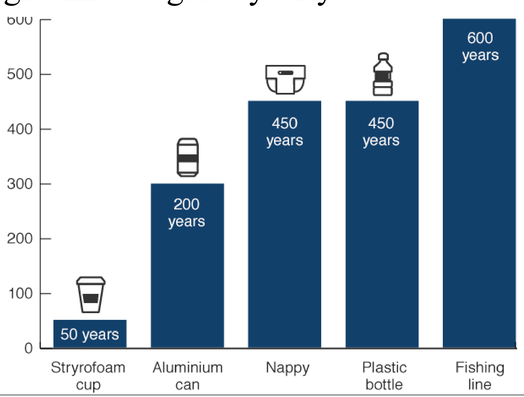
Plastic Pollution

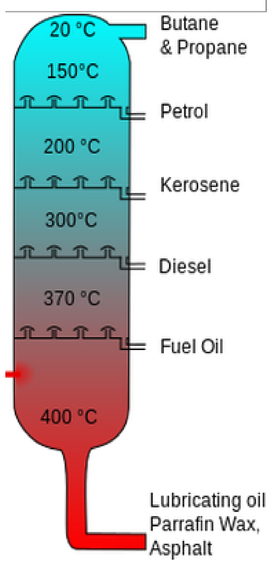
9,149 million tons of plastic has been produced since the 1950's, and 8 million tons end up in the ocean every year. The Great Pacific Garbage Patch is an accumulation of plastic waste the size of Texas off the coast of California due to ocean currents.



Plastic Production

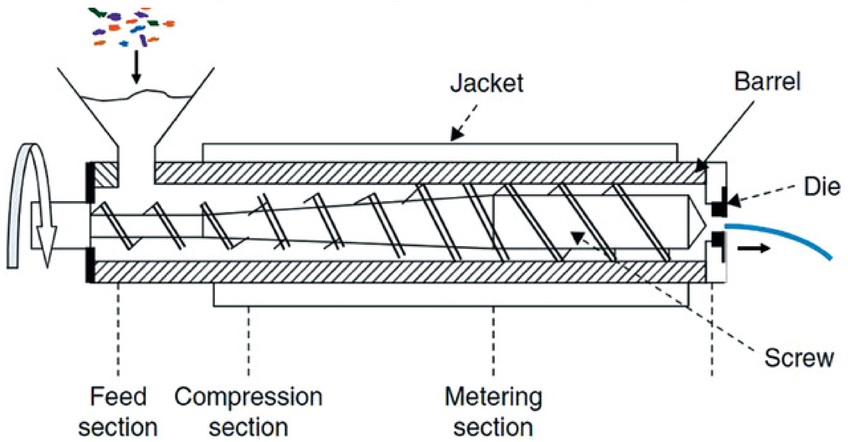
Plastic is synthesized from fossil fuels. Oil is pumped underground to a refinery and can leak into groundwater. The crude oil is distilled, heated and vaporized. It then travels until it begins to condense. This separates by boiling point into gasoline, kerosene, diesel, and fuel oil. High heat and pressure break these materials into the building blocks, monomers, which are reacted to form a polymer, or a repeating structure. This process emits 900 million tons of greenhouse gases yearly.





Current Recycling Methods

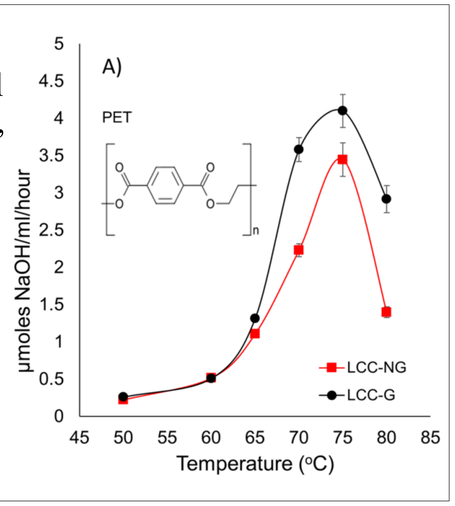
Extrusion is the most common plastic recycling method. Small pieces of plastic are melted and pressurized to cleave cross links. The molten material is put into molds. This takes high temperature and pressure, a large energy cost.



Extrusion also demands good purity. This leads to confusion about what can be recycled. Materials that are a combination of different plastics cannot undergo extrusion. Finally, the strength of extruded plastics dramatically decreases, and they cannot be used in food packaging.

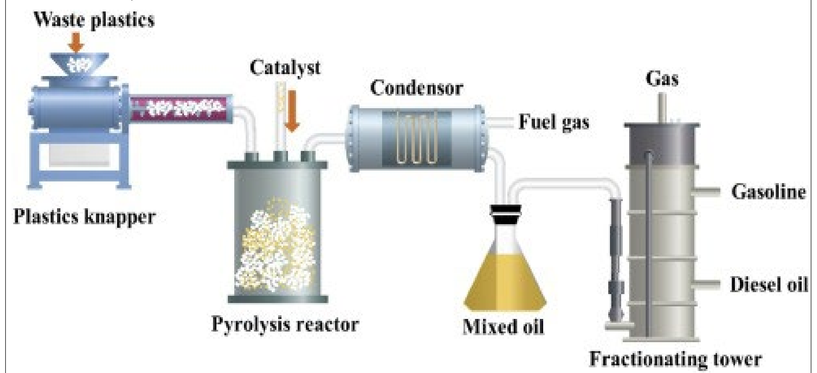
Cutinase

Cutinase is an enzyme that cuts apart PET. The optimal temperature for this is 75˚C, because PET relaxes its structure and cutinase can get inside. But, at this temperature, cutinase starts to degrade. Sugars were added at specific parts of the cutinase to increase its thermal stability.



Hydrothermal Pyrolysis

Pyrolysis breaks down plastics into their starting materials. Plastics are heated to 300-1300˚C to create a gas. Through cooling, it condenses into liquid which is then distilled into different petroleum products. A hydrothermal technique mixes supercritical water with shredded plastic. Supercritical water is heated so it has properties of a liquid and a gas. It acts as 'molecular scissors to cut the bonds and reform them into smaller petroleum molecules. Under low pressure, the liquid vaporizes and is distilled into naphtha, gas oil, wax residue, aiken and bitumen.



This process can be used in contaminated or mixtures of plastics, including food contamination. The strength is also not compromised, increasing the possible uses. The conversion rate of plastic to petroleum products is 99%. The hot gases generated during the process would be used for heating to make this renewable.

Acknowledgements and References

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References

Presentation