

Plastics to Fuel: A Community Oriented Solution

School of CBEE Polymer and Catalysis Research Lab

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Non-OSU Partners

Ocean Plastics Recovery Project (Scott Farling and Captain Andy Schroeder, Kodiak, AK)

Clean Oceans International (Captain Jim (Homer) Holmes, Santa Cruz, CA)



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**One of the Real Tragedies – Children
Scavenging in Toxic Landfills ...**



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**....and swinging in the smoldering
landfill as her playground!**

OSU Plastics to Fuel Goal

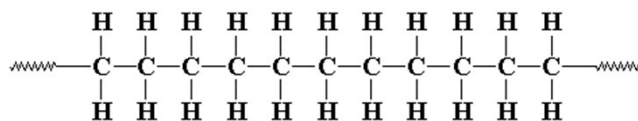


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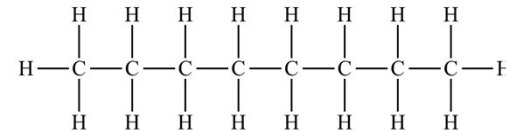
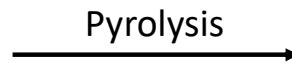
- Goal: Develop an inexpensive, open-source reactor with simple operation and minimal maintenance.
- Automated to minimize required engineering knowledge for operation.
- Target audience: Rural and Island communities as a solution to local waste management.
- Beta Test Site: Kodiak Island, AK for local plastic clean-up operations with collaboration of Island Trails Network (Captain Andy Schroeder).
- Partners: Clean Oceans International (Santa Cruz, CA), Scott Farling (Ocean Plastics Recovery Project)

Chemical Recycling of Polymers

- Pyrolysis is the thermal degradation of organic molecules in the absence of oxygen.
- Common polymers are broken down in processing facilities to produce chemical feedstocks and energy dense fuels.
- Pyrolysis's robustness can recycle plastics that would traditionally be sent to landfill.



Polyethylene: A common polymer molecule

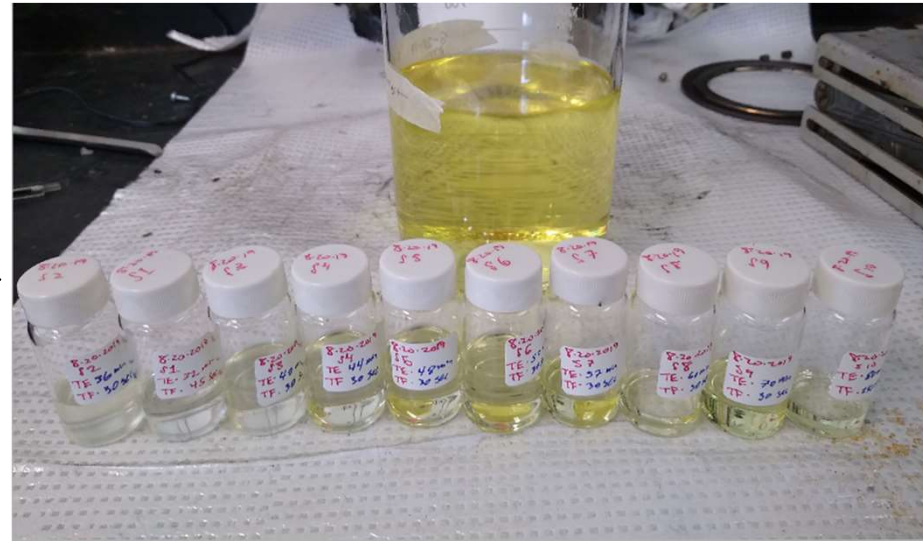


Octane: A volatile molecule found in diesel

Product of Plastic Pyrolysis

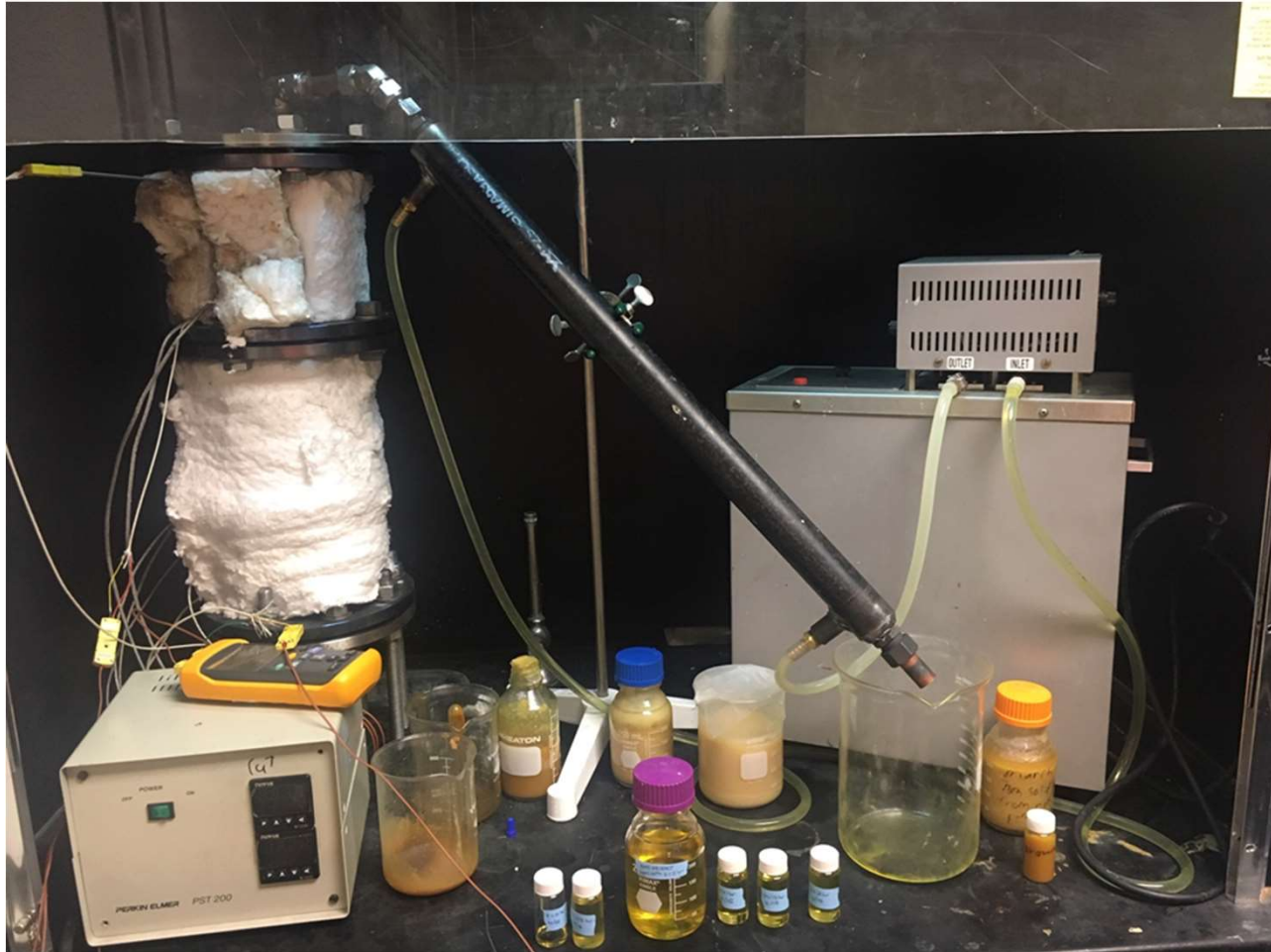


Post-consumer plastics.



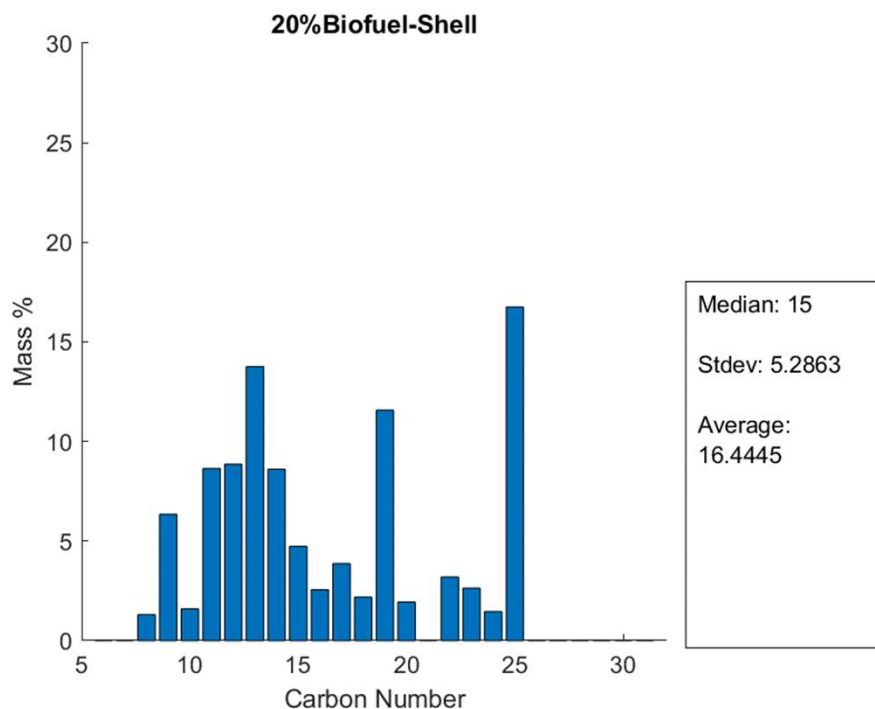
Diesel-like Product

Reactor in Operation

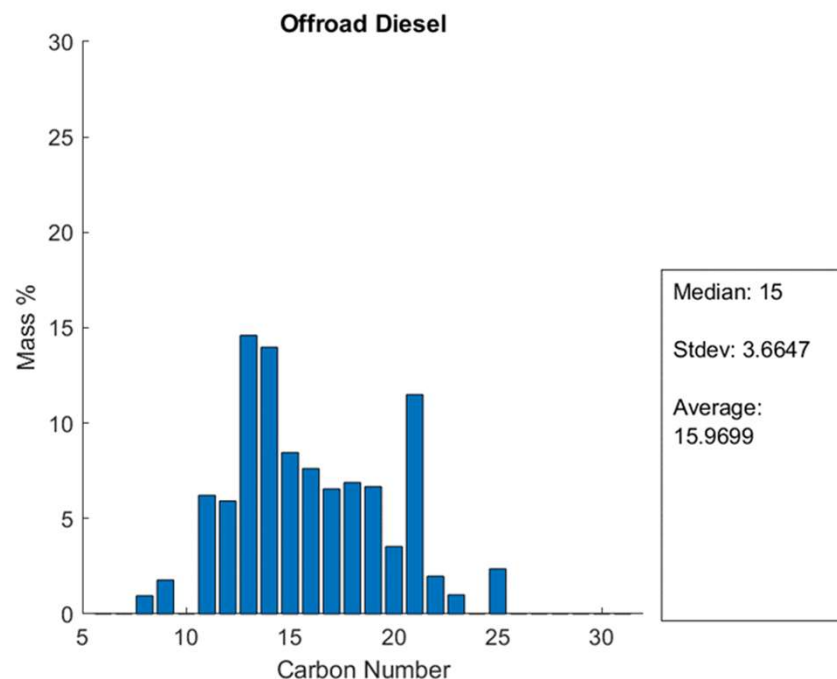


Commercial Diesel – OSU GC-FID Analysis

Standard 20% Biofuel – Shell Station

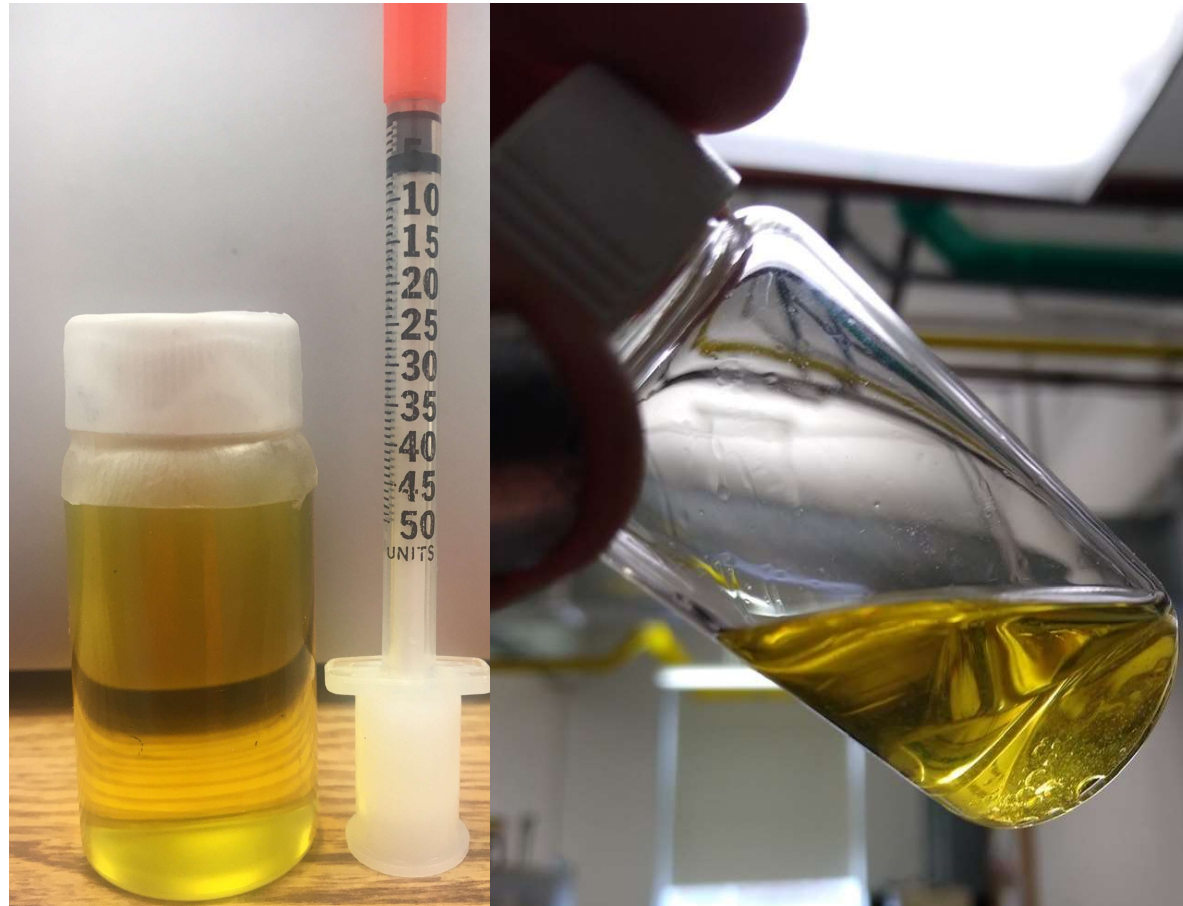


Standard Offroad (farm) Diesel



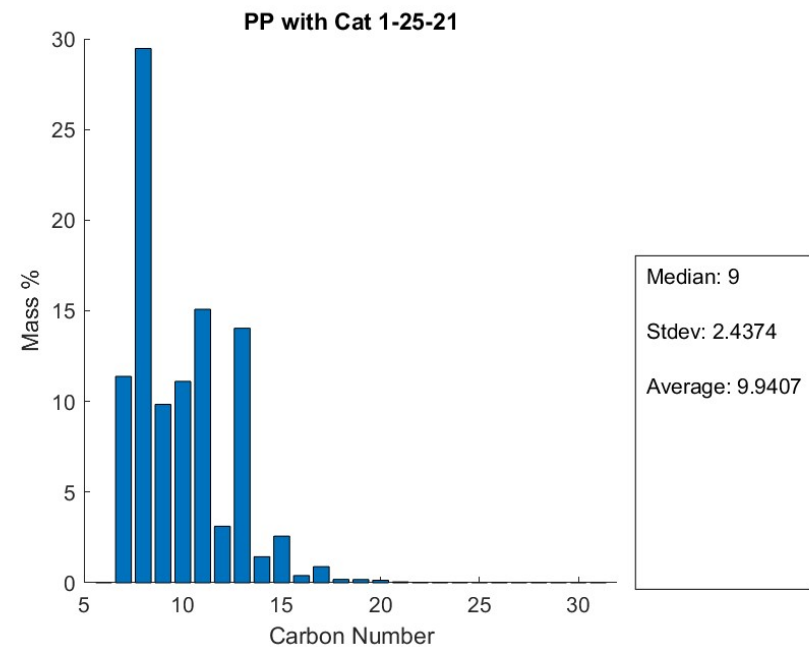
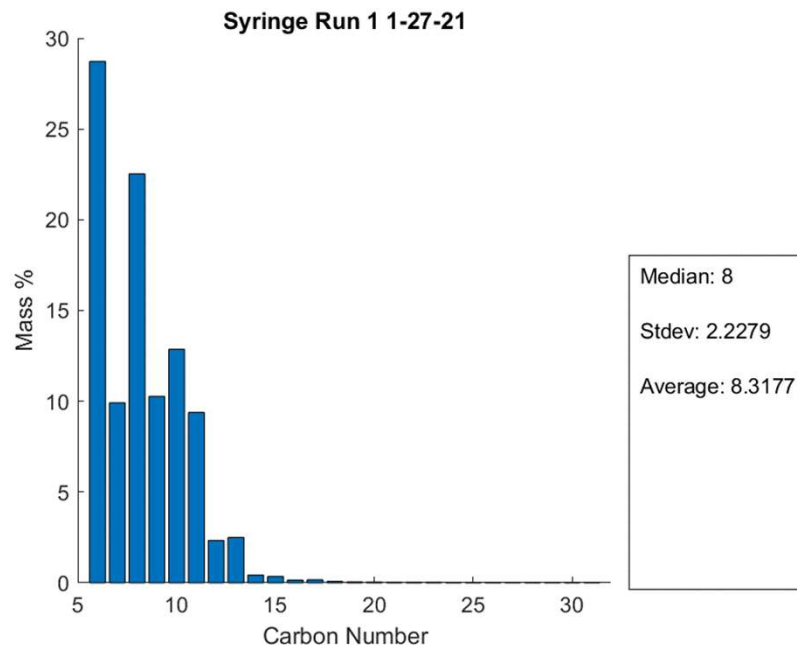
Syringe Pyrolysis

- Run Conditions: $T = 550^{\circ}\text{C}$,
Silica Alumina Catalyst
- Initial Weight = 400g ,
Yield = 70%(by weight)
- The syringes are put in the reactor as received, meaning there is no handling of the syringes other than being dumped into the reactor
- This leads to void space in the reactor





Syringe Carbon Number Distribution



This led the team to compare the carbon distribution of the syringe product to the products from virgin plastics the syringes are made of.

Plastics To Fuels Commercial Ventures

Company	Location	Method	Capacity (per year)	Product
Alterra Energy	Akron, Ohio	Rotary Kiln	21,900 tons	Diesel, Synthetic Crude
BRADAM Energies	Nampa, Idaho	Kiln	50,000 tons	Electricity, Diesel, Jet Fuel
Scarab Tech	South Africa	Mobile Machines	219,000 kg	Energy
Recycling Technologies	UK	Transport Reactors (RT700)	7,000 tons	"Plaxx oil" (refined and manufactured into new plastic)

Cookstoves

- Indoor air pollution from biomass and solid fuels affects nearly 3 billion people in developing countries
- Exposure to cookstove smoke causes nearly 4 million premature deaths and is the 4th worst health risk in the world
- Children from biomass cookstove households were 5.5% more likely to develop severe asthma

Cookstove Testing

- In partnership with Dr. Nordica MacCarty and Aprovecho Research Center in Cottage Grove, OR
- Test PTF diesel-like fuel with their assortment of cookstoves to record burn emissions
- **Test with Portable Emissions Monitoring System (PEMS)**

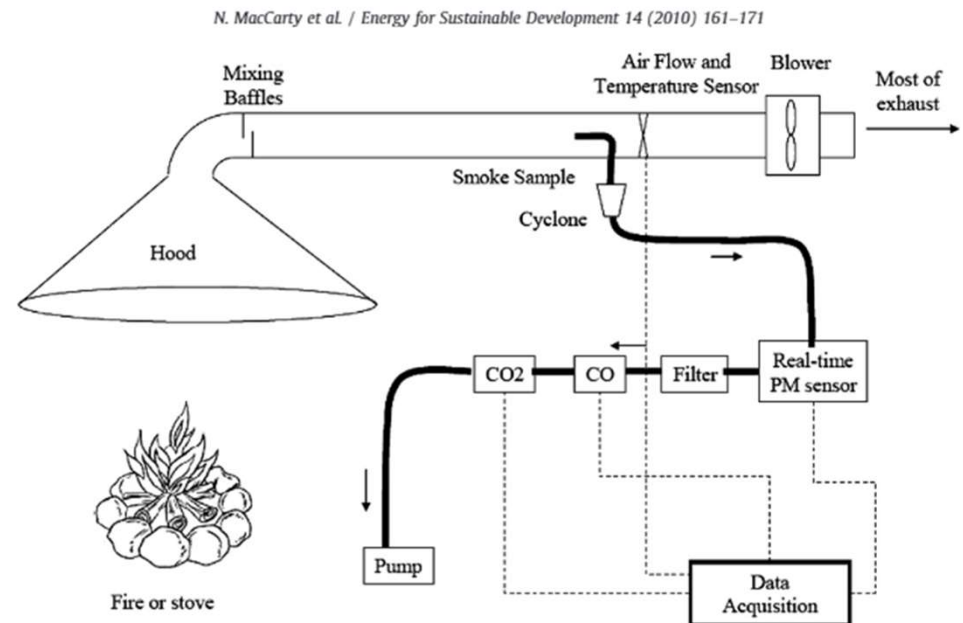


Fig. 1. Emissions measurement schematic (Source: ETHOS Technical Committee, 2009).



Future Work

Design improvements for a **2.0 bench scale reactor**

Improved yield and recycling of gases for improved heating

Test fuel produced in cookstoves through collaboration with ***Aprovecho***

• **Funding \$\$\$\$**

Plastics to Fuel Group – Spring 2021



Questions?

