

The Next Bigly Thing : Plastic-To-Oil

by Robert A. Nelson

Many experts warn that we are on the down side of the "Peak Oil" Bell Curve of supply:demand -- but we clever hominids shall probe ever deeper with mighty microwave plasma torches to strike huge nodes of abiotic oil ! Still, it will never suffice to satiate humans' lust for Plastic, so the sordid saga will continue to suck Black Goo from Earth until it implodes from our vampirism and the oceans are polymerized.

You might vocalize, "What can a crypto-technocrat like me do for profitable ecology before we go extinct? Oil is what we do! Oil is civilization! Oil is a god! Oil is our divine right!"

A few factoids will help frame the issue. Almost 10% of pumped oil goes to manufacture plastic. Humans have produced over 9 billion tons of plastic since 1950 -- enough to cover Manhattan two miles deep. Much of that polymerized petroleum has made its way to the oceans and now is concentrated in several patches totaling several million square miles in area.

The most visible portion, a vast soup called the "Great Pacific Garbage Patch", comprises several trillions of fragments from 0.33 to 200 mm in size in the first several fathoms. The patch has increased 100-fold since the 1980s, causing profound changes to the marine environment. Most of the plastic trash that goes to sea each year just disappears or dissolves, and subsequently all animal life is devastated by poisoning from disintegrated microsponges tainted with persistent organic pollutants (e.g., DDT).

"All animal life" includes You, Dear Reader, if you eat seafood.

Oceanographer Curtis Ebbesmeyer, who coined the "Great Pacific Garbage Patch" meme, has said that the only solution is to switch to biodegradable plastic and let the plastic gradually disperse over the course of a few thousand years.

"We can't clean it up. It's just too big. You'd have to have the entire U.S. Navy out there, round the clock, continuously towing little nets. And it's produced so fast, they wouldn't be able to keep up," he said.

The Juggernaut process can be slowed by gargantuan social efforts to minimize waste and maximize recycling. But Plastic is a many-headed Hydra that must be managed at every stage and level by individuals, society, and by industry. That is not happening at any largely effective scale at this time. Recycling might delay the demise of The World As We Knew it for a few nows, but it is only a

sublimated meta-hygienic ritual, analogous to wiping a sphincter after making #2.

It is not enough.

#3 Plastic can be recycled, but it is toxic, #7 is an unidentified mix, #6 (styrofoam) has limited reuse, and #4 and #5 have very little market value. The only real market is for #1 (PETE) and #2 (HDPE). And, incinerators generate environmental problems such as chlorine emissions.

In the grand scheme of things, all is vanity. Is civilization worth all the bother? After all, we may well be far advanced into The Sixth Extinction Event on Earth. So what if plastic worsens the problem? Nature wastes nothing (except individuals).

Boyan Slat : The Ocean Cleanup

One such hopeful individual is [Boyan Slat](#), a brainiac student of aerospace engineering who has made it his point to design a floating super-scooper with which to harvest large quantities of plastic concentrated by the oceans' gyres. The Ocean Cleanup project has great potential, and Slat envisions sleek modern designs to accomplish his goal.

A

and operated by crews of convicted criminals, debtors, political dissidents, Palestinians, Christians, native indigenes, undocumented immigrant non-citizens, conspiracy realists, unemployees, mental impatient, veterans, missing children, Shanghaied sailors, and such-like deplorables to do the dirty work. Surely, with a bit of United Nations subsidizing and Bilderberger negotiating it can be made profitably self-sustaining for corporatists and ecocrats alike.



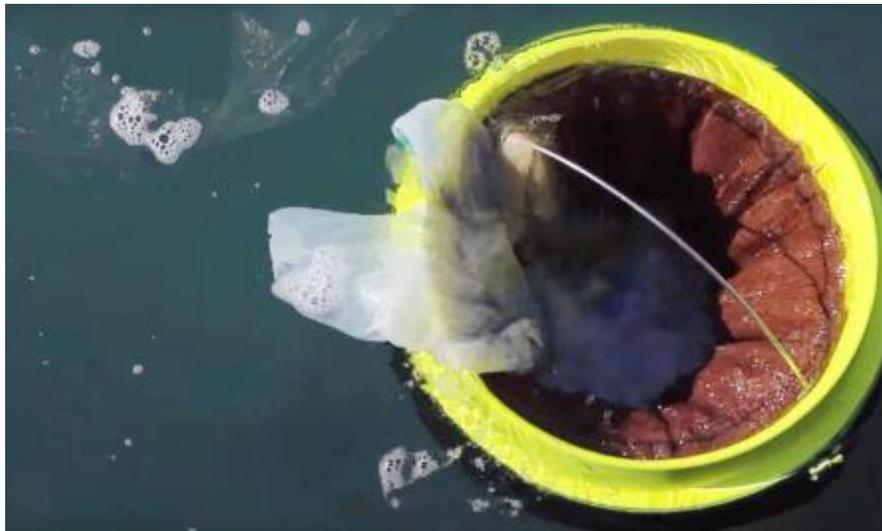
Andrew Turton / Pete Ceglinski : Seabin

Meanwhile, Andrew Turton and Pete Ceglinski have founded the Seabin project to develop their invention of a clever automatic floating garbage collector that can prevent a lot of flotsam and jetsam from ever reaching open water.



Andrew Turton & Pete Ceglinski

The Seabin is moored to a floating dock with a water pump running on shore power. The water pump creates a flow of water into the bin that brings in all floating debris. The garbage is captured in a fiber bag and the water is then sucked out the bottom of the bin and back to the water pump.



Seabins at present are designed for wharfs, floating docks and pontoons, not open water. They are targeted for markets such as marinas, ports, and yacht clubs at a price of about \$4000. Seabins are low cost, low maintenance, very effective, and work 24/7. An optional oil/water separator also is available.

As seen on YouTube : <https://www.youtube.com/watch?v=xIDJiFW4pRI>

Bravo! Well done, Planeteers!

But the problem remains: How to repurpose all that Sacred Plastic?

Redemption is at hand ! Plastic can be converted to the Oil from which it came !

Here are several simple, well-established methods for converting the recycled

plastics into fuel oil. Furthermore, the technologies need to be scaleable from a tabletop to atop landfills and ocean freighters:

Alka Zadgaonkar : Conversion Catalyst

Prof Alka Zadgaonkar (Raisoni College of Engineering, Nagpur) has invented a catalyst for cracking waste plastic (described in her patent WO2005094990 *****). It is produced by milling faujasite zeolite (5-35 wt %), pseudoboehmite alumina (10-40 wt %), polyammonium silicate (1-10 wt %), and kaolin clay (15-60wt %), forming a slurry with water, spray drying to form microspheres, and calcination at 500°C for 1 hour.



The catalyst is used in Prof. Zadgaonkar's patent WO02061015 (Process and Apparatus for Manufacture of Liquid Fuel from Waste Plastic and Refinery Waste) to convert almost any plastic to oil in 40-60% yield; 1 kg of plastic and 100 gm of coal affords 1 liter of fuel-grade oil. Unlike crude oil, the distillate contains no lead or sulfur.

Shredded waste is fed into a heated extruder, melted at a relatively low temperature, then stripped of chlorine and loaded in the reactor vessel wherein it is depolymerized to form 70% fuel oil, 15% LPG equivalent, and 5% petroleum coke. The remainder is ash and metal fines.

Akinori Ito : Blest

Akinori Ito, et al., have developed the compact "Blest" technology for conversion of plastic to oil. It yields about 1 liter of oil per kilogram of plastic. About 1 kilowatt of electricity is required to heat the machines. The batch processing time is 3 hours. Blest can process polyethylene, polystyrene and polypropylene (#2-4), but not PET bottles (#1). The crude gas product can fuel generators or stoves; when refined, it can power cars and trucks. Off-gas is decomposed into H₂O and CO₂. The smallest version costs about US\$10,000.



Ito's US Patent Application #2009117015 (Liquifying Apparatus) comprises a melting section and a cracking section for further heating the molten plastic so as to attain gasification cracking thereof. The technology also is patented as WO2008004612 (Apparatus for Conversion into Oil), JP2008195821 (Small-Sized Liquefaction Equipment), JP2007314654 (System for Treating Styrene Foam), JP2005126454 (Plastic Treatment Apparatus), JP 2004315686 (Oil-Forming Plant and Waste Plastic Recovery System), JP2004269755 (Liquefaction Plant), and JP2004175917 (Oil-Liquefaction Apparatus). In the latter invention,

crushed plastic is dissolved in collected oil while being heated to vaporization temperature. The vaporized gas is condensed to oil, and part is recycled into the process.

As seen on YouTube : <https://www.youtube.com/watch?v=WQQcm0auP1s>

Brajendra Sharma : HDPE-to-Oil

According to the Worldwatch Institute, Americans throw away some 100 billion plastic shopping bags annually. The US EPA reports that only about 13% are recycled. The rest get buried in landfills or lost.

Using a Blest system, the research team led by [Brajendra Sharma, et al.](#), (Univ. Illinois Sustainable Technology Center) have demonstrated that HDPE plastic shopping bags can be converted by pyrolysis to high-quality diesel fuel.

The conversion produces much more energy than it requires and produces diesel fuel that can be blended with ultra-low-sulfur diesel and biodiesel. Natural gas, solvent naphtha, gasoline, waxes and lubricants also can be obtained from HDPE.

Sharma says, “You can get only 50 to 55 percent fuel from the distillation of petroleum crude oil. But since this plastic is made from petroleum in the first place, we can recover almost 80 percent fuel from it through distillation.”

After addition of an antioxidant, “A mixture of two distillate fractions, providing an equivalent of U.S. diesel #2... had an equivalent energy content, a higher cetane number, and better lubricity than ultra-low-sulfur diesel.”

Obviously, a small Blest plastic-to-oil machine could be profitable for a prudent operator.

The pyrolysis temperature range of 420–440 °C was chosen based on previous studies [34]. These temperatures resulted in decomposition reactions of HDPE to provide hydrocarbons of different chain lengths. Pyrolysis of waste plastic grocery bags at temperatures of 420–440 °C provided 74% yield of liquid product referred to as PCO, a

The PCO thus obtained after pyrolysis of waste plastic grocery bags was distilled into four fractions (< 190; 190–290; 290–340; and 340 + °C equivalent of motor gasoline (MG), diesel#1 (PPEH-L), diesel #2 (PPEH-H) and VGO respectively.



*Brajendra Kumar Sharma, Dheeptha Murali, Jennifer Deluhery
Photo by L. Brian Stauffer*

David McNamara : Thermal Anaerobic Conversion

The industrial-scale Thermal Anaerobic Conversion (TAC) technology developed by [David McNamara, et al.](#), treats plastics and rubber tires to microwave pyrolysis in vacuo at 370° C - 420° C. It produces diesel fuel with very low levels of sulfur. The only waste material is 5% char, which can be incorporated into concrete.



According to McNamara's US Patent Application #2012261247 (Conversion of Waste Plastics Material to Fuel), "It has been found that having thermal degradation in the contactor and pyrolysis chamber and by having a second, vacuum, distillation column helps to provide a particularly good quality on-specification liquid fuel."

TAC plants produce up to 5,000 gallons of high-cetane fuel daily from 20 tons of "End-of-Life" Plastics (ELP).

ELP cannot be recycled and would otherwise end up as landfill. Recycling of plastic is laudable but largely futile: #3 can be recycled, but it is toxic; #7 is an inseparable, unidentified mix; #6, styrofoam has limited reuse; #4 and #5 have little market value. The only real market is for #1 (PETE) and #2 (HDPE).

Incinerators generate environmental problems such as chlorine emissions.

Thermal Anaerobic Conversion (TAC) technology reduces the need for incineration or burial of end-of-life plastics, and it complements traditional recycling systems.

Frank Pringle : High Frequency Attenuating Wave Kinetics (HAWK)

Frank Pringle, CEO of [Global Resource Corp.](#) (West Berlin NJ), has developed a process that uses microwaves to extract fuel from tires, plastic, shale, coal, and tar in seconds, without additives or emissions. Pulverized tires are gasified by microwaves, leaving carbon black residue (used in dyes and tires). About 60% of the tire is gasified and collected as sulfur-free diesel oil.



Frank Pringle [right], Hawk Hogan [left], & the Hawk recycler

The Hawk machine applies specific microwave frequencies to excite polar molecules and crack them. The process can also be used to extract heavy oil from wells.

Frank Pringle points out that, "By definition it is not pyrolysis because cracking the hydrocarbon chain is inherent to specific frequencies and has little to do with the amount of heat generated. The process however is done without water and performed in an oxygen starved environment. We call this technology: High-Frequency Attenuating Wave Kinetics or HAWK for short."

"There is also no CO₂ or CO produced in the process because there is no oxidation other than possibly a miniscule amount that may be pre-existing in the material or minerals processed. GRC's vacuum environment creates an accelerated pressure thereby assimilating what Mother Nature has done through countless years to make fuels.

"The two basic elements offered for all GRC's applications are in situ and off situ. We have designed klystron machinery for gasifying hydrocarbons where they exist or in fabricated systems. In-situ meaning processed deep in the ground, rock formations or anywhere naturally occurring and off-situ meaning processed above ground that is mined or material removed from site.

"A klystron is a microwave electron tube with velocity modulation that is different from magnetrons. Its uses were privy to military applications for radar jamming before stealth technologies became more dominant in later years. GRC is the first to commercialize this technology and by modifying amplifiers and power supplies to suit our applications, we now possess the technology that will free America from foreign oil imports."

Over the past seven years, Mr. Pringle has identified over 1200 specific RF microwave frequencies of specific hydrocarbon materials.

According to the description in US Patent Application # 20070131591 (Microwave-Based Recovery of Hydrocarbons and Fossil Fuels), the microwave radiation is in the range of from about 4 GHz to about 18 GHz.

As seen on YouTube : <http://www.youtube.com/profile?user=globalresource>

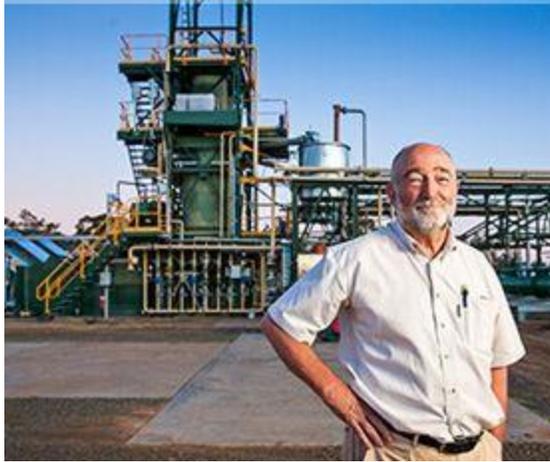
Previous patented efforts to recycle tires with microwave technology are described in US5507927 and US5877395 to Emery, in US4817711 and US4912971 to Jambey, and in US5084140 to Holland. They use single-frequencies, whereas Randall's invention applies sweeps and pulses of many specific frequencies.

Denis Randall : Green Distillation Technologies

A pyrolytic process developed by Australian company [Green Distillation Technologies](#) (GDT) recycles end-of-life tires into carbon, steel, and diesel oil. GDT won a bronze medal in the prestigious innovation award, the Edison Awards, in 2016.

Used tires are a health hazard that breed malaria and dengue-carrying mosquitoes, and they generate huge amounts of toxic smoke when burned. But when converted to oil, the tire-fuel produced a 30 per cent reduction in nitrogen oxide and lower particle mass. The oil could also be used for heating, or further refined into automotive or aviation fuel, and some of the recovered oil can be used as the heat source for the system.

A 10 kg car tire yields 4 liters of oil, 1.5 kg of steel, and 4 kg of carbon, and a 70 kg truck tire yields 28 liters of oil, 11 kg of steel and 28 kg of carbon.



Denis Randall

The GD technology is described in US6863004 (Process and System for Recovering Energy from Carbon-Containing Materials) as "comprising (a) pyrolyzing the material in a reactor to produce a carbon-enriched solid and a first gaseous product, (b) burning at least part of the first gaseous product and/or a second gaseous product obtained by reacting the carbon-enriched solid with water vapour to generate heat, and (c) and/or removing part of the first gaseous product and/or the second gaseous product as a combustible fuel.

Most existing disposal methods are energy intensive, waste resources, and cause pollution. Many waste materials constitute a source of useful energy, however, if efficient means of recovery can be devised.

"When the combustible gaseous product produced by the process is burnt to raise steam... the combustion gases may be recycled to the reactor in the pyrolysis and reaction zones. This results in a closed gas circulation system from which essentially no gaseous effluent is produced.

"At start up, an external source of heat is required in order to elevate the pyrolysis zone to the elevated temperature of the pyrolysis reaction, and to elevate the reaction zone, when present, to the second elevated temperature. Such an external source of heat may be any convenient source, but is typically a combustible gas or oil.

"A reactor vessel for use with a process of the present invention may conveniently be a twin-bell reactor of the type typically used in blast furnaces. This type of reactor includes two chambers, one above the other, the upper of which is a hopper for holding a In the coking stage, complex organic compounds are volatilized by heating to temperatures above 400 F. (205 C.) to produce carbon or char, volatile low molecular weight organics (which volatilize), steam, silica, and inorganic ash. The residue is coke or char." In Stage II , water gas is produced by blowing steam through an incandescent bed of carbon.

Tests with municipal garbage, rubber tires, wet bagasse, sawdust, and oil sludge determined that there is excess gas production from the destruction of most wastes (except tires), compared to the quantity of gas required to destroy the waste.

And there you have it : Bevatons of plastic are waiting to return to oil, there are multiple ways to collect it, and several technologies are available to exploit the opportunity.

About the Author : Robert Nelson is a 10th grade dropout with no credentials. He established [Rex Research](#) as an archival service in 1982, and continues with the effort to this date despite the seeming futility of the effort.
