CONVERTING MARINE BASED PLASTIC WASTE IN TO USABLE FUEL

Plastic on beach

Plastic delivered to Whitehorse

Oil produced from marine plastic

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Marine Plastic to Fuel findings

During the summer of 2013, marine plastic was collected from the shorelines of Northern Vancouver Island. This plastic was used as feedstock to convert in to fuel in Whitehorse, Yukon.
The project was to determine the suitability of the plastic to fuel machine to convert these plastics to usable fuel.
Due to the nature of the plastic, it is difficult to find a market for traditional recycling. This is due to contamination from marine debris such as sand, plant and algae material, barnacles as well as salt. As well, much of the plastic was in fragments that make resin identification difficult. None of these contaminants proved to be a problem in the machine.
The plastic to fuel machine requires sorted plastic. The process can only handle #2, #4, #5 and #6 plastics as well as #3 and ABS with additional equipment.
Fortunately, these plastics are sorted already by the time they reach the beaches, as the specific gravity of the materials that are desired is less than saltwater and the materials will float.

Plastic resin separation in salt water

Material	Specific Gravity	Float/Sink
#2 HDPE	.95	Float
#4 LDPE	.92	Float
#5 PP	.9	Float
#6 EPS	0.016 to 1.02	Float
Salt water	1.028	
#6 PS (Dense)	1.03 to 1.04	Sink
#1 PETE	1.38	Sink
#3 PVC	1.4	Sink
PC	1.2	Sink
Nylon	1.13	Sink
Teflon	2.1	Sink
Polyester	1.38	Sink

This natural separation of resin types resulted in 99% of the plastic collected for this project being suitable for the machine.
The unsuitable plastics were limited to:

- PET bottles with air entrained (bottle cap on)
- Rope, which could not be processed by the granulator
- Metal springs inside spray bottle tops
- Unknown composite board material

During the trials with the Blest plastic to fuel machine, no irregularities were noticed as a result of processing the marine based plastics.

Cost analysis

Processing rates and labour costs were analyzed and projected for different configurations.
By far, the largest expenditure calculated was labour to granulate the plastic.
This showed that the feed rate of the granulator had the greatest effect on the cost per litre of the fuel.
Large articles such as barrels were more time consuming due to the need to cut the barrels in to sizes that the granulator could handle.
With a Blest NVG 220 at a granulator feed rate of 50 kg/hr, a cost of $0.52/litre was realized.
Increasing the feed rate capability to 150 kg/hr decreased the cost to $0.31 per litre
The feed rate is a measure of the capacity of the granulator that processes the plastic and does not have anything to do with the plastic to fuel machine itself.
This is consistent with any source of plastic processed.
Larger machines would produce the fuel at rates o$0.14/litre or less.

Oil analysis

The following factors were determined as a part of this project. Many variables were very similar to the results obtained from land-based plastics. The chloride tests indicated that the salt water had little effect on the plastic feedstock as a source for conversion to fuel.

Analysis	Desired Result	#6PS	Mixed marine plastic	Land based plastic (averaged)
Water	<0.02%	0.01%	0.01%	0.01%
Copper Corrosion	<3	1b	1a	1b
Pour Point	<-5c	4c	-12c	-12 to -17
Plug Point	<-5c	15c	-8c	-5 to -12
Flash Point	>40	42	54	52
Sulphur	<15ppm	5	12	7 to 12
Bacteria and		0	0	0

Mold				
Ash	<0.01%	0	0	0
Viscosity	1.30 to 4.10	1.9	1.6	1.6
Lubricity	<520	297	331	305 to 375
Monomer%	>99.7	99.7	n/a	n/a
Higher heating value btu/lb	>18000	19050	18560	n/a
Carbon%		67	45	n/a
Hydrogen%		6.9	4.8	n/a
Nitrogen%		.34	.29	n/a
Chloride%	<0.05	<0.01	<0.01	n/a
Oxygen%		25.638	49.274	n/a

The only issues identified in the testing are the plug and pour points.
The plug point refers to the temperature at which the fuel will clog a filter element.
The pour point refers to the temperature at which the fuel will not pour out of a container easily.
One or more of the following suggestions can address these issues:
1: mixing with diesel fuel at a 50/50 rate
2: addition of additives to enhance these properties
3: fuel filter heating pads
4: utilizing indoor storage tanks where permitted by regulations

Conclusions

The fuel derived from marine plastics resulted in fuel qualities very similar to land based plastics. Similar issues were identified in the pour and plug points. These issues are more pronounced in areas where temperatures are consistently below freezing so most marine climates would have few problems with using the marine plastic derived fuel.