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«POLYMER WASTE AS AN ALTERNATIVE FUEL SOURCE»

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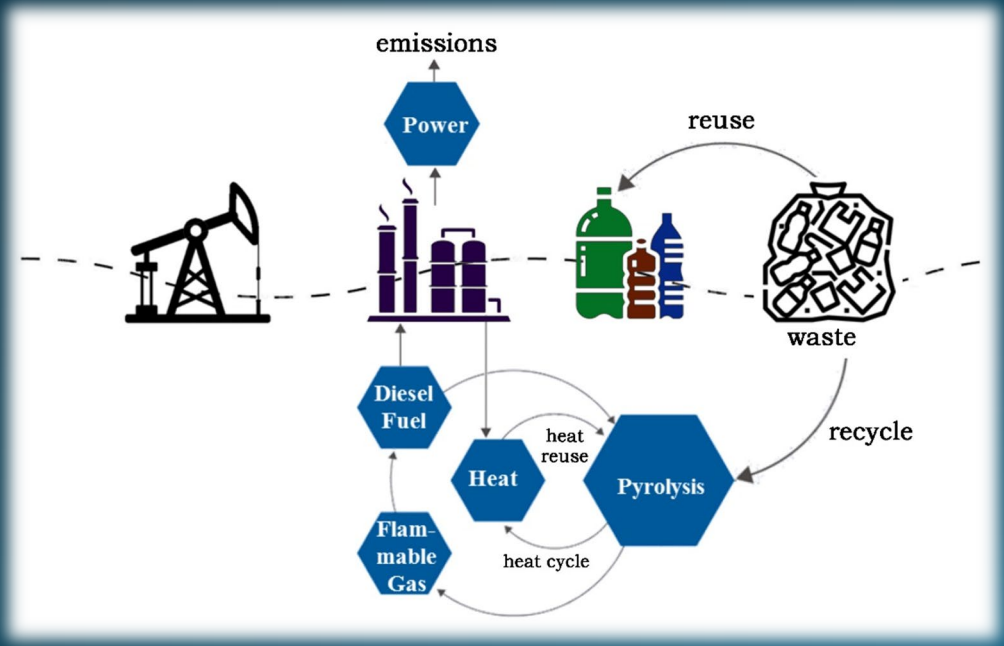
Up to one million tons of waste polymer materials are accumulated in Ukraine annually according to preliminary estimates, and there is a steady trend to increase their amount in the future. At the same time, the state lacks an appropriate structure for salvaging, sorting and preparing these wastes, which makes their processing extremely difficult. It is known that in Western European countries, waste accumulates in larger quantities: in Austria up to 3 million tons per year, in Germany up to 8 million tons per year, and in the USA up to 30 million tons per year. In these countries, there is an established system for salvaging such waste.

Waste is partially processed into secondary polymer materials in the amount of up to 10 % of the total amount of raw materials. The quality of products made of secondary polymer materials in some cases does not meet the requirements of the ecological and hygienic standards for developed countries. Polymer waste in these countries is not processed practically but is accumulated for further disposal.

The problem of polymer waste processing has two aspects: environmental and energy. On the one hand, we improve the environment by destroying polymer waste. On the other hand, this waste is a hydrocarbon derivative and can be a raw material for obtaining alternative motor fuel that will be used in the fuel and energy state complex. Only polyethylene, polypropylene, polystyrene and their copolymers, which do not contain harmful compounds and consist mainly of carbon and hydrogen, are subject to processing.

Packing material (plastic film, boxes, bottles, cans, etc.), household goods, disposable dishes, syringes, medical blood transfusion systems and other products are subject to recycling. The listed polymer materials can be decomposed into liquid hydrocarbons by the cracking thermal (450…550 °C and 2…7 MPa) or catalytic principle (450 °C and atmospheric pressure in the presence of catalysts – aluminosilicates). Synthetic gasoline is obtained from a gas mixture, which contains 56.5 % hydrogen, 28.5 % carbon (II) oxide and other gases.



The basis of the developed technology, like other similar ones, is low-temperature controlled pyrolysis of polymers without air access in the presence of catalysts.

The processing equipment of the technological unit does not need addition-al energy carriers, since the energy source is the processed raw material. A small amount of electricity is required for the operation of pumps, fans, automation systems and lighting, the costs of which are approximately 45…50 kW per waste ton.

As a result of pyrolysis, decomposition products of three main types are formed:

20…25 % by weight *pyrolysis gas*	70…75 % by weight *liquid hydrocarbon fuel*	0.1… 5.8 % by weight *solid residues*

Thus, up to 750 kg of synthetic fuel is produced after processing one ton of raw materials, which does not contain sulfur and is free from several dangerous organic compounds that are part of engine fuels. This product is a mixture of gasoline-kerosene-fuel oil fractions and can be used as boiler fuel without additional processing. Synthetic liquid fuel can be separated to obtain gasoline, high-quality diesel fuel and heavy fuel oil during the completion of the technological unit with separation and rectification devices.

We can obtain after rectification from synthetic fuel 35…40 % by weight unethylated gasoline A-76, 45…50 % by weight summer diesel fuel L-0.2-40 and 10…15 % by weight boiler fuel.

Indexes	A-76	A-76A
Octane number	76	76
Fractional composition: distillation start temperature, °C (not lower)	35	35
10 % is distilled at temperature, °C (not higher)	70	56
50 % is distilled at temperature, °C (not higher)	115	99
90 % is distilled at temperature, °C (not higher)	180	163
boiling point of gasoline, °C (not higher)	195	190
residue in the flask, % (no more)	1.5	1.3
balance and losses, % (no more)	4.0	3.8
Saturated vapor pressure, kPa (no more)	66.7	68.0
Acidity, mg KOH/100 cm^3 of gasoline (no more): ethylated	3.0	—
unethylated	1.0	1.0
Sulfur mass fraction, % by weight (not more)	0.1	unavailable
Testing on a copper plate	withstands	
The content of water-soluble acids and alkalis	unavailable	
The content of impurities	unavailable	
Water content	unavailable	
Color	yellow	
Density at 20 °C, kg/m^3 (no more)	—	711

Indexes	L-0.2-40	L-0.2-40A
Cetane number	45	45
Fractional composition: 50 % distilled at temperature, °C (not higher)	280	270
90 % distilled at temperature, °C (not higher)	360	350
Kinematic viscosity at 20 °C, mm^2/s	3.0…6.0	3.4
Flash point in closed crucible, °C (not lower): for locomotive and marine diesel engines	62	—
for general-purpose diesels	40	43
Mass fraction of sulfur, % by weight (not more)	0.2	unavailable
Hydrogen sulfide content	unavailable	
Testing on a copper plate	withstands	
The content of water-soluble acids and alkalis	unavailable	
Concentration of actual resins, mg/100 cm^3 of fuel	40	
Iodine number, g of iodine/10 g of fuel (no more)	6	6
Ash content, % by weight (not more)	0.01	0.005
Coking power of the 10 % residue, % (no more)	0.2	0.05
Filtering factor (no more)	2	2
The content of mechanical impurities	unavailable	—
Water content	unavailable	
Density at 20 °C, kg/m^3 (no more)	860	

The use of waste polymer materials allows you to significantly save primary raw materials (primarily oil) and electricity, which contributes to the energy state independence. The utilization considered method of waste polymer materials based on pyrolysis allows obtaining high-calorie fuel.

At the same time, the comparative composition of alternative motor fuel obtained by processing thermoplastic polymers and traditional fuel (of petroleum origin) is similar to each other. This allows its use as an alternative fuel source in internal combustion engines of transport and technological vehicles.

Thanks for your attention!