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 [1]. 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 [2, 3]. Only polyethylene, polypropylene, polystyrene and their copolymers, which do not contain harmful compounds and consist mainly of carbon and hydrogen, are subject to processing. It is allowed to process chloro- and fluorine-containing polymer materials, as well as plastics that contain CN groups in an amount not exceeding 5 % of the mass of the main raw material. 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. Catalysts are used for this at a moderate temperature.

Both domestic and foreign scientists are working on the development of technology for converting polymer waste into alternative energy fuels. 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. At the same time, pyrogenic transformations of organic raw materials include several thermal

processes: structure change by decomposition (cracking) and their complication by condensation and polymerization. Individual groups and radicals try to occupy a position in the molecule by the introduction of high temperatures from the outside. This corresponds to maximum stability under real physical and chemical conditions.

Thermal decomposition of molecules is associated with the decrease in the strength of internal bonds as the temperature increases. The thermal decomposition process of organic raw materials takes place in the direction of transformation of less stable high-molecular compounds into more stable low-molecular substances – liquid hydrocarbons of various compositions.

The processing equipment of the technological unit does not need additional 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 (in % by weight) of three main types are formed: 20…25 pyrolysis gas; 70…75 liquid hydrocarbon fuel; 0.1… 5.8 solid residues depending on the contamination of the primary raw material [4].

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.

References

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