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Secondary catalytic recycling of used automobile tires

In our world each year a large number of used tires are accumulating, but the parts which are recycled and used as a secondary product made up only 15% of the total. The other parts of the used tires are accumulating and stored on the places of enterprises and organizations, because the main reason is lack of appropriate processes and technologies. We can't accumulate and store waste tires infinitely, because this situation requires large areas of land. Also, this type of garbage is one of the greatest potential dangers to the environment. Slow destruction of tires which is caused by natural and climatic factors, also by rodents, it is leads to the formation of small particles in the form of crumbs, which are dispersed in the environment and carried to long distances by the wind. The storage spaces of used tires turned into a huge area of the clusters and a large number of living species (rodents, birds, microorganisms, etc.) [1].

In this connection it is necessary to develop effective ways of recycling used tires, which will simultaneously solve the problem of secondary use of tires and protection of the environment.

Considering the complexity of the chemical composition of the rubber material, the most promising method to clean is the complex chemical recycling. Using this method we can produce: boiler fuels, high-octane components of motor fuels, raw materials for the petrochemical industry, organic and biochemical synthesis, asphalt for road construction, carbon materials, and anode paste for electrothermal and electrochemical industries. Solving this problem we can significantly expand the raw material base of hydrocarbons, which gives opportunity

for us to preserve the natural resources of oil, rate of exploration, production, also solve the complex environmental issue and the harmless disposal of waste rubber.

By mentioned facts, we carried out investigation to produce synthetic liquid products by catalytic thermal processing of waste tires. In the process of heating the weaker aliphatic chains will firstly break, which are bound with the condensed aromatic structures. We can control the process of breaking specific bonds by selective introduction of catalysts in to the functional groups of organic matter.

The main raw material of recycling process is the worn out automobile tires and products of this process are very useful. They are: gases, which are used for post-combustion, liquid products (fuel, fuel additives), the solid residues, various sorbent. Approximately, one radial tire consists of: synthetic rubber - 27%, sulfur, zinc oxide - 3%, steel - 10%, textiles - 4%, softening oil - 10%, other petrochemical components - 4% soot - 28% and natural rubber - 14%. The main component is rubber. In accounting the proportion of the rubber in the used tires is more than 65% [2,3].

Heavy oil fraction from "Kumkol" field boiled above 773K was used as paste formation (PF) and instead of hydrogen donor.

The experiment was carried out on the batch-type installation at the temperature of 673K. Duration of the experiment is 60 minutes. Proportion of tires and paste formation (T : PF) is 1:1. One of the main problems of the secondary catalytic recycling of the waste tires is the use of efficient catalysts that provide a high yield of liquid products.

In this connection, in order to select the best catalysts for the production of liquid products from used tires, we investigated catalysts based on natural materials (bauxite-094, zeolite from "Semey-tau" deposit and the red sludge - waste from bauxite ore). Activity of the catalysts was evaluated by the total liquid output. Results of research are presented in Table 1.

The experiments of catalytic processing of used tires were produced hydrocarbon gases and primary products that had been subjected to distillation at temperatures of 453-593K. From the data of table, we see that the most active catalyst is a natural zeolite which is treated at temperature of 673K.

By the presence of catalyst the pressure is being decreased in the reaction apparatus on account of more effective transfer of atomic hydrogen from the components of the hydrogen donor solvent. This is due to the deepening of the process, which shows the output of gaseous products and light fraction. With the presence of the active hydrogen donor increases the degree of conversion and the output of liquid products, which is equal to 48.6%. It should be noted that the catalyst can improve the output of liquid products and the fraction contents, which is boiling among 523-593 K.

Table 1 – The influence of catalysts on the output of liquid products by catalytic recycling of used tires (T = 673K, m_{PF} = 15g, m_{catal} = 0.67, τ = 60 min).

Catalysts	P_{max} MPa	Yield of gases,%	Yield of liquids, %				Yield of sludge, %	Loss of mass
			Before 453K	453-523 K	523-593K	∑LP		
Without catalyst	3.7	35.9	6.9	4.3	9.2	20.4	41.4	2.4
Zeolite "Semey-tau"	2.6	13.3	4.6	7.8	21.4	33.8	44.5	8.3
Catalyst treated with temperature	2.1	12.7	9.2	9.2	30.2	48.6	34.1	4.6
Bauxite-094	2.3	11.5	7.5	11.8	11.2	30.6	50.4	7.5
Red sludge	3.4	22.7	5.3	1.7	22.2	29.0	44.6	3.5

Thus, all of the products formed by the catalytic recycling of worn out tires are being used in industry (fuel - oil, gas - post-combustion, the heat source, the solid residue - additive to road bitumen, sorbents), which is the basic foundation of non-waste recycling of tires.

References:

1. E.V. Suhonosova, I.V. Lihomanenko. Study compositions and properties of the liquid products of pyrolysis process of used automobile tires. // Proceedings of the All-Russian Conference "Korshunovsky reading." 2008. - S. 106-110.

2. E.K. Papynov, N.P. Shapkin. Recycling of organic wastes using thermal cracking // Chemical Technology. - T. 10. - № 1, 2009, pp. 48-52.

3. Patent of RF 2110535, C 08J 11/04. // Method of recycling rubber, organic industrial and household wastes. - Posted on 05/10/98.