

Production Of Alternative Fuels From Wear-Out Tires And Rubber Materials

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Abstract

In this work, alternative fuel and other types of products were obtained from car tire waste and their components were determined as a result of physical and chemical analysis. To determine the optimal temperature during pyrolysis, one of the modern methods for studying physical chemistry, derivatographic analysis, was carried out. As a result, it was determined that the temperature for the optimal process is 450-550 °C and the amount of liquid, solid and gaseous substances released as a result of this temperature.

Keywords: Pyrolysis, thermogravimetry, carbonaceous, metal cord, liquid phase.

Introduction. The number of car parks in the world is increasing every year, which naturally leads to the formation of landfills of worn tires. According to the statistics of the European Tire Recycling Association, more than 9 million tons are generated in Europe. amortized automobile tires. In the USA in 2010, the number of worn tires was over 1.5 million tons. In the UK, almost 500 thousand tons of worn-out tires are produced annually, of which 34% of this volume is recycled, 26% is restored, 15% is burned and 6% is taken to landfills for burial. In Japan, 96 million worn-out tires (1056 thousand tons) were formed in 2008, of which 88.5% were processed during the same period, in France more than 400 thousand tons, in Germany-460-510 thousand tons. And in Russia, more than 1 million tons are formed. worn tires, of which no more than 10% is recycled.

The results obtained and their discussion

The paper shows that the thermal decomposition of rubber materials and worn tires occurs in the temperature range of 400-500 °C. We have studied the thermal characteristics of worn-out car tires and rubber materials in a derivatograph of the brand "Labsys evo Setaram". According to the analysis of the DTGA curve, it can be seen that the curve consists of two sigmoids, which shows the course of thermal degradation in two stages, occurring in the temperature range: the first temperature range is 50-500 °C, the second temperature range is 500-800 °C. According to the analysis of the DTGA curves, it can be seen that in the temperature range from 50 °C to 500 °C, the weight loss is 17.8 mg, which is 40.5%. At this temperature range, the rate of decomposition of rubber proceeds intensively and is 2.609 mg/min. In the temperature range of 500-800 °C, the rate of decomposition of rubbers proceeds moderately and is 1,836 mg /min, and the weight loss is 47.4%.

From the analysis results, it can be concluded that thermal oxidative pyrolysis is preferably carried out in the temperature range of 500-550 °C.

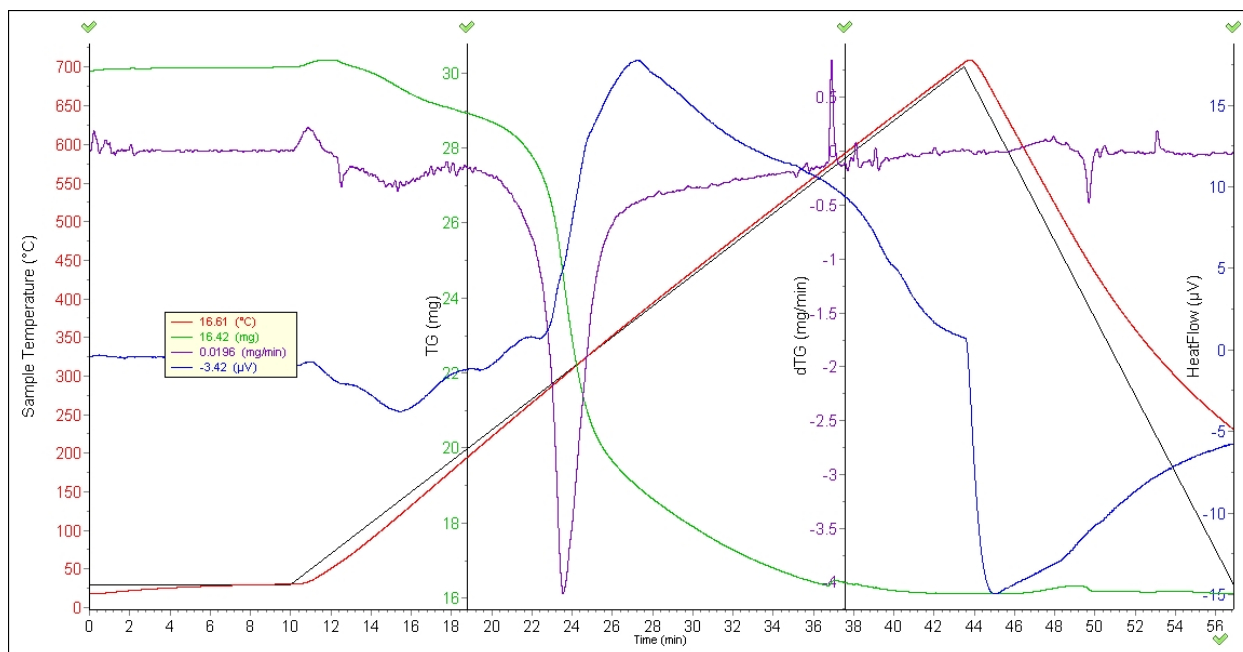


Fig.1. Derivatogram of worn car tires.

Differential scanning calorimetry (DSC) (4), dynamic thermogravimetric curves (DTA) (2) and TGP curves (3) of carbon black.

Analysis of the results of the DT and DSK curve of rubber

Table 1

No	Temperature, °C	Lost mass, gr	Rate decomposition matter mg/min	Amount of energy expended (µV*s/mg)
1	50	0,485	0,137	1,45
2	100	0,885	0,465	2,88
3	200	1,025	0,453	2,01
4	300	3,222	0,087	3,02
5	400	6,985	0,147	1,02
6	500	10,569	0,455	2,03
7	600	12,012	2,481	1,57
8	700	14,215	2,499	1,59

As a result of this derivatographic research, we can assume that the main mass load is observed in the range of 150-430 °C cause the decay temperature of the car tire and the substances that separate from it is precisely to this temperature that it is carried out. It contains 46.2% of the main mass that is, 14.0 mg of the mass.

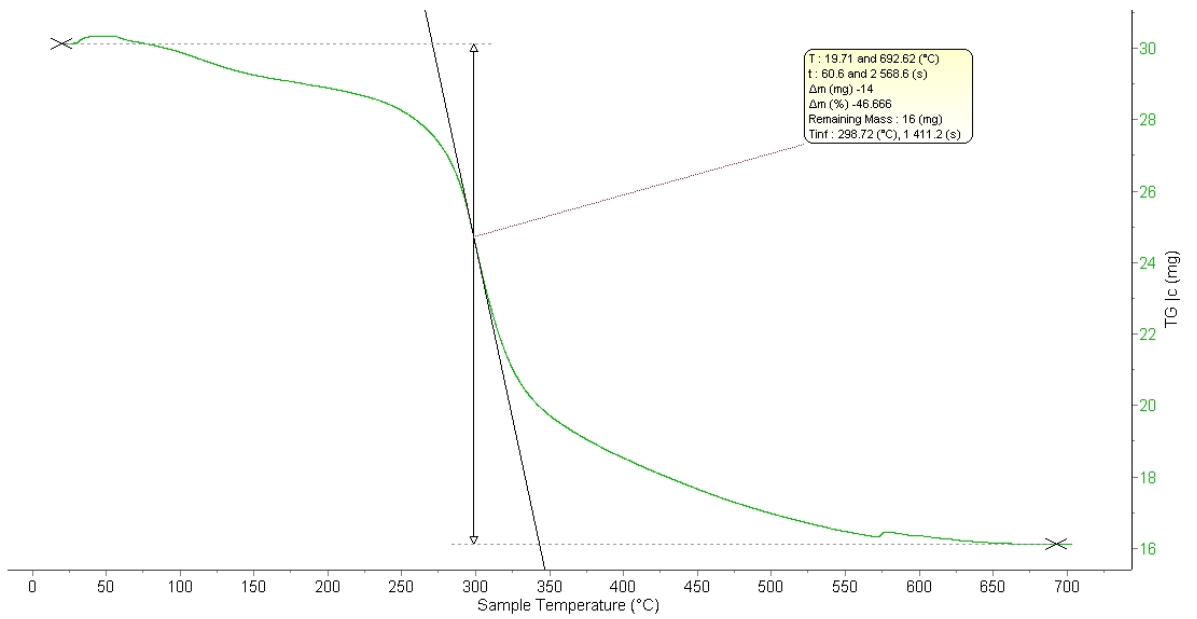


Fig.2. Drawing of thermogravimetry of rubber

According to the analysis of the thermogravimetric TG the first step of decay it had been between at 19 °C and 145 at °C The second step of decay it was started at 153 °C and finished at 645 °C

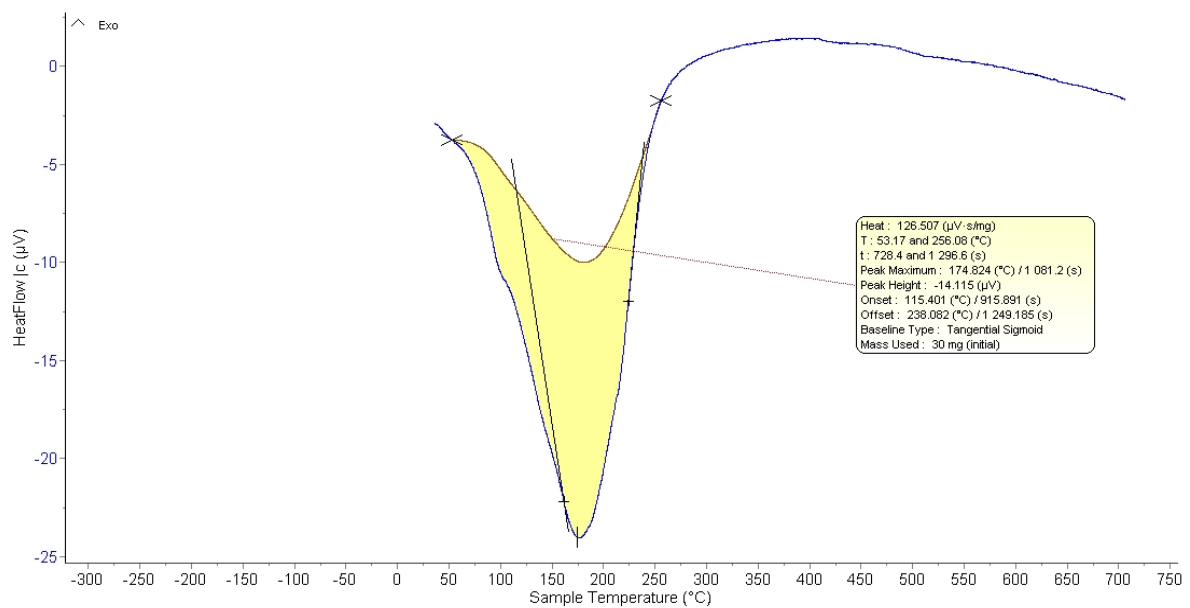


Fig.3. THE ANALYSIS RESULTS OF DGT IN RUBBER

With the help of a differential scanner calorimeter, we can observe whether the heat output or heat absorption processes of a substance go in an exothermic or endothermic process. The results of this study show that the main exothermic process occurs from 115 °C to around 246 °C. We can be afraid that the loss of the main mass is carried out at -14.11 μv. We can see that the maximum heat output amount is equal to 128,507 μvs/mg.

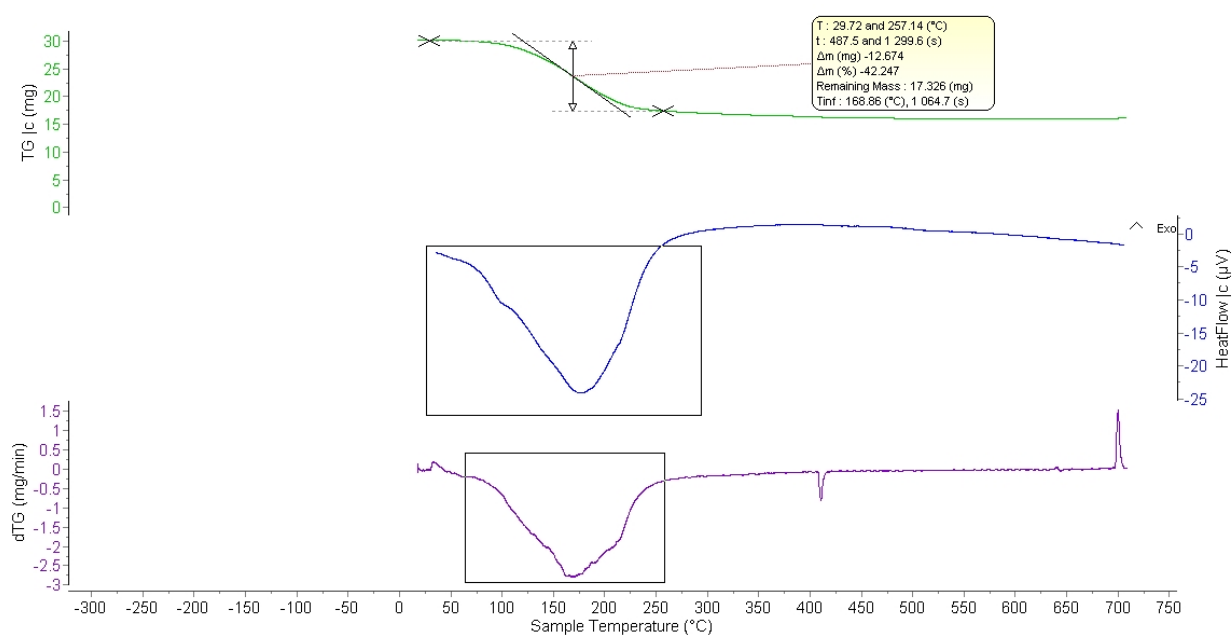


Fig 4. THE ANALYSIS RESULTS OF DGT IN RUBBER

Based on the results of the differential thermogravimetric study, it is shown that tg analyzes and DSK analyzes are interconnected by the fact that exactly the mass decomposes in the range from 30 °C to 260 °C, and the exothermic process produces heat in the same range , and the maximum decay rate is been done 169 °C at 1064.7 seconds.

Based on the results obtained, we have developed a technological process for processing used rubber products and tires. After stripping, the raw material is loaded into a retort (crucible). The raw materials in the retort are decomposed at a temperature within 500-550 °C, in the process of which intermediates are obtained: gas, pyrolysis liquid, carbon-containing material and metal cord. During the pyrolysis process, the retort is hermetically sealed. All rubber warms up, but does not burn, after the release of gases to the nozzle and to the pyrolysis plant, wood waste is burned in an amount of about 800 kg and gas is supplied with dilution of air, its combustion is performed. Dilution with air in a certain ratio, allows you to withstand the working temperature. Pyrolysis gases are discharged through the heating pipe of the raw material. The process of thermal decomposition of worn car tires occurs without air access. When the oil is heated and brought to the operating temperature, its thermal decomposition occurs with the release of a large amount of gas, which is discharged to the heat exchanger by means of a connecting pipe, where it condenses. The formed hydrocarbon fractions released when the rubber is heated are sent from the retort to the heat exchanger through which the hydrocarbon fractions are cooled and condensed, turning into liquid pyrolysis fuel. Those fractions that have not condensed, as a gas, are sent partly to the retort, and partly to the release. The cooling water is recycled and reused. Liquid fuel, metal cord and carbon-containing material are sent to the warehouse.

The liquid is collected in the product sump. As the pyrolysis liquid accumulates, the resulting liquid is drained into the storage tank, the resulting water is drained from the bottom of the sump through the mounted nozzles. The heat exchanger is cooled by process water (the water is used by both, which is downloaded from the pool of chilled water). After the end of the process, the furnace cools down, the crucible is removed from the furnace, after natural cooling, its lid is removed from the crucible and the solid residue is discharged. Then the next crucible is installed in the furnace, which is loaded with processed raw materials. The gas is returned to the furnace furnace to maintain the process, if necessary, the remaining part of the gas is discharged through the pipe. The carbon-containing residue after quenching and cooling is sieved through a sieve to separate the metal cord wire. Pyrolysis products mainly consist of gas, liquid and solid phases (Table).

Table 2. Characteristics of the products of thermal oxidative pyrolysis of worn car tires.

No	Name	Exit, %	Product Feature	Recommended scope of application
1.	Pyrolysis gas	13,0	Gas composition: methane-45.0%, ethane-14.9%, propane-	In mini boiler plants, for heating in pyrolysis reactors.

			5.0%, butane-3.5%, propylene-1.5%, ethylene-2.2%, butene-1.3%, hydrogen-17.5%, carbon monoxide-4.2%, carbon dioxide-4.9%.	
2.	Liquid fraction	41,0	Density=16948 kg/m ³ Viscosity=1.7957	For the production of aromatic hydrocarbons, petroleum products and furnace fuel.
3.	Carbon-containing material	39,0	Density=0.408±0.02 Viscosity=0.4 ± 0.05 Humidity= 22.7 ± 0.44	For the production of activated carbon, coke and thermal energy and as a filler
4.	Metal Cord	7,0	Wire in a partially shiny surface, dark gray light. Well pressed.	As scrap metal

It is shown that the study of the gas phase mainly consists of 45% methane, 14.9% ethane, and 17.5% hydrogen. Therefore, the gas mixture can be used for heating car tires in reactors in pyrolysis plants, which at this time the gas mixture is reused in reactors as fuel.

Among the pyrolysis products, a special place is provided by the liquid fraction, which is being developed for the production of alternative diesel fuel.

Conclusion

Thus, the results obtained show an improvement in the technological properties of rubber compounds filled with modified carbon compared with technocarbon P 803.

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