X-RAY PHASE ANALYSIS OF CARBON-CONTAINING MATERIAL PRODUCED BY PYROLYSIS OF WORN-OUT CAR TIRES

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РЕНТГЕНОФАЗОВЫЙ АНАЛИЗ УГЛЕРОДСОДЕРЖАШЕГО МАТЕРИАЛА ПОЛУЧЕННОГО ПИРОЛИЗОМ ИЗНОШЕННЫХ АВТОМОБИЛЬНЫХ ШИН

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ABSTRACT

The article presents the results of a study on carbon-containing material products of low-temperature pyrolysis of worn-out car tires. The granulometric composition of the carbon-containing material crushed was determined. Physico-chemical characteristics such as bulk density, acidity, moisture content and ash content of the carbonaceous material. Carbon-containing material was also studied by X-ray phase analysis. According to the analysis of the carbon-containing material, it consists mainly of 88.24% amorphous carbon, 7.59% calcite, 1.21% ankerite, 1.14% zinc oxide and other components.

АННОТАЦИЯ

В статье приводятся результаты исследования по углеродсодержащему материалу продукта низкотемпературного пиролизп изношенных автомобильных шин. Определили гранулометрический состав измельченного по углерод-содержащему материала. Физико-химические характеристики, такие как насыпная плотность, кислотность, влажность и зольность углеродсодержащего материала. Также исследованы состав углеродсодержащего материала методом рентгенофазного анализа. Углеродосодержащие материалы получен вывод о том, что материал состоит в основном 88,24 % аморфного углерода, 7,59 % кальцита, 1,21 % анкерита, 1,14 % окиси цинка и других компонентов.

Keywords: carbon-containing material, pyrolysis, temperature, microscopy, particle, size, flooring material, bulk density, humidity, ash content, X-ray phase analysis, carbon, calcite, ankerite, zinc oxides.

Ключевые слова: углеродсодержащий материал, пиролиз, температура, микроскопия, частица, размер, наполнитель, насыпной плотность, влажность, зольность, рентгенофазный анализ, углерод, кальцит, анкерит, окиси цинка.

Introduction. In the world, the number of motor transport complexes is increasing every year, which naturally leads to the formation of dumps of used tires. According to the statistics of the European Association, tire recycling in Europe generates more than 9 million tons of depreciated car tires.

In the USA, the number of worn-out tires is about 1.5 million tons, in the UK almost 500 thousand tons of worn-out tires are formed 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, approximately 96 million worn-out tires are formed, 88.5% of them are recycled, in France - more than 400 thousand tons, in Germany – 460-510 thousand. tons, and in Russia more than 1 million tons of worn-out tires are formed, of which no more than 10% is recycled Among the existing methods of recycling worn-out car tires, the optimal method is thermal decomposition - pyrolysis [1-4]. Currently, there are various methods for recycling worn-out rubber products, such as low-temperature technology, bar-destruction, ozone and high-temperature technology, and others. Among the existing methods of recycling used car tires, the optimal method is high-temperature thermal decomposition - pyrolysis [1-4]. The use of waste-disused car tires, as a raw material base is relevant both from the economic and environmental side. Automobile tire is a valuable secondary raw material containing rubbers - 65-70%, carbonaceous material -15-25%, metal cord-10-15% [5,6]. Among these products, carbonaceous materials are of great importance. Therefore, the physicochemical characteristics of this product have been studied in detail.

Research object. The density, ash content, pH and granulometric composition of the obtained carbon black were studied by GOST methods and its qualitative and quantitative composition was determined by X-ray phase methods.

Methods and materials. The object of the study was a carbon-containing material, a product of low-temperature pyrolysis of worn-out car tires.

The objects of study were carbon black obtained by pyrolysis of worn tires. Certain physical and chemical characteristics have been determined, such as ash content (Ad)-GOST 1022-95; mass fraction of moisture (Wa) - GOST 52917-2008; such as bulk density (Pn)-GOST 16190-70; pH was determined according to the procedure [7, 8], ash content (Ad)-GOST 1022-95; mass fraction of moisture (Wa)-GOST 52917-2008; Granulometric composition - GOST 2093-82.

The diffraction patterns were obtained on a ShimadzuXRD-6100 X-ray powder diffractometer equipped with a copper (Cu) tube (K ∞1=1.5406, K ∞2 = 1.5443, K ∞2/K ∞1= 0.5 Scintillation detector Microscopic analysis was made on a Diotox1500 instrument.

Results and discussion

Therefore, the physicochemical characteristics of this product have been studied in detail. Carbon-containing material occupies a special place among pyrolysis products. Therefore, its properties have been comprehensively studied, namely, microscopic analysis of carbon-containing material after pyrolysis in a crushed form, the results of which are presented in Fig.1.

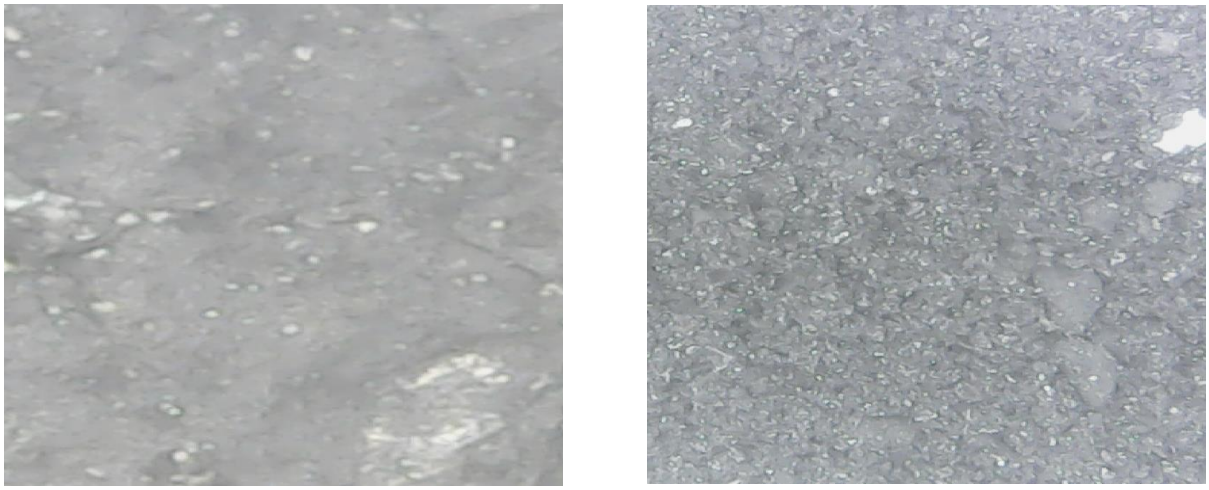

Figure 1. Microscopic general view of the carbonaceous material after pyrolysis

Microscopic analysis of carbonaceous material was studied. It was determined that the carbonaceous material is a relatively fragile, lumpy black with a grayish tint, with an unpleasant odor, a substance in some pieces of which there are metal inclusions. Before use, the carbonaceous material was crushed with a BB 600 laboratory jaw crusher.

The granulometric composition of the crushed carbonaceous material was determined. It was revealed that particles of carbonaceous material with a fraction with a size of 0.063 mm, which is 63.0% of the total content of particles, particles with a size of 0.25 mm is 24.0 wt%. Also particles with a size of 0.5 mm are about 9.0 wt %. The use of a carbonaceous material with crushed metal inclusions as a filler for industrial rubber.

Table 1.

Physical and chemical characteristics of the carbonaceous material of the original (before grinding UM-1) and crushed (UM-2)

Characteristics	$\rho_н$, g/sm^3	pH	A^d, %	W^a, %
CM-1	0,408 ± 0,02	6,5-5,4	22,70 ± 0,44	0,40 ± 0,05
CM-2	0,323 ± 0,02	6,5	22,65 ± 0,44	0,24 ± 0,05

Analysis of the results of the study (Table 1) shows that a decrease in the particle size of the carbonaceous material leads to an increase in bulk density, acidity, humidity and practically does not affect the ash content. The composition of the carbon-containing material was also studied by X-ray phase analysis, the results of which are shown in Fig.2. The diffraction patterns were obtained on a Shimadzu XRD-6100 X-ray powder diffractometer.

Detector-scintillation, X-ray phase analysis by the Rietveld method was carried out on the software "Profex-Open sourse XRD and Reitveld Refinement".

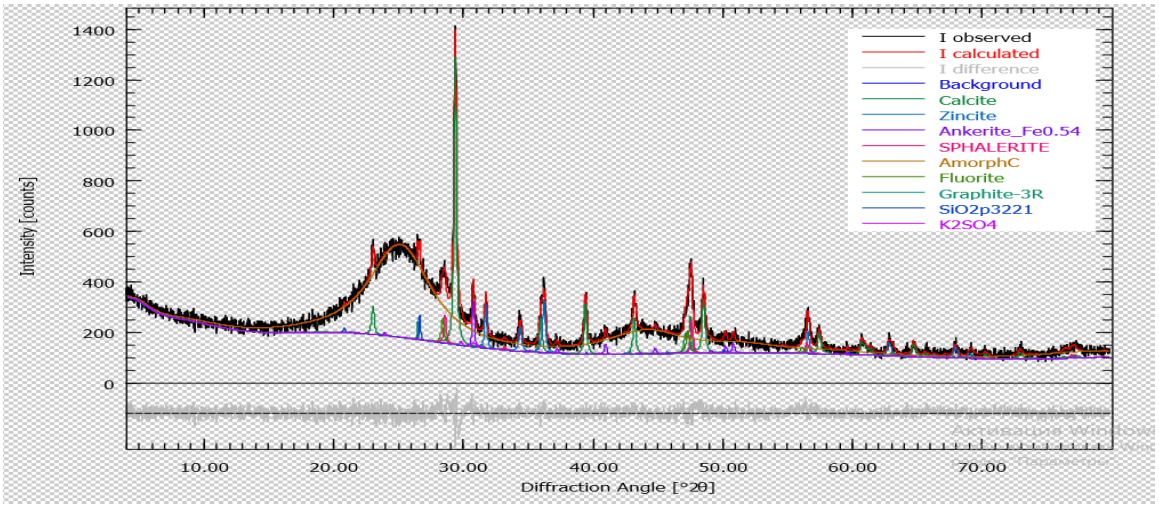

Figure 2. Radiographs of carbon-containing material obtained by pyrolysis of worn-out car tires

Table 2.

The composition of the carbonaceous material

№ т/р	Names	Quantity, %
1.	Calcite	7,59
2.	ZnO	1,14
3.	Ankerite ($Ca(Mg, Fe)[CO_3]_2$	1,21
4.	ZnS	0,39
5.	Amorphous carbon	88,24
6.	Fluorite	0,66
7.	Graphite-3h (crystals)	0,24
8.	Quartz	0,32
9.	K_2SO4	0,22

According to the results of the analysis, 88.24% of the carbonaceous material consists mainly of amorphous carbon, 7.59% of calcite, 1.21% of ankerite, 1.14% of zinc oxide and other components.

Conclusion

The article presents the results of a study on carbon-containing material products of low-temperature pyrolysis of used car tires. The granulometric composition of the crushed carbonaceous material was determined. It was revealed that particles of carbonaceous material with a fraction with a size of 0.063 mm, which is 63.0% of the total content of particles, particles with a size of 0.25 mm is 24.0 wt.%. Particles with a size of 0.5 mm is about 9.0 wt. %. Physico-chemical characteristics such as bulk density, acidity, moisture content and ash content of the carbonaceous material.

The composition of the carbon-containing material was also studied by X-ray phase analysis. According to the analysis of the carbon-containing material, it mainly consists of 88.24% amorphous carbon, 7.59% calcite, 1.21% ankerite, 1.14% zinc oxide and other components.

References:

1. Dekking Hendrick , 2011 Propagation of Vinyl Polymers on Clay Surfaces.II. Polimerization of monomers Initiated by free radicals. Attached to Clay. – J. Appl. Polym., v.11, N1, p.23-36
2. Peri Hand and Aron Hanslay 2012 The surface structure of silica. Gel.- J. Phys.Chem . № 12, p 2986-2933.
3. Chaser David and Matheny Paul 2001 Some factors affecting nitrosaimine formation from accelerators in styrene – butadiene rubber. Kautsch und Gummi. N 58. - C. 435-438.
4. Sh.T.Juraev, A.S.Ibodullaev, B.F.Mukhiddinov. Investigation of the properties of rubber compositions filled with carbon material. «International Journal of Recent Advancement In Engineering and Research» India. Volume 04,Issue 04; April-2018. PP.1-5.
5. Shokhruh Juraev, Axmadjon Ibodullayev, Bahodir Muhiddinov and Kahramon Xusenov 2020 Properties Of Rubber Mixtures Filled With Carbon-Containing Material. International Journal of Advanced Science and Technology Vol. 29, No. 9s, pp. 4111-4118
6. Shokhruh Juraev, Axmadjon Ibodullayev, Bahodir Muhiddinov,2020 Study of the physicochemical characteristics of carbon black obtained by pyrolysis of worn tires. Uzbek chemical journal. - No. 1. - P. 42-49.
7. Sh.T. Juraev, Teshabayeva E.U, A.S. Ibodullaev, B.F. Mukhiddinov. Investigation of the properties of rubber compositions filled with carbon material. The international conference on “Integrated innovative development of Zarafshan region: achievements, challenges and prospects”. Navoi. 26-27 october, 2017. – pp. 387-391.
8. Sh.T. Juraev, B.F. Mukhiddinov, A.S. Ibadullaev, O.I. Isroilov. Physical and chemical characterictics of the carbon material obtained by the pyrolysis of rubber technical products. XIV international scientific specialized conference «international scientific review of the technical sciences, mathematics and computer sciences» Boston. USA. March, 2020. – pp. 32-36.