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Henarava T.[1], Chernova T.[2], Kartuzava A.[2]
([1] HMTI NAS Belarus, Minsk,
[2] IBOC NAS Belarus, Minsk)

FRACTIONAL DISTILLATION OF PYROLYSIS OIL

Pyrolysis oil of car tires is a mixture of organic substances. Pyrolysis oil can be used as motor fuel, in addition, it can be a source of valuable chemical compounds. The most valuable chemical compound contained in pyrolysis oil is limonene, the mass content of which is from 10 to 17% [1-3]. Limonene is used as an essence in perfumes and in the production of fragrances [4].

Due to limited sources of fossil fuels and the need to find a suitable replacement or additive for diesel fuel, various alternative fuels are being investigated [1]. One of these fuels is pyrolysis oil obtained from waste car tires, because a large number of used tires are thrown away annually and there is no proper recycling strategy and converting used tires into pyrolysis oil is an attractive way to solve the problem of used tires [5].

The aim of this study is to study the suitability of fractional distillation for the separate pyrolysis oil and isolation of limonene from pyrolysis oil.

It is known that fractional distillation is used to separate complex organic mixtures into components, and fractions are obtained during refining, so it was attempted to separate the pyrolysis mixture by fractional distillation.

Separation, identification and quantitative analysis of the target components of pyrolysis oil is a complex task. The main method for the quantitative determination of liquid pyrolysis products is the method of gas chromatography-mass spectrometry.

In the literature there are several works devoted to the study of pyrolysis oils of waste automobile tires, and each of them presents its specific methods and goals, and the results of their chemical analysis differ. According to the results of GC-MS analysis, it was found that pyrolysis oil contains aromatic hydrocarbons, alkenes, sulfur- and nitrogen-containing organic compounds, as well as organic acids: hexadecanoic and octadecanoic acids.

In the work [3] fractional distillation and oxidative desulfurization were carried out to improve the quality of the pyrolysis oil. During fractional distillation, 30%, 20%, 6.35%, 6% and 4.5% by volume of oil are obtained at temperature ranges: 121-180°C, 211-260°C, 71-120°C, 191-210°C and 181-190°C. Then, about 54-58% sulfur was removed by desulfurization. Hydrogen peroxide and formic acid were used for desulfurization.

After vacuum fractional distillation of pyrolysis oil four fractions were obtained (Fig.1, 2). During fractional distillation, 16%, 40%, 17%, and 10% by volume of oil are obtained at temperature ranges: 38-125°C, 125-220°C, 180-350°C, 350-410°C.

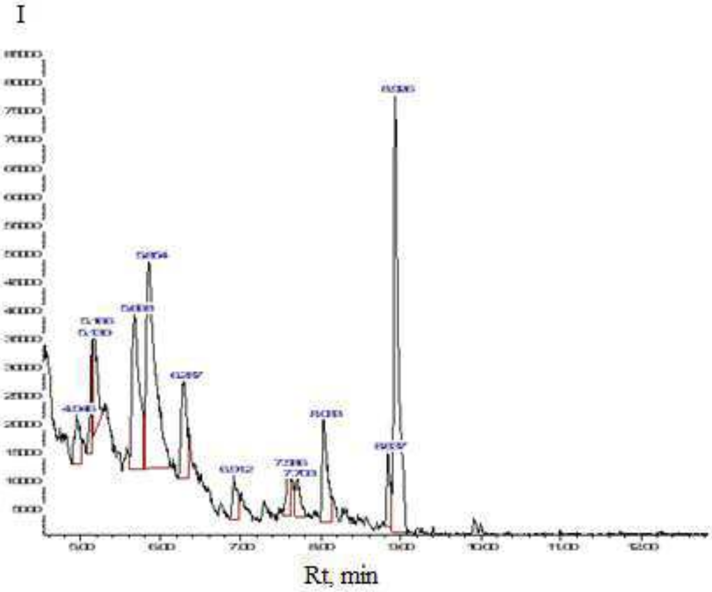

Fig. 1 The chromatogram of the first fraction of pyrolysis oil

In fig. 2 chromatograms of the second, third, and fourth fractions of pyrolysis oil after distillation are shown.

According to four fractions, it can be seen that, with increasing boiling points, the peaks shift toward longer retention times, i.e. a certain mass differentiation occurs, but the number of components changes little, due to the formation of possible azeotrope mixtures due to the multicomponent pyrolysis mixtures.

The distillation of the pyrolysis oil does not provide a clear separation of the components, in particular, limonene is found in all four fractions. It is shown that the content of low-boiling fractions in the indicated temperature range is up to 60%, which makes pyrolysis oil a promising source of motor fuel or additives after hydrotreating.

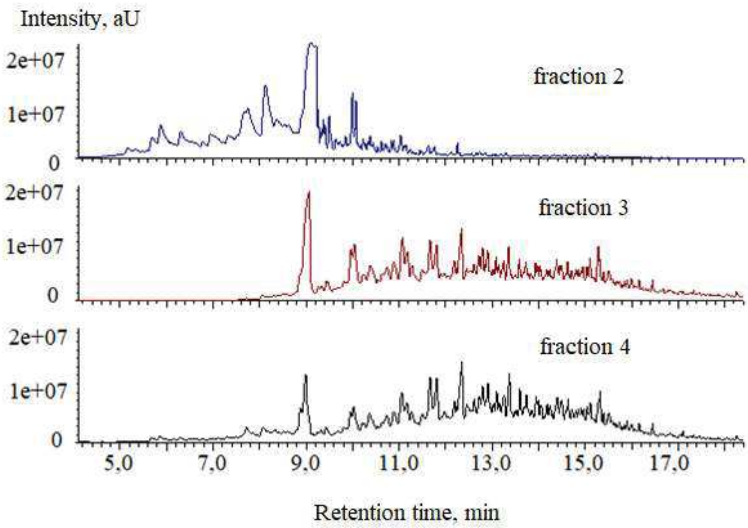

Fig. 2 Chromatograms of the second, third and fourth fractions after distillation of pyrolysis oil

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