Conference Paper

Phenol Extraction from Schistous Tar of Shubarkol Deposit

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Abstract

The process of extracting phenols from schistous tar using extractants based on water solutions of technical ethanol with concentration of 70% is considered in this article. According to chromato-mass-spectrometric (CMS) analysis, initial schistous tar contains 28.29 % of summary phenols, after extraction with 70% alcohol solution this had dropped by 8.76 %. According to results of laboratory studies, the best extraction properties were identified as occurring with 70% water ethanol of schistous tar with the ratio 1:1. As we see from obtained data, after extraction with ethanol, phenol content in tar is decreased by up to 8.76 %. After elimination of phenols, schistous tar might be applied as hydrocarbonic material for future processing into motor or boiler fuel.

Keywords: Schistous tar, phenol, extraction

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Schistous tar contains 82 - 84 % of carbon, 9,5 – 10,5 % of hydrogen and 5,5 – 6,5 % of oxygen. Due to this, it is possible to derive a number of products of schistous tar, whose production on the basis of petroleum feedstocks is impossible or economically unprofitable today. Under the listed reasons, main direction of thermal processing of combustible schists is the extraction of maximal quantity of tar. Solid residue of partial carbonization in such case has high ash content (65 - 80 %), and is out of interest in the role of fuel [1]. Tar, obtained at the processing of combustible schists generator stoves, contains up to 20 - 25 % of phenol [2].

Tar obtained of the schists of Shubarkol open pit is related to low-temperature tars, and is not subject to thermal processing. Unlike with tars of high-temperature coking, it is characterized with high content of oxygen compounds, mainly phenols and unsaturated compounds. Tar of partial carbonization contains little if any aromatic unsubstituted compounds. Hydrogen contained in the tar is included mainly into the content of aliphatic groups (substitutes) of aromatic and unsaturated compounds. Tar is composed of large number of compounds, some of them is represented in small amounts.

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The goal of this work is to extract the phenol from schistous tar using extractants based on water solutions of technical ethanol with concentration of 70%.

Dephenolization, as a rule, is applied to low-boiling parts (boiling out up to 300°C) of tars. These are petrol-ligroine and kerosene parts of low-temperature tars, phenol, naphthalene and absorbing parts of coal tar, part of 60-240°C of hydrogenate of brown coals [3]. For phenol extraction, extraction with polar solvents is applied, in majority of cases with methanol and its water solutions, as well as extraction with alkali with their transition to phenolates. The latest approach provides the fullest and selective extraction of phenols, but it is related to not-reversible consumption of large amount of alkali, which is expensive enough. Caustification of soda liquors, obtained after phenolates decomposition, applied in the production process, causes significant expenses and formation of large amount of discharge water [4]. Considering the difficulties, with the application of methanol (high toxicity), we have carried the studies with its replacement with ethanol in the process of schistous tar dephenolization. Extraction with water solutions of alcohols is convenient through simpler regeneration of solvent, and, in number of cases, is more preferable, despite the high level of phenol extraction by alkali method.

With the aim to study the opportunity of phenol extraction directly from schistous tar, we have carried the work on their extraction, using extractants on the basis of water solutions of technical ethanol with concentration of 70%. Elemental composition and physical properties of schistous tar are shown in table 1. According to chromato-mass-spectrometric (CMS) analysis, initial schistous tar contains 28,29 % of summary phenols, after extraction with 70% alcohol solution– 8,76 %. According to results of laboratory studies, it was defined that best extraction properties are shown with 70% water ethanol of schistous tar with ratio 1:1.

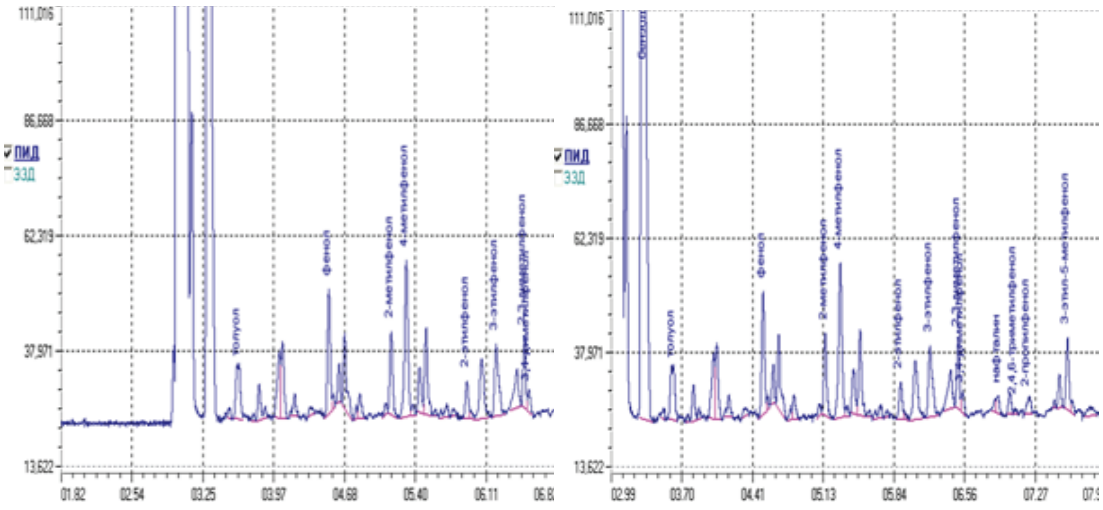
According to chromatograms (Figure 1), the content of schistous tar was defined, as well as of product after its cleaning from phenol (table 2)

As we see from obtained data, after extraction with ethanol, phenol content in tar is decreased up to 8,76 %. It must be noted that quantitative content of phenol is one of the restraining factors of industrial application of schistous tar, but, at the same time, shows promises for their extraction with the aim to apply in chemical industry. After elimination of phenols, schistous tar might be applied as hydrocarbonic material for future processing into motor or boiler fuel [5].

Phenol is applied in the industry for obtaining of phenolformaldehyde resins, applied in production of phenoplasts. Large amounts of phenol are processed into cyclohexanol, necessary for production of synthetic fiber. Mixture of cresols is used to obtain

Table 1: Physical properties of schistous tar

Indications	Schistous tar
Density at 20°C, kg/dm^3	0,973
Viscosity at 80°C, Pa* c	4,3
Ash content. %	0,04
Sulphur content, %	0,36
Phenol content, %	21,21
Calorific value on dry weight basis (Q^di), mJ/kg	38,82
Pour point, °C	-2
Flash point in an open cup, °C	112
Elemental composition, % mass	2
C	83,60
H	8,97
N	0,10
S	0,36
O	6,97
Fraction composition, % mass	
up to 200°C	17,5
200-360°C	47,5
over 360°C	35,0
Group composition of dephenolized tar, %:	
- hydrocarbons	44,0
including arenes	23,7
neutral oxygen-containing compounds	56,0



(а) (б)

Figure 1: Chromatograms initial schistous tar (а) and after extraction cleaning from phenols (б)

cresolphormaldehyde resins. Pure cresols are applied for synthesis of colorants, medical preparations, antiseptic substances, antioxydants [6].

Table 2: Content of main phenols of initial schistous tar and after its extraction cleaning

Component	Time, min	Concentration, %	
		Initial tar	After extraction
Phenol	4,52	4,63	1,39
2-methylphenol	5,15	3,31	0,99
3-methylphenol	5,30	7,45	2,23
2-ethylphenol	5,91	1,60	0,48
3-ethylphenol	6,20	4,22	1,26
2,3-dimethylphenol	6,49	2,46	0,74
2-ethyl-4-methylphenol	6,53	0,84	0,25
2,4,6-trimethylphenol	7,06	0,21	0,06
2-propylphenol	7,20	1,00	0,30
3-ethyl-5-methylphenol	7,59	2,77	0,83
Group composition:			
Phenols		28,29	8,76

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