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## **PREPARATION OF PR-1 COMPOUND BASED ON LOCAL RAW MATERIALS AND STUDY OF ITS PHYSICOCHEMICAL PROPERTIES**

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### **ABSTRACT**

The optimal ratio of components in the preparation of PR-1 is 1:1:1, and the optimal temperature for 40 minutes is 80 oC. Under these conditions, the productivity of the installations is up to 95%. The ratio of starting products is 2:1:1 and 1:2:1, the highest dry residue is produced, but the washability of the resulting products is low. The duration of the reaction is also important in the production of chemical products.

### **KEYWORDS**

Hydrolyzed polyacrylonitrile, sulfate acid, ethanol, sodium hydroxide, PR-1, Infrared spectroscopy.

### **INTRODUCTION**

The main indicators of lubricants are given in GOST 27674 - 88. Lubricating oils are liquid at normal temperature. According to their purpose, they are divided into motor, transmission, industrial, turbine, electrically insulating, conservative, compressor and others [1]. The most important characteristics (quality indicators) of Surkov oils are: density, viscosity; temperature dependence of viscosity (estimated by viscosity index or temperature-viscosity coefficient); oiliness (viscosity, oiliness) - the ability of oils to stick to a solid surface, forming a thin durable oil film called the boundary layer; pouring point; chemical resistance (thermo-oxidation stability) - not reacting with oxygen

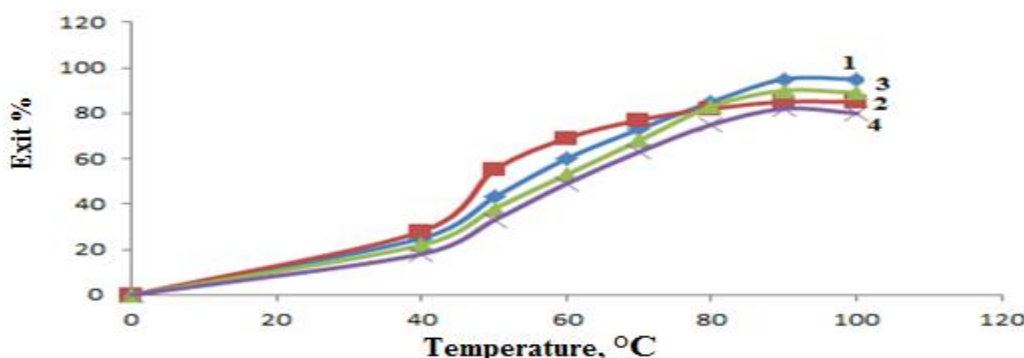
at high temperatures (50 - 60 ° C); coking ability - the ability to form coke under conditions of high temperature and pressure and without the introduction of air; the vapors of lubricating oils forming a flammable mixture with air are determined by the flash point when ignited [2]. Motor and transmission oils are the most common in the consumer market - they are required by private car owners. Motor oils consist of a base oil (80 - 90%) and a package of additives (10 - 20%), the nature and proportion of which determine their range and set of consumer properties [3].

The composition of essential oils can be as follows; mineral - a complex mixture of hydrocarbons obtained from oil; [4] Synthetic - organic compounds obtained as a result of targeted chemical reactions. These are hydrocarbon liquids (polyalphaolefins, alkylbenzenes) and ethers; [5]. Semi-synthetic - a mixture of high-quality mineral base oil and synthetic base components. A set of additives usually consists of: [6]. Thickening agents - stabilization of oil viscosity in conditions of temperature changes; detergents (detergents) - to reduce and prevent the formation of high-temperature deposits; [7]. Dispersants (dispersants) - storage of pollutants contained in oil in the state of finely dispersed suspension; [8]. Anti-oxidation and anti-corrosion - reducing the rate of oxidation and formation of oil-insoluble and corrosive products; depressants - lower the pour point of oil; [9]. Corrosion inhibitors - prevention of corrosion of parts made of ferrous metals; anti-friction - reduce friction; [10]. Anti-foam - prevention of foam formation. There are several classifications of engine and transmission oils: [11]. The classification of the American Society of Automotive Engineers (SAE) provides for the division of winter, summer and off-season oils by viscosity; [12]. American Petroleum Institute (API) classification takes into account application conditions and operating levels. When marking, the letter first indicates the type of engine - gasoline or diesel, the number indicates the cycle of the engine - four-stroke or two-stroke; [13]. Local classification in designation includes oil viscosity class, type of additives, oil viscosity, engine type - gasoline or diesel [14].

At normal temperature, plastic (oil) lubricants are in the form of a paste, when heated, they turn into a liquid state. They are complex colloidal systems, the

solid phase of which is a thickener (sometimes a filler), and the liquid phase is mineral oil. The most important properties (quality characteristics) of lubricating oils are as follows: penetration (consistency) - the degree of thickness of the lubricant (measured using a penetrometer by immersing a cone in the lubricant, evaluated by the number of penetration expressed in decimal fractions of a millimeter); the falling point (melting point) at which the lubricating liquid changes to the state, describes the upper limit of the operating temperature of the lubricant; chemical and mechanical stability; colloidal stability - resistance to disintegration of lubricants into liquid and solid phases; thermal stability - the ability to maintain its structure and properties during heating for a long time. The most popular oils are grease, graphite oil, litol, etc [15]. Depending on the type of base, oils can be: petroleum oils - obtained by oil refining; on synthetic oils - synthesized; vegetable oils - obtained as a result of processing natural products; in a mixture of petroleum and synthetic oils. According to the nature of the thickener, oils are divided into: [16]. Soap-based, soaps are used as a thickener for their production. They are divided into sodium, calcium, aluminum, lithium and complexes [17]. They account for more than 80% of all lubricants production; hydrocarbons. For their production, paraffin, ceresin and petrolatum are used as thickeners; inorganic. For their production, silicates are used as thickeners; organic. Carbon black and polymers are used as thickeners for their production [18].

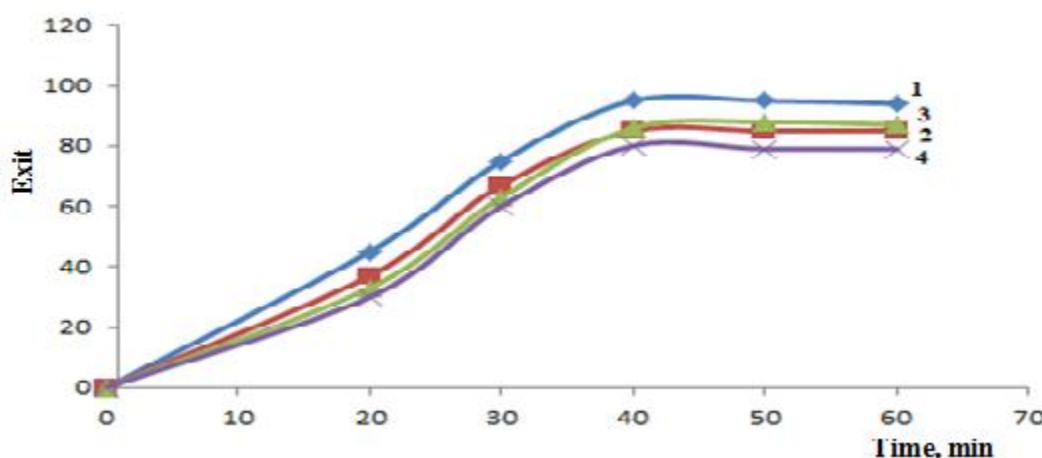
Experience part; Preparation of organic surface active substances, physical-chemical properties were studied, and PR-1 compound was first synthesized. Temperature is important in the PR-1 casting process.



The mole ratio of hydrolyzed polyacrylonitrile, sulfate acid and ethanol is 1-1:1:1; 2-1:1:2; 3-1:2:1; 4-2:1:1

Picture. 1. - Temperature dependence of PR-1 performance

As can be seen from Figure 1, the optimal ratio of components in obtaining the PR-1 device is 1:1:1, and the optimal temperature is 80 oC. Under these conditions, the productivity of landings is 95%. The ratio of starting products is 2:1:1 and 1:2:1, the highest dry residue is produced, but the washability of the resulting products is low. The duration of the reaction is also important in the production of chemical products. In the figure below, the performance of the PR-1 installation depends on the duration of the reaction at a temperature of 80 oC.



The mole ratio of hydrolyzed polyacrylonitrile, sulfate acid and sodium hydroxide is 1-1:1:1; 2-1:1:2; 3-1:2:1; 4-2:1:1.

Figure 2. - Time dependence of the performance of the PR-1 installation.

As can be seen from the figure, 95% yield of the reaction was obtained for 40 minutes under optimal reaction conditions. Further duration of the reaction leads to a decrease in yield. This is due to the progress

of parallel reactions (degradation, separation, intermolecular interaction, etc.), which reduce the effectiveness of washing. Thus, the optimal conditions for the reactions to obtain the PR-1 compound are set

at 80 oC for 40 minutes, and the ratio of components is 1:1:1. The product obtained under such conditions has a very good cleaning effect. Further research on the effect of PR-1 on fuel properties was carried out with the product obtained under the above conditions. In

hydrolyzed polyacrylonitrile, a product with a polar functional group -NH<sub>2</sub>, -COON is formed. Glue based on hydrolyzed polyacrylonitrile was used for assembly synthesis.



Figure 3 - Infrared spectroscopy of hydrolyzed polyacrylonitrile

As can be seen from the picture, the absorption lines in the IR spectrum in the region of 1550-1610 cm<sup>-1</sup> are characteristic of asymmetric valence vibrations of the COON group - the absorption lines of the COONa functional group are characteristic of symmetric valence vibrations in the region of 1400 cm<sup>-1</sup>. In addition, the absorption lines formed in the region of 3000-3200 cm<sup>-1</sup> indicate the presence of the CONN<sub>2</sub> functional group in the structure of the raw material.

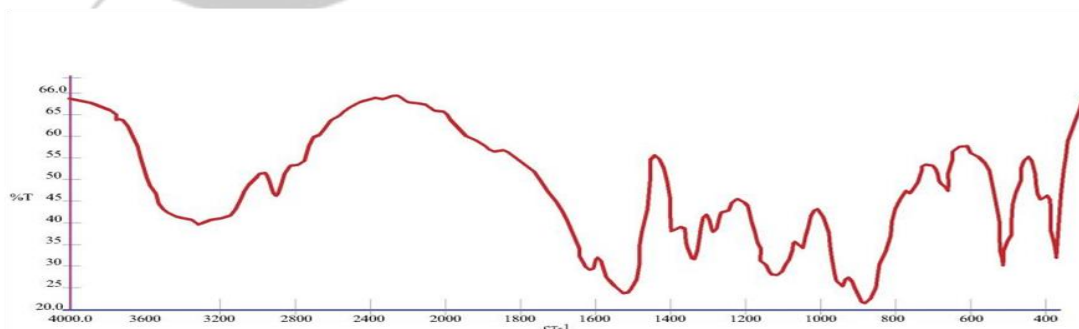


Figure 4 - Infrared spectroscopy of the synthesized device.

After neutralizing the raw material with sulfuric acid and ethyl alcohol, some changes in the structure of the raw material appear. These changes can be seen in the IR spectrum in Figure 4. After treatment, absorption

lines in the region of 3000 – 3200 cm<sup>-1</sup> disappeared and new absorption lines appeared in the region of 3346 cm<sup>-1</sup>. These changes changed the chemical bond in the CONN<sub>2</sub> functional group to CONN-. During the work,

the raw materials were treated with formaldehyde and a curing agent. Then it was neutralized and a new functional group – Na CH<sub>2</sub>SO<sub>3</sub> appeared. This means that the absorption lines in the region of 1150-1260 cm<sup>-1</sup> are asymmetric to valence vibrations. Absorption lines in the region of 1010-1080 cm<sup>-1</sup> are symmetrical to

valence vibrations. The glue used as a raw material for the production of coatings has hydrophilic (- COONa, - COOC<sub>2</sub>H<sub>5</sub> -CONH<sub>2</sub>) and -C-C- chemical bonds in its structure. The installation must be prepared based on the following requirements (table.1.)

**Table 1**

**Technical requirements of PR-1 installations**

Name of indicators	The value of indicators for additions			
	In the form of a solution		In powder form	
	High air flow	Reduced air intake	High air flow	Reduced air intake
Appearance	Dark brown uniform liquid, may precipitate		Light brown uniform powder	
The density is not less at 20°C	1.17		0.5	
The mass fraction of water% is not high	66.0		10.0	
Hydrogen ion activity indicator (pH), 2.5% aqueous solution	7,0 ± 1.0		7.0 ± 1.0	
Mass fraction of chlorine ions in dry matter, no more	0.1		0.1	

From the studies carried out it is clear that the results obtained fully comply with the production and technical requirements.

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