

**IMPLEMENTATION OF COMPOUNDING TECHNOLOGY WITH THE
OBTAINMENT OF ROAD BITUMEN AT «JV «CASPI BITUM»**

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Abstract. The article provides data on the implementation of compounding technology with the production of road bitumen at «JV «CASPI BITUM» LLP. As a result, the quality of compounded road bitumen obtained using this technology variant is higher than the quality of road bitumen of the same brand, but obtained from standard raw materials using direct oxidation technology. Compounded bitumen is more plastic, has better low-temperature characteristics, a higher value of adhesion to inert materials used in road construction, and has increased resistance to thermal-oxidative aging processes.

Keywords: bitumen, road oil bitumens, compounding, oxidation, tar, softening temperature, plasticity, low-temperature characteristics, adhesion, thermo-oxidative aging.

Introduction. Actuality of the work. Bitumen is a solid or viscoplastic, resin-like product of a dark brown or even black color, consisting of complex mixtures of hydrocarbons and their non-metallic derivatives. Bitumens are classified as residual, acidified, cracking, and compounded.

Residual bitumen is obtained in vacuum installations after continuous distillation (by deep-vacuum distillation) of fuel and lubricants from high-tar oil. Residual bitumens are solid substances with a low viscosity. Oxidized bitumen is obtained through tar and other oil residues by air purging with oxygen. When oxygen is purged, the viscosity of the residues increases, they are oxidized and compacted, thus leaving the final product (oxidized bitumen). Oxidized bitumen is more elastic and heat-resistant than residual bitumen. Cracking bitumen is obtained by decomposing crude oil and oils to produce gasoline output at a high temperature. Further, by oxidation of the residues, cracking bitumen is obtained, which has a high brittleness.

Compounded bitumen is obtained by mixing the residues obtained during the processing of crude oil. In bitumen compounding technology, additives are often used, such as: oils, tar, light oil fractions, since they can be used to obtain bitumen with specified properties, which cannot be done by deep-vacuum distillation or by oxidation [1].

Problem statement. For the implementation of compounding technology at LLP «JV «CASPI BITUM», the possibility of operating the unit at the design capacity has been determined. The limited yield of bitumen (33.66 % for refined oil, against 40 % for the project) is due to erroneous design decisions:

- insufficient capacity of installed bitumen pumps 01R-1201 A, B, C;
- insufficient heat recovery in heat exchangers 01E-1201 A, B, C when using a high-temperature coolant.
- lack of technological flexibility for paired binding of oxidation columns.

These problems limit the possibility of maintaining an optimal oxidation regime, including two oxidation columns and increasing the productivity of oxidized bitumen, and also exclude parallel operation of columns with the simultaneous production of two grades of oxidized bitumen.

Currently, at LLP «JV «CASPI BITUM», road oil bitumens are obtained by compounding by mixing oxidized bitumen with the tar of a vacuum column. This decision was made due to the fact that the shortcomings of the design scheme for the production of road bitumen do not allow working on two columns at the same time.

In 2017, central laboratory of the enterprise conducted an internal analysis on the extensibility of tar and bitumen, laboratory tests were verified in different proportions, parameters

were collected and a pattern was identified. And in November 2017, road bitumen was produced by mixing oxidized bitumen with tar. Production of bitumen was achieved in excess of the design quantity-57.4 t / h (113 % of the project) by using the compounding method.

For example, in August 2018, the demand for bitumen was 47 thousand tons. This volume of bitumen could not be produced by direct oxidation, since the maximum capacity of the bitumen plant is 42.3 t / h (the yield of bitumen is 31.6 % when loaded with oil – 134 t / h), the monthly production volume would be 31.5 thousand tons.

Novelty. The technical solution to the problem of improving the quality of bitumen products produced today, provided that high-viscosity straight-run tar is used as the main raw material component, can be based on a new modern technology for the production of high-quality road bitumen, called «re-oxidation → dilution» [2].

Method of research. Raw materials used to produce oxidized bitumen:

- Tar from the EDP-AVCU (electrical desalting plant, atmospheric and vacuum crude unit) installation has a density at 20 °C equal to 999 kg/m³, a kinematic viscosity at 20 °C equal to 18800 mm²/s and a flash point of 228 °C.

- The darkened fraction from the EDP-AVCU installation has a density equal to 962.6 kg/m³, a kinematic viscosity at 20 °C equal to 24 mm²/s, and a flash point of 164 °C.

The group chemical composition of tar is shown in table 1.

Table 1 - Group chemical composition of tar for bitumen production

Name of samples	Content of individual groups of hydrocarbons, % mass					Asphal- tenes
	Paraffin- naphthenic	Aromatic			Resins total	
		light	medium	heavy		
Tar	20	5,6	6,0	15,0	34,0	18,0

Research result. The project «Production of road bitumen at the Aktau plant of plastic masses» provides for the technology of oxidation of tar or a mixture of tar with a darkened fraction (further mixture) with air oxygen, proposed by Nanjing Petrochemical Engineering Company, LTD (China).

The technology of bitumen production has been changed. The basis of the technical solution to improve the quality of the produced bitumen products is based on an industry-proven and well-proven technology for the production of high-quality road bitumen, called «compounding».

The essence of the technology for obtaining compounded bitumen is as follows:

1) the initial tar/mixture is oxidized to the value of the indicator «softening temperature»:

- for the road petroleum bitumen (RPB) 70/100 brand up to 51-52 °C;
- for the RPB 100/130 brand up to 48.5-49.2 °C.

2) Further, this «structural framework» of bitumen – a concentrate of resins and asphaltenes is plasticized by adding to it the initial non-oxidized once-run tar with the value of the indicator «softening temperature»:

- for the RPB 70/100 brand up to 45.5-46.5 °C;
- for the RPB 100/130 brand up to 43.5-44.2 °C.

The advantages of this technology include the following:

- the oxidation unit operates in a stable mode, producing only one product-compounding bitumen with laboratory quality control of the final product by its softening temperature;
- the entire range of road bitumen is produced in a tank farm with laboratory quality control of the final product in accordance with the requirements of ST RK 1373-2013;
- oxidation is not subjected to the entire volume of raw materials, but only a part of it (about 60 %).

The required performance is achieved by diluting the oxidized component with raw materials and other stable non-oxidized components. This significantly reduces energy

consumption on oxidation, gas oxidation, requiring a heat of neutralization, the amount of fuel for combustion gases of oxidation is also reduced. As a result, the total amount of emissions from the plant is reduced, which makes this technology more environmentally safe in comparison with direct oxidation technology.

- the quality of the final product is almost independent of the viscosity of the tar entering the oxidation process. Moreover, the greater the deviation of the conditional viscosity of raw materials from the standard values (upward), the higher the quality of the resulting road bitumen due to the fact that the share of the unoxidized component in the composition of bitumen increases.

Conclusions. As a result, the quality of compounded road bitumen obtained using this technology option is certainly higher than the quality of road bitumen of the same brand, but obtained from standard raw materials using direct oxidation technology. Compounded bitumen is more plastic, has better low-temperature characteristics, a higher value of adhesion to inert materials used in road construction, and has increased resistance to thermal-oxidative aging processes.

In 2019, the work done to legalize the compounding method for obtaining petroleum road bitumen at the LLP «JV «CASPI BITUM»:

1. Approved the instruction «Obtaining oil road bitumen by compounding at the LLP «JV «CASPI BITUM» by the Nanjing Petrochemical Engineering Institute.

2. Amend an Operator's manual of the EDP-AVCU production unit, the block of bitumen oxidation and modification.

3. The Passport of production of LLP «JV «CASPI BITUM» in terms of compounding was re-approved.

Based on the practice of applying the compounding method, taking into account the production of oxidized bitumen on one column instead of two, LLP «JV «CASPI BITUM» currently has the ability to produce road bitumen 42% of the processed oil. At the same time, the Bitumen plant plans to modernize the production unit of oxidized bitumen. After which it will be possible to involve more oxidized bitumen in compounding with tar. Thus, the Bitumen plant plans to produce road bitumen 52% of the processed oil.

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ВНЕДРЕНИЕ ТЕХНОЛОГИИ КОМПАУНДИРОВАНИЯ С ПОЛУЧЕНИЕМ ДОРОЖНЫХ БИТУМОВ В ТОО «СП «CASPI BITUM»

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Аннотация. В статье приводятся данные о внедрении технологии компаундирования с получением дорожных битумов на ТОО «СП «CASPI BITUM». В результате на основании практики применения метода компаундирования, учитывая производства окисленного битума на одной колонне вместо двух, ТОО «СП «CASPI BITUM» на сегодняшний имеет возможность производства дорожного битума 42% от перерабатываемой нефти.

Ключевые слова: битум, битумы нефтяные дорожные, компаундирование, окисление, гудрон, температура размягчения, пластичность, низкотемпературные характеристики, адгезия, термоокислительное старение.

**«CASPI BITUM» БК» ЖШС ЖОЛ БИТУМДАРЫН АЛА ОТЫРЫП
КОМПАУНДТАУ ТЕХНОЛОГИЯСЫН ЕНГІЗУ»**

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Аңдатпа. Мақалада «CASPI BITUM «БК» ЖШС жол битумдарын ала отырып, компаундтау технологиясын енгізу туралы деректер келтіріледі. Нәтижесінде компаундтау әдісін қолдану тәжірибесі негізінде, тотыққан битум өндірісін ескере отырып, екі бағананың орнына бір бағана қолдануын ескере отырып, «CASPI BITUM «БК» ЖШС бүгінгі таңда өңделетін мұнайдың 42% жол битумын өндіру мүмкіндігіне ие.

Түйінді сөздер: битум, мұнай жол битумдары, компаундтау, тотығу, гудрон, жұмсарту температурасы, иілгіштік, төмен температуралы сипаттамалар, адгезия, термототықтырғыш қартаю.