

## THE BROWN COAL AND COMBUSTIBLE SLATE(S) THERMOCATALYTIC PROCESSING OF THE «KENDERLYK» DEPOSIT

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The article is devoted to the actual problem – expansion of raw hydrocarbonic base, involving of brown coal and slates in processing. The process of simultaneous thermocatalytic transformation of coal and slates of the «Kenderlyk» deposit is studied. Results demonstrate the fact that transformation degree of coal and slate mix above by 8–9 % than of coal, the process proceeds without intensive coke formation in the temperature interval 425–440 °C and under the pressure 5 MPa. It is shown that organic and mineral parts of slates make activating influence on the coal hydrogenolysis. The mineral part, containing aluminosilicates, iron oxides and others catalytically active forms of metals, activates cracking of coal hydrocarbons, and the organic part of slate promotes hydrogenation and stabilization of formed radicals. The bitumens received from the firm leavings of a coal and slates mix processing with  $T_{\text{boil}} > 320\text{ °C}$  meet the requirements of state standard for oil bitumens.

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**Keywords:** coal, slate, catalysis, heat treatment

The raw materials source of the industry should be flexible enough and be based on the various inter – related types of the organic raw materials application for the sustainable development of the country. From this point of view, the most valuable are the coal, the combustible slates and the oil – shales, the oil – bituminous rocks, the already proven reserves, as in Kazakhstan, well as abroad are very huge and great. So, in the future, these fossil fuels and the combustible minerals consumption will be increased, as the energy source, and their complex processing into the synthetic fuel and the chemical products will be further developed. This carbon and slate – chemistry direction is the widely – studied subject in many countries, including Kazakhstan. We note that their application may be economically justified just now, for a number of the regions.

On the Kazakhstan's territory, up to the present time, about 25 combustion slates and the oil – shales manifestations deposits have already been identified, they have been confined to the Upper Devonian, the Lower Carboniferous, the Upper Paleozoic, the Middle, and the Upper Jurassic, and the Paleogene sedimentations. So, they are quite different and various by the initial substance, the starting material composition, and their formation conditions, which have largely been predefined their main technological – numerically characteristics. All these deposits, except for the «Kenderlyksky» and «Chernozatonsky» fields, have been poorly studied. The «Kenderlyksky» deposit combustion slates and the oil – shales reserves are made up more, than 4 bln. tons, of which 750 mln are the balance ones. In addition, over a billion tons of the coal, and the brown coals extraction is quite be possible on this deposit, which is increased the economic attractiveness of this deposit's further development.

A number of processes of the combustion slates and the oil – shales thermochemical pro-

cessing is being developed in the Scientific Research Institute of New Chemical Technologies and Materials (NCHT&M), which are based on the NCHT&M study results by the complex technological – chemically coal and the brown coals processing in Kazakhstan, having carried out in 1990–2010-es. All these obtained studies have already been shown, that the organic and the mineral parts of the combustion slates and the oil – shales have been made the activating effect upon the brown coals and the lignites thermal conversion.

A number of the authors [1–4] explain the combustion slates and the oil – shales activating effect, that the combustion slates and the oil – shales liquefying liquid products, having formed in the 390–440 °C temperature range, are contained the significant amount of the tetrahydroderivative condensed aromatic hydrocarbons, the oxygen and the nitrogen compounds, and also the alicyclic alcohols, which are had by the hydrogen – donor properties. By their hydrogen activity, all these compounds are quite similar to the tetralin, and in some reactions, they are surpassed it, in terms of its ability reactivity [2–5].

This has been confirmed by the obtained data, having shown, that in the 390–440 °C temperature range in the hydrocarbon raw materials cracking, in the presence of the combustion slate and the oil – shale, the hydrogenation and the reduction reactions are actively proceeded, the dimerization and the condensation reactions are suppressed, and the carbon – the carbonaceous bond destruction is accelerated [2].

The combustion slate and the oil – shale mineral part, having contained the aluminium silicates, the iron oxides, and the other catalytically metals' active forms, in its turn, is quite activated the cracking reaction proceeding [6, 7].

So, the process of the co – catalytic thermal processing of the brown coal and the combustion slate, and the oil – shale of the «Kender-

lyksky» deposit has been studied by us in the present paper. The coal and the slate, and the oil – shale liquefaction process, having taken in the equal quantities by their organic mass, has been carried out in the laboratory installation under the 5,0 MPa pressure, at the 420°C temperature. For the coal liquefaction process intensification, the catalytic system has been introduced, having consisted in the fine – dispersed solid particles of the multimetallic ores concentration sludge. So, further, the destructive processes are additionally realized on these particles surface. Under the experiments conditions, the coke – forming products have not been formed on the installation walls and in the reaction mixture volume in the process of the catalytic processing of the coal, the slate, and the oil – shale mixture.

The liquid products, having obtained in the process, have been subjected to the distillation with the fraction selection, with the boiling point up to 200°C, the fraction with the 200–320°C boiling point. The residue with above 320°C boiling point has been contained the undissolved organic matter of the slate, the oil – shale, and the coal, and also their mineral component in their composition. The process characteristic of the catalytic thermal processing of the brown coal and the ordinary «Kenderlyksky» slate and the oil – shale has been shown in the Table 1.

**Table 1**  
The Process Characteristic of the Catalytic Thermal Processing of the «Kenderlyksky» Coal, and the «Kenderlyksky» Slate and the Coal Mixture

The Process Indicator	Coal	Coal + Slate
<i>The Process Conditions</i>		
The Coal: paste-former (slate + coal): paste-former	1:1,3	(0,6 + 0,4) :1,3
OMC:OMY		1:0,9
Temperature, °C	420	420
Pressure, MPa	5,0	5,0
Duration, min	15	30
<i>The Products Yield, %</i>		
Gas	11,8	4,4
Losses + water	8,8	5,3
Fraction with boiling point up to 200°C	10,3	13,5
Fraction with 200–320°C boiling point	12,7	15,6
Fraction with above 320°C boiling point	40,5	43,0
Solid products	15,9	18,2

As our studies results have been shown, the combustible slates and the oil – shales catalytic properties are quite allowed to be carried out, under the optimum conditions, the process of the thermal decomposition of the organic coal matter, with the high degree of the coal conversion into the liquid distillate products, without the intensive carbon – producing. The conversion degree of the organic matter mixture of the slate, the oil – shale, and the coal is much higher, than that of the coal. The solid residue with the above 320°C boiling point has been tested, as the organic binder for the road construction (see, the Table 2).

**Table 2**  
The Quality Characteristic of the Ash Binding Materials, Having Obtained at the Thermochemical Conversion of the Coal and the Coal + the Slate

The Indicator	Coal	The Coal + the Slate
The needle penetration depth, mm <sup>-1</sup> at 25°C	130	138
at 0°C	-	68
The softening temperature by KiSh; °C	40	42
The extensibility, cm at 25°C	-	68
at 0°C	-	11
The adhesion test	-	It is withstood

The tests results have already been indicated, that the bitumen – based products processing of the slate and the brown coal mixture of the «Kenderlyk» deposit are completely satisfied the GOST main requirements for the petroleum bitumen.

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