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Processing of Shubarkol coal for obtaining chemical products

In the sour coal contain till 35–45 % (on working weight) of gumin of acids, that allows to consider these westers as raw material for reception of chemical substances. As a result of chemical processing sooting coal receive the valuable import-replaced products, which can be used as fertilizer in an agriculture, stabilizers of chisel clay solutions at deep drilling, collectors extending waste water of ions of heavy metals (coop, zinc, lead, mercury).

Key words: coal, gumin of acids, chemical processing of coals, application.

It is well known that the most rational way to increase the economic efficiency of coal mining complex is in the processing of raw coal into the target products at the production site [1].

However, what can be understood by the term «target products»? Coal is so rich with raw materials that the list of products derived from it is around five hundred names. Which of them should be performed? The answer to this question determines all further work on the transition to deep processing of coal at the production site. Let us consider this problem with specific examples.

We will not deal with the problems associated with coking coal of steady sales. The most efficient coal enterprises of Kazakhstan produce mainly coal of D, DG and G grades. These so-called «young» coals are characterized by low calorific value and high demand. However, many of these coals have a low ash content and could be used without enrichment. On the world market, there is only one criterion of value of coal, as well as any fuel — the price of one mega calorie consumer.

The conclusion is, the higher the calorific value of coal becomes, the less the transport component in the price of calories, and, paradoxically, the less the cost of a kilowatt-hour of electricity and Gcal of heat by reducing the cost of internal power station coal is. Thus, the most popular item at the market is a hot commodity high-calorie, low-ash, preferably smokeless, but reactive solid fuel.

In addition, liquid fuels are also of a large and stable demand, as well as the motor ones. Demand for heavy organic liquids such as bitumen and pitch is also being increased. The demand and prices for organic oxygenates, primarily phenol, cresol, xylenols are found to be of high demand and interest.

So, having defined the initial list of products, we shall consider the matter of the technology to be used in developing the products. The main criterion for selecting technologies for processing coal with the desired products produced, is to ensure that their cost will be at least no higher than obtained from alternative raw materials.

The choice must be based on the assessment of current technologies in accordance with the following parameters:

– The presence of the current and forecasted demand on the items produced in Kazakhstan, Russia and abroad;
– The possibility of rapid implementation on an industrial scale;
– Economic efficiency and environmental purity;
– The value of specific capital investment and attractive to potential investors, both in Kazakhstan and abroad.

Nowadays there are more than two dozen coal processing techniques, from simple sorting and enrichment and ending with production of carbon fiber and new forms of carbon. However they have different degrees of readiness for implementation. It would be nice to organize production in Kazakhstan Buckminsterfulleron and sell them out packed in leather briefcases. With the price of crude Buckyball $50 per gram the value of this case study will be a quarter of a million dollars. However, not all even mastered in industry, technologies can be easily implemented in the economic conditions of Kazakhstan.

The attempts to transfer coal into liquid fuel by hydrogenation are of general knowledge. Theoretically, this is a very attractive way, but it is brought to a standstill by some unsolvable technical and economic problems. This is primarily the huge cost of processing in excess of the amount of value added produced. Only

the work on the installation of the hydrogenation of coal, together with the processing of heavy oil residues, as part of a petrochemical complex, gives us the hope to reach an acceptable level of profitability. This technology provides a smokeless high-energy solid fuel and liquid low-sulfur fuel. Capital investment unit at $65 per ton processed and refining costs at 6 dollars per ton, provide an opportunity to have a high profitability.

Coal processing technology of soft pyrolysis or, as it is sometimes called in the United States — LPC technology, consists in drying and subsequent heating of coal at 550^0C in an inert atmosphere. The result is a high-energy smokeless char, light fuel oil.

Fuel oil can be divided into gasoline, cresol, diesel fuel and bitumen.

This condition is feasible only in the case of realization of the Russian coal chemists' ideas expressed at the beginning of the century that a mine or its section should be regarded as a component of the so-called energy-technological complex. What does the energy technological complex stand for in contemporary understanding based on modern technologies of coal processing?

It is a complex comprising a number of modular productions that gradually increase added cost to original coal. The first stage of the complex is the introduction of crushing and screening plant that allowing to increase the price of raw coal due to high-quality coal production.

Then, the setting for the briquetting and pelletizing of fine coal is introduced. This allows to avoid coal losses during transportation and to increase the total cost of production. These technologies are widely known and do not require additional comments.

The second step is to build a plant for soft coal pyrolysis of three modules and power plants. This step is also implemented gradually. The introduction of the first module allows to turn high-quality coal into smokeless fuels and light fuel oil, which dramatically increases the efficiency of the entire complex.

Then, the mechanism on distillation to obtain fuel oil diesel cresols and pitch is introduced. Diesel fuel is used in mines and is delivered aside. Cresols are very expensive raw material used for production of plastics and it is highly demanded on the world market. Pitch is used in manufacturing coal briquettes and obtained on the first module of char, it also can also be used in road construction. Smokeless pellets derived from the screenings of char have a price not less than 100–120 dollars per ton. The second module is introduced for processing pellets prepared on its own binder to get a molded coke as a substitute for metallurgical one. The third module is introduced for the processing of pellets from a mixture of semi-coke, limestone and iron ore according to the direct reduction of iron, similar COKEX technology. This technology is becoming more common, forcing the domain industry.

A part of the semi-coke produced at the first module is activated to produce a cheap adsorbent for the purification of water and gases. Such a sorbent, operating on water purification from organic impurities such as phenols, does not require regeneration and can be therefore used at power plants as an additive to the coal, increasing its calorific value. Its expected price comprises $100 per ton.

It is also possible to establish production of the building blocks made of ash and slag, generated during the third module and power station. To solve all these problems the acceleration of the introduction of innovative technologies for processing coal is required. This will improve the economic and environmental conditions in Kazakhstan.

Thus, the energy technological complex consuming non-caking coals of young Kazakhstan, limestone and iron ore, can issue:

– high-quality coal;
– pellets for domestic use;
– molded coke substituting metallurgical coke;
– carbon powder reducing for metallurgy purposes;
– smokeless high-energy solid fuel for power stations
– diesel fuel for motor vehicles; cresols for the chemical industry;
– organic binders (pitch) for road construction;
– electrode and chemical industries;
– cheap absorbents of general use;
– building blocks made of ash and slag materials.

One of the problems associated with the open coal mining is the wastes of coal industry which in most cases do not find practical application. Overburdens containing sooty coal, used to go to spoil and pollute the environment.

Widespread of coal in Kazakhstan, the high value of their organic part necessitate an integrated approach to the use, especially those types of coals, which are not suitable for power generation and coking, and provides a wide range of different products and materials that have no analogues in the processing of other types of natural resources.

Data is necessary for identification existing and working out of new ways of processing of coals for the purpose of reception of gaseous and liquid fuel about laws of decomposition of coal weight in various conditions. Influence of mineral components on thermal destraction coal of the Shubarkolsky deposit is with that end in view studied. Results granulation semicoke structure Shubarkolsky coals are presented in Table.

Table

Results of granulation semicoke structure Shubarkolsky coals

Thermodestruction temperature, ºC	Classes, mm				
	> 40	25–40	13–25	7–13	7
1. The taken class					
50–100 mm	57,1	30,7	9,4	2,8	–
500	48,1	28,1	15,5	4,4	3,3
700	26,1	44,3	18,5	6,8	4,3
900	28,3	29,1	25,0	8,6	9,0
2. The taken class					
6–50 mm	5,2	27,9	40,4	26,5	–
500	–	28,8	36,9	24,6	9,7
700	–	32,4	34,1	25,5	8,0
900	–	20,5	36,9	31,8	10,8

The wastes of previously exposed oxidized coal seams of the Shubarkol deposit itself amount to more than 2 million tons. According to their composition, they can be regarded as a potential raw material.

Among the priorities in the sphere of carbon chemistry one may refer to the research and implementation of industrial technologies and technical solutions of chemical processing of off-balance sheet coal as an organic raw material for the production of humic substances.

It is still an actual and urgent issue for Kazakhstan to establish production of affordable and highly effective sorbents-gatherers and inhibitors of deposits of mineral salts, and corrosion protection of pipelines for the purification of large amounts of waste water. Implementation of the ion exchange purification of waste water from heavy metal ions are constrained by the high cost and scarcity of commercially available cation and anion exchangers.

Humic substances are essential chemical products, widely used as a lignin-alkaline reagent to stabilize the drilling muds, emulsion breakers for the desalting and dehydration of crude oil sorbents for the purification of waste water from heavy metal ions, inhibitors of deposits of mineral salts and pipeline corrosion protection, organic fertilizer for improve soil fertility and productivity of agricultural products [2].

Thus, Kazakhstan has a strong raw material base for the development of high technologies and the creation of the country's chemical industry of chemical processing of the off-balance sheet coal, which has been previously sent to the dumps. The production is important not for the Republic only, it is of great concern abroad too.

The scientific processes of producing organic-mineral fertilizers, lignin-alkaline reagent and corrosion inhibitors are worked out.

The high efficiency of humic fertilizer on different cultures is established in different researches:

– Barayev Institute of Grain Farming (Shortandy village);

– Institute of Soil Science (Almaty city);

– Aral Sea region Research Institute of Agroecology and Agriculture (Kyzyl-Orda city).

The results of the studies show that humic fertilizers increase yield of vegetable crops to 30 % and rice to 22 %. They have not only a fertilizer and soil improving properties, they also have physiological activity.

The results of the research conducted by the Research and Project Institute of Oil and Gas (Aktau city) on the API standard show that the lignin-alkaline reagent quality is not inferior to foreign analogues (SS — 16; carbonox at «BAROID» company), and the cost of CAR is twice or three times cheaper than that of its analogs.

Much of the research is devoted to the practical aspects of chemical processing: development of new technologies of extraction of humic acids in relation to specific coal deposits, their introduction into the production, as well as the search for new fields of application of humic acids and their salts. Fundamental research on the production of inhibitors to protect the pipe from corrosion and coagulant and other modified products from coal are not held. Few studies on modification of humic acids and practical implementation of coal (Kyrgyzstan. Uzbekistan, Russia. Belarus. Estonia and Japan) were held. On a number of coal deposits in the CIS and in Kazakhstan in particular (Maykyuben — West) there are experienced mechanisms of small capacity designed for getting sodium humate.

The data mentioned above show a concern of a number of states of the world community paid to the problems of chemical processing of coal. With state support Kazakhstan for a number of positions could take a leading position in the field of chemical science and technology. The use of off-balance coal for the production of inhibitors of deposits of mineral salts and corrosion protection rude, sorbents for water purification from heavy metals and many other products will solve the problem of import substituted products and environmental problems of the Republic of Kazakhstan. Production of the necessary products from carbon waste is quite competitive with petrochemicals.

Use of an inhibitor (deposition of mineral salts and protecting pipes against corrosion) on the basis of the off-balance coal in the technological cycle of water treatment prevents corrosion of the metal, thereby prolonging the service life of the pipeline. Recycling off-balance coal emitted together with the overburden will reduce pressure on the environment and improve the environment pas open coal mines.

Products of humic acids obtained from the off-balance coal (inhibitors deposits of mineral salts in the water supply piping and pipe protection against corrosion), sorbent for cleaning technical and drinking water from heavy metal ions, a coagulant for drinking water treatment is a new direction in the coal chemistry. They do not have the domestic and foreign analogs.

Humic substances can be used to normalize the situation in non-hazardous areas: Semipalatinsk, Aral and the Aral Sea region (for a set of measures to combat soil erosion, alkalinity, salinity, rich in organic matter, macro- and micronutrients). The use of humic substances improves the physical and chemical properties of soil and binding of heavy metal ions.

One of the major challenges facing the industry of sorbents and adsorbents is to find an alternative source of expanding the range of active carbons with desired and improved performance. Humic products with new properties will be produced from the off-balance coal. Processing and finishing products of the developed technology is waste-free and eco-friendly.

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Химиялық өнімдер алу үшін Шұбаркөл көмірін өңдеу процесі

Қазақстандағы көмірлердің химиялық өндірістер аймақтары қарастырылған. Көмірден әр түрлі химиялық заттарды, тынайтқыштарды алу процестері шығымын арттыратындағы дәлелденді. Қазақстанда көмірден шикізатты өңдеудің қазіргі мәселелері, ғылыми ауқымды, экологиялық таза технологияларды қолдана отырып, көмір өңдеу өндірістердің даму жолдары зерттелген, сондай-ақ ағынды суларды ауыр металл (мыс, мырыш, қорғасын, сынап) иондарынан тазалау тәсілдері ұсынылған.

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Переработка Шубаркольского угля для получения химических продуктов

В окисленных углях содержится до 35–45 % (на рабочем весе) гуминовых кислот, которые позволяют рассматривать эти продукты как сырье для производства химических веществ. В результате химической обработки забалансовых углей получают ценные импортозамещенные продукты, которые используются в качестве удобрения в сельском хозяйстве, в качестве углещелочного реагента для стабилизации буровых растворов, коллекторов, для очистки сточных вод от ионов тяжелых металлов (медь, цинк, свинец, ртуть).

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