NOT FUEL USING OF BROWN COAL

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There is written about most perspective and well-known methods of coal using in industry. It is described more complex technology of brown coal using as source of humates and waxes production and subsequent traditional application as solid fuel.

Keywords: *using of brown coal, power-plant using, gasification, pypolysis, coking, production of wax, organic acid*

INTRODUCTION

Among biological active substances of a natural origin widespread in a brown coal a special place is occupied humic substances which are not synthesized in alive organisms, but are formed in a significant amount after dying off during decomposition and transformation with participation of microorganisms.

Now brown coals are widely used as power-plant fuel. Extracted by open way brown coals are very perspective materials. Therewith Russia has such large brown coal fields like Kansko-Achinsky, South-Ural and vicinities of Moscow [1].

The geological age of deposits of brown coal is various, hence, and on structure of an initial material and conditions of its accumulation and transformation causes differences of physical, chemical and technological properties of brown coals [1].

There are various ways of processing of brown coals: power, thermal and chemical.

Power-plant using of coals

Global consumption of coal is now about 3.6 billion tones conditional fuel from which 3 billion tones goes on electric power production, and 0.6 billion tones - on coke production. According long-term forecasts consumption of mineral coals in depending on rates of growth of economic increase will be approximately from to on 1 billion tones within the first decades of XXI century is predicted [2, 3]. Increasing interest to coal as to the major mineral source of energy is caused by its huge world reserves which one some hundreds years in view of perspective need will suffice on the subsequent. Therefore at the bounded stocks of oil and gas, it is quite interquartile reorientation world power engineering predominantly on coal. Today about 40 % of the global electric power and 70 % of steel are made with using of coal already [4].

Gasification of coals

Besides electric power production, gasification was used for reception of chemical products. Now it is known one industrial production (Sasolburg, the republic of South Africa) liquid products with application of Fisher – Tropsh's method from the synthesizing-gas by gasification of coal. It is known about planned to realization approximately 60 developments on gasification of coal from which one, however, no more than 10 are intended for chemical production.

Over 350 gas plants worked in the USSR in 50-th years. In these plants were installed the order of 2500 gas generators for reception of power fuel and a process gas [5]. As is known, in the subsequent 20 - 25 years in global power balance happened the alterations caused by growth of extraction and consumption of oil and natural gas. Thereof competitiveness artificial power and the process gases reception from solid fuel has sharply decreased, and its producers practically everywhere (except for the republic of South Africa) have been stopped. However in recent years in connection with reduction of resources of oil and gas raw material process of gasification of solid combustible minerals again has drawn to itself attention, artificial gases again start to be considered as one of essential components of thermal balance.

Hydrogenation. Hydrogenation is a complex of the reactions proceeding at interaction of coal with hydrogen at high temperatures and pressure of hydrogen, carbon-carbon bonds are broken and taking place connection of hydrogen to molecule. Catalytic destructive hydrogenation of coals and others solid fuels is the way of practically full processing of its organic substances in a mix of the gaseous, liquid and solid organic matters which are valuable substances as a stock for organic synthesis and for reception of liquid fuel. All recent works on hydrogenation of coals were directed on reception motor fuel and lubricant oils from coals [6]. It is necessary to note, that hydrogenation processes of coal realized in compliance with all known technologies are still insufficiently perfect. Artificial liquid fuels produced in pilot plants are noncompetitive with oil products [7].

Pyrolysis and coking

The majority of chemical products were received by pyrolysis and coking of black coal prior to the beginning XX centuries. These processes are based on heating of coals without access of air with purpose of their thermal destruction [8]. Thus two basic groups of chemical reactions are proceed: depolymerization organic mass of coal with formation of organic molecules of smaller molecular mass and reaction of the secondary transformations of formed products (condensation, polymerization, aromatization, alkylation and others). Both groups of reactions are proceed consistently and in parallel. Liquid, gaseous and solid products are formed finally as a result of thermochemical transformations [9].

Pyrolysis is carried out in various temperature bands depending on assigning receivable products. low-temperature pyrolysis (or semicarbonization) is realized usually at 500 – 600 ˚C, and high-temperature pyrolysis (or coking) - at 900 – 1100 ˚C.

Modern processes of low-temperature pyrolysis of brown coals are focused mainly on reception of synthetic liquid fuel and semicoke. It is possible to receive motor fuels by hydrogenation of pyrolysis resins, however their cost while above, than motor fuels from oil. Solid products of pyrolysis of brown coal have wider application as the improved power fuel: the bricketed fuel of household purpose, reducing agents in ferrous and nonferrous metallurgy, components of charges at reception of metallurgical coke, and also carbon sorbents. Among known methods of semicoke reception from brown coal catalytic pyrolysis in a boiling layer of the catalyst of oxidation is rather perspective for commercial application. The major advantage of catalytic pyrolysis technology is the increase of ecological cleanliness caused by absence of resinification, abrupt abatement of the contented cancerogenic substances in solid product, abatement of volume of outbursts and concentration of harmful substances in gases [9].

Wax reception

Waxes components of coal's bitumen is characterized by specific properties and wide application in various areas of a national economy finds. Brown coal's bitumen is applied as raw material for extraction. Extracts are contained no more than 20 % of a resinous part. Lignit and peat also can be used for extraction of bitumen, however practical value of these kinds of raw material now is insignificant [10, 11]. Crude mountain wax is the name of bitumen part taken under production condition. Production of mountain wax is one of few examples when reception of the products representing commodity value from coal doesn't demand a deep decomposition of structure of a stock [5]. High moistureproofness, chemical stability, mechanical strength, ability to produce solid shining coverings, heat of fusion, low conductivity, good solubility in organic solvents, ability to produce a composition with paraffin, stearin, beeswax and native paraffin, practical absence of cancerogenic action are the main useful properties of wax determining its practical value. World production of crude and purified of wax in last years constantly grows and now exceeds 45 thousand tons per year. The brown coal mined selectively serves as raw containing 14 – 16 % benzene bitumen.

Industrial production of crude wax consists of stages of opening-up of raw to extraction, actually of raw to extraction, separation from an extract of resolvent and formation of preforms of marketable wax. Opening-up of coal consists in grading, grinding and drying. The size of fragments and damp of coal are the relevant technological arguments of process influencing an output of wax, and their optimum values for each coal are defined experimentally. Parameters of extraction depend on wettability of coal by resolvents, nature mass exchanged processes, design features of extractors and other factors which one in a sufficient measure are not studied yet, however available data [12] testify about determined dependence between the size of fragments of coal and time which one is necessary for reception from them an extract. Fullest withdrawal of bitumens is reached for minimal time from fragments of coal of the optimum size. At extraction of coal with wide granulometric structure optimum conditions of process can be provided at limitation of the maintenance of classes of coal less than 0,2 mm up to 10 % [13]. Optimum raw are fractions with fragments in the size 0,2 – 1,0 mm at withdrawal восков from coals of the Alexandria field. Damp of coal differed within the limits of 14 – 15 % though variation in a spacing 4,4 – 19,5 % practically do not render of influence on an output of bitumens [14].

Devices of chambered type and bucket extractors of Gressa working is continuum at atmospheric pressure can be applied for extraction from coal of crude wax.

Chemical properties of resolvents render of solving influence on an output and properties of bitumens. For comparison of extraction capacities of various resolvents at extraction brown coals of various fields of the USSR of table 1 data on extraction are cited [5].

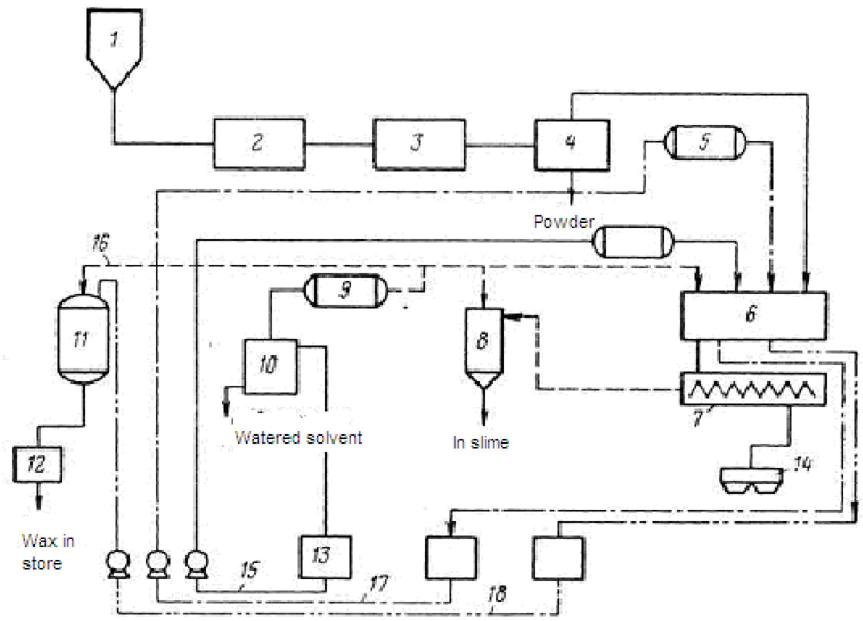
At a choice of industrial resolvent except for an output and quality of receivable wax, necessity of the determined combination of properties of coal and resolvent which one provides free infiltration of the last into holes of coal and its fast wetting is allowed also. Benzene, mixtures of benzene and the highest alcohols, various fractions of gasolines, a mixture of benzene and gasoline are used in the industry as resolvents [5].

Table 1

The Output of bitumens from brown coals in percentages rather of benzene extract

Field of coal	Resolvent			
	benzene	gasoline	dichloroethane	alcohol-benzene
Alexandria's	100	79	-	149
Babajevo's	100	71	122	170
Voroshilovsk's	100	63	106	157
Tulgansk's	100	59	-	163
Grachevsk's	100	79	103	174

The principal schema of production of crude earth wax on Semen`s factory of earth wax is demonstrated in figure 1, and quality of receivable wax is resulted below.



1 - the bin for coal; 2 - sizing plant; 3 - drying facilities; 4 - compartment of control crushing; 5 - a preheater of a separator; 6 – compartment of extraction; 7 - compartment of steaming of coal; 8 - dust separators; 9 - chillers; 10 - separation vessels; 11 - compartment of evaporating vehicles; 12 - compartment of casting of wax; 13 - a storehouse of resolvent; 14 - the bin of extracted coal; 15 - a line of light resolvent; 16 - a line of steams of resolvent; 17 - a line of dark resolvent; 18 - a line of micelle

Figure 1. The principal schema of production of lignite wax on Semen`s factory

Reception of organic acids

Coal deposits are practically unlimited source of humic acids - a unique product which plays a key role during formation and functioning of soil and can be used for the decision of many agricultural and environmental problems.

The opportunity of use as raw for production of humic acids of the brown earthy coals, the weathered black coals and brown coals is demonstrated as a result of works of Institute of combustible minerals, the Dnepropetrovsk agricultural institute, Institute of radiology of plants Academy of Sciences of USSR and others. These low-grade propellants give from 60 up to 80 % of humic acids of various assortment [6].

By works of last years it is shown, that humic acids and humates are diluents in ceramic industry, which are increased plastic properties of pottery, and also serve as good descaleres of water in steam boilers during the process of portland cement production. Humic acids are applied instead of peptizing agents (tannin and starch) while drilling rocks. Continuously extending scopes use of humic acids are put in the forefront a problem of the further expansion of their production and processing in the preparations possessing set physical and chemical properties [6].

There are following basic methods of humic acids extraction: processing of solid coal with solid alkali with the subsequent dissolution in water; processing of solid coal by sodium, potassium or ammonium alkali solution; oxidation of coal by a mix of water solution of mineral and organic acids.

So-called ballast humates are processing from solid coal by alkali extraction method in humic acid extraction units. Ballast humates are containing up to 70 % of residual coal. Application of ballast humates creates the difficulties connected with a contamination of soil, especially in conditions of the protected soil and with possible self-ignition of a commodity output at storage.

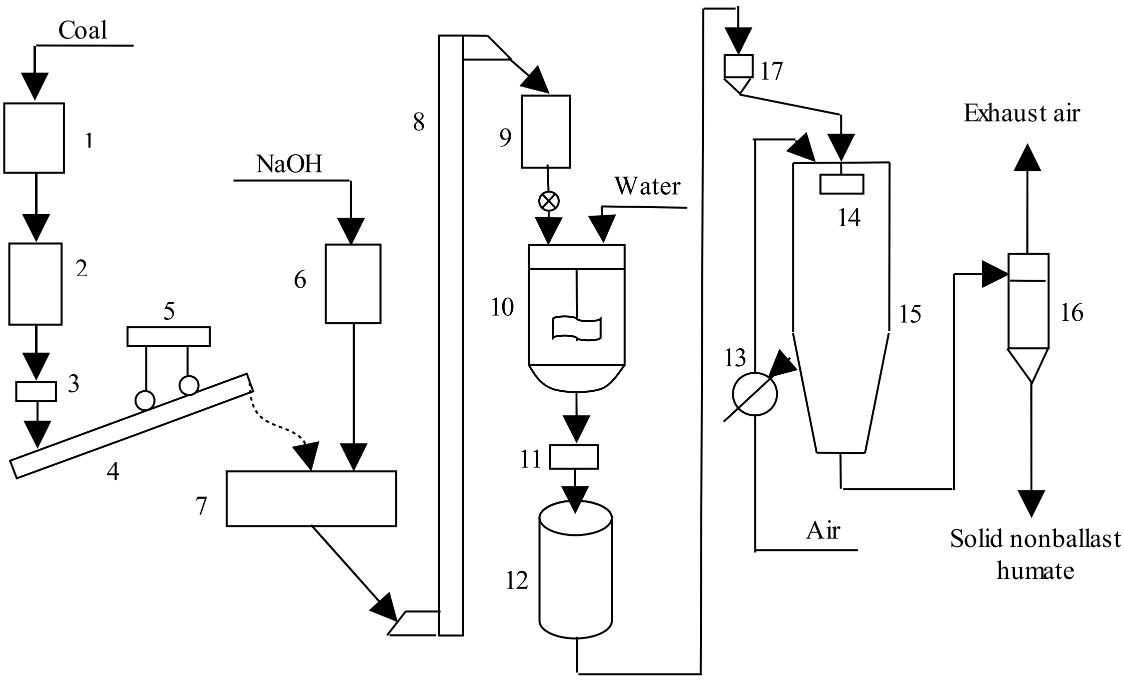
Coal after wax extraction is good raw material for organic acids reception by processing of solid coal by sodium hydroxide solution. Sodium humates received by the produced method are ecologically pure, harmless biological growth factors and developments of plants. Sodium humates reduce action of poisonous chemical substances on plants, reduce accumulation of poisons in biomass, in fruits and vegetables, increase of seeds germination and energy of its germination, promote establishment sprouts and plants at change [11]. Humic acids (in the form of very diluted alkaline solution of humate and the alkalis of peat processed by water solutions and coals) are used as fertilizers for increase of productivity of agricultural crops.

Development of new technology of reception of nonballast humates which one application eliminates noted lacks, is the most perspective. Works on reception of nonballast humic auxesis of plants from brown coals for use in an agriculture are developed in Institute of Combustible Minerals in last years actively. Now grounds of technology are designed and the pilot plant (output up to 5 tones of humates per year) on reception of nonballast humates of sodium is mastered [15].

Production of pure humates is carried out under the schema indicated in figure 2. The dried crushed coal is blended with aqueous solution of caustic (caustic soda), a mixture is maintained at stirring at the set temperature and endurance, then it entered on separation on firm (not diluted residual coal) and liquid (an alcalinous solution of humates) phases. The solution of humates acts on drying for reception of solid humates or in case of application of growth factors of plants near to a place of their production, it is possible up to the necessary concentration and it is used on the forward assigning. The solid rest is a waste product and can go on incineration, and distillate from evaporation can be used for repetitive preparing of solution of alkali or it can be dumped off in the water drain [15].

The production technology of nonballast humate of sodium is fulfilled in conditions of pilot plant ICM on Jelevsk's (the Moscow region). Humates (up to 2 t/y) were delivered and with success were applied more than in 15 agricultural enterprises within 10 years.

The contract design of installation on reception 500 tons of dry powder of humates from brown coals is designed for the organization of industrial production. The output of humates depends on properties of coal and differs within the limits of 10 – 30 % counting upon dry ashless coal. So, for example, 6410 tons of coal of Tulgansk's brown-coal fields or 2100 т coal of Kansk-Achinsk's basin is required for reception 500 tons of humates in a year [15].



1-container; 2 – the header bin of coal; 3 – a feeder; 4 – the belt transporter;
5 – guard magnet; 6 – the header bin of alkali; 7 - a crusher; 8 – a belt elevator;
9 – the storage hopper; 10 – a reactor; 11 – centrifuge; 12 – interim capacitance;
13 – a steam heater; 14 - an axifugal atomizer; 15 – atomizing drier;
16 – a cyclone of gas purification and a unloading; 17 – the bin.

Figure 2. The technological schema
of reception of nonballast growth factors of plants

CONCLUSION

Well-known, that use of coals as fuel (meaning its direct burning) leads, on the one hand, to rather essential environmental contamination, with another, - to direct losses of a significant amount of the valuable components containing in it. The most rational way use of coal is a complex processing with reception of more ecologically pure and power-intensive by-products according the opinion of the overwhelming majority of the researchers specializing in the coal fuel chemistry and also ecologists. In particular it concerns brown coals which in the raw and not advanced kind are classified as low-grade fuel. At the same time brown coal is especially valuable feed for complex processing with reception liquid, gaseous and improved solid fuels. Complex processing of coals in the specified directions is one of the most actual problems of XXI century in the field of fuel and energy maintenance.

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