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For a Bulgarian Coke-Chemical Industry

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Coke was obtained in all these experiments. However, its quality does not permit its use in high and average furnaces. It can only be used in low-pit furnaces, as an addition (up to 30%) to ordinary coal. The results achieved in the German Democratic Republic, showing that the production of coke with rather good mechanical qualities is possible, are most encouraging. This coke, however, has a very low degree of porosity (26 to 30%; while for normal coke, it is over 50%). The German specialists have observed that this coke can be added to ordinary coke in amounts up to 30%.

Taking into account that a great deal of work has been done on methods of coking brown coal during the past decades, and that coking techniques are still being perfected, it can be expected that brown coal will widely be used for making coke in the very near future. Even at present, the German Democratic Republic uses coke produced from brown coal in ferrous metallurgy (despite the fact that the classical high furnaces are not employed).

The results of research carried out so far on coal for coking give us the opportunity for evaluating the Bulgarian raw-material resources for the production of coke.

The most important thing is that we have coal including all the technological grades necessary for coking. However, it has a rather high percentage of ash and sulphur. In general, its concentration is a difficult process, and obtaining the necessary concentrate for coking (having a low percentage of ash and sulphur) requires the utilization of a considerable tonnage of the geological reserves known.

The reserves of coal for coking now known still do not permit

the establishment of a cokeproducing industry on a large scale. Furthermore, lean caking and noncaking coals predominate in the deposits so far tested, which limits the possibilities of using all the deposits of hard coal so far discovered for coking.

The quantities of coal of the "Gas," "Fat," and "Coke" grades which would be added to the batch with the "lean" and "lean caking" coals are insufficient.

The technical possibility, in the future, of using brown coal as well for coking widens the raw material resources for coke production.

This problem, however, is now under research. The use of brown coal is still limited. In this connection, there are also other obstacles: the Bulgarian brown coal pits (we have in mind those in Dimitrovo, Bobov Dol, and Pirin) have small reserves of high quality coal, and the coal with high ash content is difficult to concentrate and reduce its ash content to 6-7%, which is required for coking.

Under such circumstances, the problem of the development of the coke-chemical industry in Bulgaria must be analyzed in the following manner.

The research and studies made on the coal reserves in the Balkan basin and in certain other places justify a serious consideration of the problems concerning the construction of a coke-chemical plant. It is necessary, of course, to know in advance that from this coal we will produce coke only under rather difficult conditions -- chiefly due to the difficulties involved in concentrating, and to the lack of sufficient "gas" and "fat" coal. The

size of this plant will have to be determined on the basis of existing reserves as well as the prospects for the discovery of new reserves of coal for coking. Meanwhile, until the necessary reserves of "gas" and "fat" coal have been discovered in Bulgaria, coal can be imported from abroad.

The construction of a coke-chemical industry on a wider scale, calls for several undertakings to be carried out in the shortest possible time, the most important of these, in our opinion, are the following.

1. Still wider geological research must be carried out in the Balkan basin for locating further reserves of hard coal, with special attention to prospecting for reserves of "gas" and "fat" coal. Research in other regions containing hard coal, particularly in northwestern Bulgaria, must also be undertaken.

2. Systematic chemical and technological research on coal must be carried out, along with geological research, in order to determine the suitability of the coal for making metallurgical coke. Particular efforts are required in choosing the proper methods of concentration suitable for Bulgarian coals, and for insuring the production of a concentrate having a low ash and sulfur content. Systematic research and semiindustrial and industrial tests with a view to discovering the most suitable method of mixing the coal must be carried out, in favor of making coke with high physical, mechanical, and chemical qualities, and to achieve better utilization of existing hard coal reserves.

3. Research on the use of brown coal for coking -- mainly for adding to other types of coals used for coking, and also as an independent raw material -- must be carried out in Bulgaria.

4. Work on drafting plans for pits must be completed on schedule, then the construction of these pits must begin immediately to insure the supply of coal necessary for the operation of the coke-chemical plant.

5. It is necessary to pay attention to the problem of limiting the current exploitation of the valuable kinds of coal ("gas," "fat," and "coke") in the Balkan basin, and to reserve these types for the projected coke plant.

These tasks call for the mobilization of some considerable forces -- material and manual. So far, technological research on coal for coking has been carried out almost exclusively by the NIITIG. Even at the Institute only 3 or 4 persons, who are inadequately trained and poorly equipped, are engaged in research on the problems of coke production. The number of specialists engaged in research on coal for coking must be increased as quickly as possible, and the basic material necessary for carrying out qualitative and fruitful research work must be created. Furthermore, specialists must be sent abroad for training, where they can become acquainted with the methods and techniques necessary for carrying out the necessary research.

The specialists of the BAN (Bulgarska akademiya na naukite, Bulgarian Academy of Sciences) and the VUZ (Visshi uchelni zavedeniya, Higher Educational Institutions) must participate more actively in the implementation of this task, by taking over part of the research work related to the establishment of the coke-chemical industry in Bulgaria.

The planning and the building of a coke-chemical plant will

obviously require the help of foreign specialists. This will probably necessitate a final research project on coking (industrial experiments in active modern furnaces) to be carried out abroad.

As far as preliminary research is concerned, including the choice of the most likely and favorable mixture for coking, this can be carried out entirely in Bulgaria. It is wrong to consider that such research must be carried out abroad. It is difficult to send all the samples necessary for research out of the country. The location of the various deposits and the variety in the kinds of coal make numerous combinations and tests impossible if they were to be conducted abroad. Also we must pay for such tests perhaps even more than it would take to equip a research center locally and to train local personnel.

The time is already ripe for a serious discussion of the problems of establishing a Bulgarian coke-chemical industry. We must devote the efforts required and invest the funds necessary for the final solution of this problem.

FOR A BULGARIAN COKE-CHEMICAL INDUSTRY

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The industrial development of any country depends on numerous factors. One of the principal factors is the metal industry, particularly, the production of pig iron and steel.

Bulgaria is pursuing a course of speedy industrialization. The major efforts of the party and the government have been directed toward the building up of heavy industry, which is the basis for transforming the country from an agrarian country into an industrial-agrarian one. However, it is difficult to build up heavy industry without domestic production of pig iron and steel. That is how the building of the "Stalin" DMZ (Durzhaven Mashinostroitelen Zavod, State Machine-building Plant) was one of the first large construction projects in Bulgaria. This plant is now being expanded, and the first blast furnace for the production of pig iron is currently being added to it.

Along with this, in the past few years research has been carried out on a large scale with a view to locating iron ore deposits, which are necessary for pig iron production. In this connection, Bulgarian geological research organizations have achieved considerable success, and it can safely be said that iron ore reserves sufficient to last several consecutive decades are assured. Reserves of manganese ore, equally necessary for the ferrous industry, have also been insured.

However, the ferrous metallurgical industry also requires

coke, for the blast furnaces. In order to insure the supply of coke, the directives of the Sixth Party Congress have called for sufficient geological research for the discovery of more hard coal reserves which is the basic raw material for coke production. The plan calls for an increase of 38 times in the known reserves, by the end of the current Five-Year Plan. During the past few years, large scale geological research with a view to the discovery of new hard coal reserves for coking have been carried out in Bulgaria. At the same time, considerable technological research for the purpose of determining the possibility of the production of coke from one or another kind of coal has been conducted in Bulgaria and abroad.

In the present article, we wish to provide a short summary of the research carried out so far on the problem of the production of coke in Bulgaria and to attempt to point out some of the further measures necessary for the final solution of this problem.

Attempts to organize a Bulgarian coke-chemical industry date back to the bourgeois capitalist period. The Bulgarian capitalists who owned the deposits of hard coal, good for coking, in the Balkan basin, thought of instituting such production, and, as result, the coke factory at the Plachkovtsi railroad station, consisting of only a few furnaces, was built. The lack of proper development in industry at that time, the contradictory interests of the mine owners, the lack of interest on the part of the bourgeois fascist state in the development of the coke-chemical industry, and the influence exerted by other capitalist countries, made it impossible in practice to solve the problem of the organization of coke production in Bulgaria.

Then for the first time in Bulgarian history this question was posed for complete solution, by the People's Regime. The production of coke is linked with the problem of the development of the Bulgarian entire industry, particularly ferrous and nonferrous metallurgy, the chemical industry, and the machine-building industry.

Brown coal was sent to France in 1949 for research work on the possibility of producing coke by new methods. Later, brown coal was also sent to the German Democratic Republic and the Hungarian People's Republic, for the same purpose. We shall review the results achieved after we have analyzed the research on hard Balkan coal in greater detail; the latter still represents the most feasible raw material basis for the production of coke.

On the basis of previously collected geological data, the General Administration of Geological and Mining Research has since 1953 been carrying out a detailed study of the Balkan coal basin, with a view to locating reserves of coal suitable for industrial coking. The reserves in the active pits and those of the new sectors are being studied in detail. Technological research is being carried along with geological research, with a view to determining the suitability of the coal for the production of metallurgical coke.

The technological tests were carried out by NIITIG (Nauchnoizsledovatelski institut za tekhnologhki izsledvaniya na gorivata, Scientific and Research Institute for Technological Research on Fuels) on samples of coal, 30-50 t each, submitted by the geological research groups. The tests included: (1) chemical analysis; (2) sifting operations to establish granulation; (3) fractional analysis to determine concentration capacity; (4) industrial

concentration test to obtain concentration indexes for coal under industrial conditions, and mainly to obtain larger quantities of concentrated coal necessary for the other tests, and (2) bun [sanduchno] and compartment coking of the concentrated coal -- separately or in a mixture with other coal -- in order to determine the coking capacity. Recently, since receiving the Raposhnikov apparatus, it has been possible to determine the plasticity indexes of a large part of the tested coal as well.

These tests leave many gaps to be filled. Still no complete research on petrography, tendency to cake, plasticity, swelling pressure, etc has been carried. Moreover, the industrial concentration testing has been conducted at the "Lev' DMI installations at the Plachkovtsi railroad station, which are still not fully equipped, and the resulting data cannot really be used in the final planning of installations for the industrial concentration of coal. The coke testing was carried out in the coke compartment kilns of the above mentioned enterprise, in which work is done without heat regeneration, at relatively low temperatures. It is well known, however, that modern furnaces are built mainly for high temperature heating.

Despite these gaps in the research, the results achieved make it possible to evaluate the coking capacity of the coal and to determine the possibility of its use as raw material in coke production.

The Institute for Technological Research on Fuels has so far carried out more detailed research on the coal obtained from the following regions: Kachulka, Chumerna ("Chumerna" pit, "Divina" pit, "Koks" pit, and the "Kichesta" and "Sheshkingrad" sites), Tvurditsa, and Butura. A certain amount of research has been carried out by

the institute, and by other organizations and individuals, on the coals obtained from Plachkovtsi and other regions of the Balkan basin, and also from some other northwestern Bulgarian sites. Coal from some sites has been tested in the USSR as well.

With few exceptions, the regular coal from the sites studied appears to have a high ash content. In general, the ash content varies from 10% to 60%, mainly between 20% and 45%. The sulfur content varies between 0.85% and 5%, and in some sites in northwestern Bulgaria (Gorno Ozirovo) the sulfur content has been over 10% in certain tests. Because of this, the coal from all these sites must be concentrated before it is used for coking. Some of the coal layers at numerous sites could not be used for coking in any case, because after concentration this coal still retains high ash or sulfur content. This further reduces the quantities of coal suitable for coking, on the basis of the reserves of hard coal which have been studied.

The phosphorous content of the coal (about 0.015 to 0.020) is relatively low, and it will not impede its use for coking.

In general, silicium and aluminum oxides predominate in the ash content of the coal and its concentrates. These contents make the coal further unsuitable for coking.

In terms of size as indicated by sifting, the finer grades of coal predominate. There is an average of 40% to 60%, mostly 50%, of coal of the 0 to 3 mm grade, while the percentage of large-size grade of coal decreases as the grade rises. Thus only a small percentage, rarely even 10% to 15%, falls in the over 50-mm grade category. In general, the ash content is low in the finer grades,

and the sulfur content is high in the middle grades. However, there is no sharp differentiation.

Coal lends itself to concentration in varying degrees, but usually with difficulty. The concentrates which can be produced from various coals vary between 30% and 70% -- mainly 45%. The ash content of the concentrates is between 6% to 15-20%. Coal which has been subjected to stronger metamorphoses (belonging to the group of thin-caking coal) concentrates better, while coke and fat coals of the Kachulka and other regions concentrate with greater difficulty. For coals of the finer grades, concentration has to be carried out at installations equipped for finer grades, while the finest grades and residue will have to be enriched by flotation.

The technological classification of the coal tested is determined on the basis of the data provided by the research so far conducted on the coal (production of volatile substances, kind of coke residue, plasticity indexes, petrographic composition, and coking capacity) in the compartments of the Plachkovtsi coke kilns.

If, for the time being, we adopt the classification applied to the Donets coal for grade classification of the Bulgarian coals, we have: "Gas" (g) -- at some sites in Plachkovtsi region (Lev and others); "Fat" (PG) -- at some sites in Plachkovtsi region and in northwestern Bulgaria (Gorno Ozirovo, Zelenigrad, etc); "Coke" to "Fat" (K to PG) -- Kachulka, Yantra-Izvor, etc; "Coke" -- (Sheshkingrad, etc); "Thin caking" (PS), with varying degrees of caking -- from rather high, close to that of coke, to poor (Koks, Kichesta, Tivina, Chumerna, Butura, and Tvurditsa); "Thin noncaking" (T) --

some sites in Tvurditsa region (Nadezhda), Karabair, etc. Further research will be necessary to assess more accurate technical grading of the above. The data available at present indicates that some of these types of coal fall into categories intermediate to those described above. This calls for more exhaustive testing of the coal from each site, as well as a more flexible system of grading.

The present classification, even though only preliminary, shows that, in Bulgaria, we have all the technological grades (including the basic grades, "coke" and "fat") necessary for the compilation of a proper mixture for the production of metallurgical coke.

We mentioned earlier that experiments for coking Bulgarian brown coal have been carried out in the German Democratic Republic, France, and the Hungarian People's Republic. All of these experiments were carried out in large laboratories. The coal was subjected to various tests, particularly thorough experiments being carried out on the so-called 2-step method of producing briquettes. Basically, the method consists of the following operations: preliminary low-temperature carbonization of the coal at temperatures from 450° to 650° C (to varying degrees according to the temperature). The low-temperature carbonization tar thus obtained helps to make briquettes of the semicoke of the coal, after which the briquettes are coked. In some of the experiments, tests were also made with the process of adding certain quantities of Bulgarian hard "gas" coal. The coke thus obtained retained the briquette form and acquired various physical, chemical, and mechanical qualities depending on the conditions maintained and the components used.