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USSR DEVELOPS NEW METHODS OF GASIFYING AND BRIQUETTING COAL

METHODS OF UNDERGROUND GASIFICATION OF COAL IMPROVE -- Moscow, Master Uglya, No 8, Aug 53

As early as 1925, B. I. Bokiy, one of the leading representatives of the USSR mining industry, proposed a scheme for the underground gasification of coal, and, during the First Five-Year Plan, Soviet scientists developed several designs for underground gas generators. From 1930 to 1936, five experimental mines were constructed in the Donbass, the Kuzbass, and the Moscow basin, and experiments in gasification of coal were conducted in these mines under different mining and geological conditions, in slightly dipping and steeply dipping coal seams, with different types of coal, from lignite to anthracite.

In the first period of research and experimentation, the engineers turned their attention to gas generators in which the gasification process was carried out under plant conditions, where air was blown through a layer of crushed coal in the gas generators. To create similar conditions underground, the engineers developed a process by which the coal was also crushed for use in underground gas generators.

The first experimental station for underground gasification of coal was constructed in Lisichansk. The coal seam at this station was uncovered by ordinary mine workings, and charges of explosives were inserted in several spots of the panel prepared for gasification. After this the seam was set on fire. Air and steam were conveyed by pipes to the panel being gasified, and the gas formed was drawn off by a special suction fan. As the coal burned, the charges of explosives exploded and crushed the coal.

The experiments indicated, however, that the underground process cannot be carried out in exactly the same way as in a plant gas generator. The explosives did not crush the coal evenly but produced a combination of coal dust, fines, and large lumps. The air being injected to the panel also failed to circulate uniformly about the entire layer of coal. Control of the gasification process was not achieved by this method.

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The Moscow basin modified somewhat the above method of the underground gasification of coal by employing forced blasting from the surface in addition to automatic blasting of charges inserted in the gasification panel. This change, however, did not result in an effective method.

The Shakhty Experimental Station tried out a method of underground gasification which involved preliminary storage of coal. Here, too, the coal seam was uncovered by ordinary mine workings. Special storage chambers were cut in the section to be gasified; they were filled with previously broken up coal and served as underground generators. This method proved impractical because of the numerous, laborious mining operations required in preparing for it.

All these experiments, based on the principles of operation of plant gas generators, led to the conclusion that the specific conditions of the underground gasification of coal require a specific solution. Such a solution was found in 1934 by Engineers V. A. Matveyev, P. V. Skafa, and D. I. Filipov, who proposed gasifying the coal seam under the actual conditions of its occurrence, that is, in the block, dispensing with preliminary crushing.

The proposed scheme was as follows: Two sloping workings, several hundred meters in length, were cut along the dip of the coal seam, a section of which was to be gasified. These two workings were connected below by a horizontal working, the so-called combustion drift. In this combustion drift, wood and fiber soaked in oil were piled up. Then a draft was turned on and, with the help of electric spiral heating units, the wood was set on fire. The coal continuously exposed to the current of air warmed up, and gasification started at the exposed surface of the coal.

Air, steam, or gas, depending on the type of gas desired, was transmitted through one working to the gasification panel. The gas, as it was formed, was conveyed to the surface through the other working. The gas was formed in the combustion area, which moved upward along the rise of the seam as the coal burned. The area under the combustion area was filled with slag and crumbling rock from the roof of the seam.

In addition to such a panel, which looks like an inverted Russian П, more complicated types of panels were also developed with three, five, or even more sloping workings.

The new method has been designated the continuous method. The Gorlovka Underground Gasification Station, put into industrial operation in 1937, operated by this method and, in February 1938, gas obtained from the underground gasification of coal was, for the first time, made available as fuel for boilers of a coke plant. The Gorlovka Station continued to operate for 15 months, after which time the fire in the gasification panel was extinguished for panel inspection. During that time about 12 million cubic meters of fuel and technological gas had been obtained.

At the same time, the continuous method of underground gasification was tried successfully in other coal panels of the Donbass and Kuzbass. On the eve of World War II, several experimental and industrial stations in the Donbass and Moscow basin were subjecting blocks of coal to underground gasification.

These stations still used mining methods in preparing for underground gasification, and many workers and much hard labor were required in the construction of regular mine workings of various types. Soviet scientists and engineers therefore directed their attention toward finding a nonmining method of gasifying coal which would completely exclude underground operations.

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Even before World War II, vertical holes had been drilled in preparing coal for underground gasification. In present-day underground gasification stations, these vertical holes have completely replaced regular mine workings. Some sloping holes have also been drilled from the surface along the coal seam. Both vertical and sloping holes drilled from the surface should be connected, but by nonmining methods, that is, not by a regularly constructed mine working.

The rapid and extensive industrial development of the underground gasification of coal depends on further perfecting of the entire technological process of obtaining gas by a nonmining method. In this connection, the competition for improved scientific and planned development of the technological process of the gasification of coal announced during 1953 by the Ministry of the Coal Industry and the Academy of Sciences USSR acquires great significance.

Soviet scientists and engineers are developing new methods of underground gasification and processing of coal and other types of fuel to obtain high-calorie gas. The Power Engineering Institute of the Academy of Sciences USSR has worked out a flameless method of burning gas. Powerful new gas turbines, just being completed, will open up excellent possibilities for the utilization of gas obtained through underground gasification.

The greater the development of methods and technological means of underground gasification, the more obvious their advantages appear as compared with usual methods of mining and utilizing coal. Present methods of underground gasification have already resulted in a sharp increase in labor productivity. Production costs of gas obtained by underground gasification of coal are considerably less than production costs of coal extracted by usual mining methods. Working conditions are far less arduous at underground gasification stations than in coal mines.

NEW BINDER FOR COAL BRIQUETTES -- Moscow, Ugol', No 8, Aug 53

In sorting anthracite and noncaking bituminous coal, up to 40-45 percent of fines, 6 millimeters and below in size, are obtained. These fines can be burned to good advantage in certain types of fireboxes which are available to only some enterprises. However anthracite culm and bituminous coal fines can be transformed into a high-grade fuel through briquetting. Coal tar pitch, a residue in the distillation of tar, obtained during the coking process, is used as a binder in the coal-briquetting process, and the briquettes themselves have been used quite extensively as fuel in railroad and water transport.

The technology of obtaining briquettes includes the following operations: The pitch is subjected to two-stage crushing to reduce it to one millimeter in size and then it is mixed with the coal fines. The mixture then goes to a mixing tank for initial heating. Superheated steam under a pressure of 3-4 atmospheres and at a temperature of 300-350 degrees is fed to the tank. On leaving the mixing tank, the mixture has a temperature of 80-90 degrees; it cools to 70-80 degrees in transit from the mixing tank to the roller press. After the briquettes have been pressed, they are moved by belt conveyer to the ramp. The temperature of the briquettes is 55-65 degrees, which is close to the softening point for pitch (65-75 degrees). As a result, the briquettes stick together in a single block, the breaking down of which is accompanied by the formation of small particles.

This technological method is characterized by a number of defects:

1. Although the pitch is supposed to be crushed to pieces one millimeter in size, about 50 percent of it is above one millimeter.

2. Up to 160 kilograms of superheated steam are consumed per ton of briquettes.

3. Servicing of the mechanisms in the press department is made difficult by the presence of steam, particularly in winter, and the period of their service is shortened as a result of corrosion.

4. Because of the relatively low softening point of pitch and the inadequate cooling of the briquettes, the latter stick together in a single block.

Coal tar pitch is used extensively in several branches of industry. However, it is in short supply and is an expensive binder.

The search for and introduction of new and inexpensive binders in large supply are very important for the national economy. Such a binder should conform to the following basic requirements:

1. It should not increase the ash content of the briquettes.

2. It should not lessen the combustible properties of the briquettes.

3. It should not be sensitive to atmospheric conditions.

4. It should be a factor in obtaining briquettes of great mechanical toughness.

5. It should be inexpensive and in plentiful supply.

A number of extablishments and specialists have undertaken the search for a substitute for pitch and have tried, among other substances, petroleum bitumens and the organic part of acid gudron. These have not proved satisfactory; for example, the gudron has a high sulfur content and a lower softening point than that of pitch.

Laboratory and industrial experiments have been conducted in briquetting the fines from lean (T) coal with an additive of "fusy" from some plants in the Donbass and Dnepr region. Fusy is the Russian name for a product of the condensation of coke oven gases. It is a thick, viscous, tarry mass, black in color, and containing minute particles of the coal concentrate which have been carried along by the gas from the coking chamber. Formerly, there was no demand for fusy and it was sent to the dumps as a waste product.

The technology of producing fusy is as follows: The volatile substances formed in coking bituminous coal leave the coking chamber at a temperature of 600-700 degrees and are carried off by pipe to the gas collector. Here the gases are sprinkled with water and their temperature is lowered to 80-90 degrees. As a result of the sudden cooling of the gas, the chief part of the tar (60-70 percent) is condensed in the gas collector and then carried off by the water through the gas pipe to the settling tank. The fusy, as the heaviest part of the mixture, settles at the bottom of the tank, from which point it is removed by a scraper conveyer.

The ash content of fusy is higher than that of pitch. However, since a relatively high percent (15 percent) of fusy goes into the briquette, the ash content of the latter is not only not increased but even decreased. [The ash content of the coal is considerably higher than that of either binder.]

The briquetting is carried out in a hydraulic press with a 60-ton pressure capacity, and the finished briquette is cylindrical in form with a diameter of 70 millimeters.

Resistance of the briquette to impact load is determined by dropping it according to GOST 5544-50 and comparing the weight of the briquette after it has been dropped with its initial weight. Moisture resistance of the briquette is [redacted] 50X1-HUM

determined by leaving it in water for 24 hours, and heat resistance by burning it at a temperature of 900 degrees. After 24 hours in water, the briquette shows no sign of saturation. Its moisture absorption does not exceed 3 percent. The coefficient of cohesion of the briquette exceeds 95 percent, and this is almost unchanged by the 24-hour period in water. At 900 degrees the briquette ignites in the second or third minute, burns from 6 to 9 minutes with a long, smoky flame, and after that without a noticeable flame. These qualities of the briquette, observed during the experimentation period, differ very slightly from the qualities of the finished briquette. Comparative data on composition of briquettes obtained with the use of pitch and fusy as binders are given in the following table:

Type of Analysis	Briquettes With Pitch Binder	Briquettes With Fusy Binder	Remarks
Ash content (%)	8.65	8.28	Consumption of pitch amounted to 8%; consumption of fusy, 15%
Moisture content (%)	5.50	5.10	
Sulfur content (%)	1.35	0.9-1.1	
Volatile matter (%)	16.02	13.44	

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