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(FOUO 4/79)

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TRANSLATIONS ON USSR RESOURCES

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 [III - USSR - 37 FOUO]

ELECTRIC POWER AND POWER EQUIPMENT

ECONOMIC EFFECTIVENESS OF SUBSTITUTING LIQUID BOILER FUEL WITH COAL IN ELECTRIC POWER PLANTS OF EUROPEAN RUSSIA

Moscow KHIMIYA TVERDOGO TOPLIVA in Russian No 4, 1978, pp 15-19

[Article by L. I. Yerkina, D. Yu. Ibragimov, O. P. Kirsanova, I. P. Krapchin, S. A. Feygin, and T. Ye. Frolova, Institute of Mineral Fuels]

[Text] The present shortage of energy-producing fuel in the European part of the USSR will continue during the subsequent periods of planning. In order to make up for this shortage, it is necessary to include the Kansk-Achinsk coals and the products of their processing into the fuel balance. At the present time, a considerable volume of work has been done on improving the quality of these varieties of coal by thermal treatment (semicoking in the units of the Power Engineering Scientific Research Institute imeni G. M. Krzhizhanovskiy (ENIN), thermal treatment in the vortex chambers of the Institute of Mineral Fuels (IGI)). In the first case, the main type of the output product will be semicoke, and in the second case -- thermocoal.

Semicoke and thermocoal can be transported in railroad cars or by special types of transportation and used as energy-producing fuel.

Definite successes have been achieved in the improvement of the quality of these types of coal by the hydrogenation method. As a result of this, a liquid low-sulfur boiler fuel suitable for transporting by railroad and through pipelines will be obtained. In order to determine the economic effectiveness of substituting liquid boiler fuel with other types of fuel in the European part of the USSR, technical and economic indexes of six possible variants were computed and compared:

the first variant envisages the mining of the Kansk-Achinsk coals, production of electric energy in the area of their mining, and its transmission to the European part of the country through a direct-current electric power transmission line (LEP) of 2500 kv and a cryogenic LEP;

the second variant envisages the mining of the Kansk-Achinsk coal, its transportation by railroad, and production of electric energy in the European part of the USSR;

the third variant envisages the production of thermally treated coal (thermocoal) at the place of mining of the Kansk-Achinsk coal, its transportation by railroad and through a pipeline with its subsequent burning at the electric power plants of the European part of the USSR;

the fourth variant envisages technological power conversion of the Kansk-Achinsk coals in the area of their mining and transportation of powdered tarred semicoke by railroad and a pipeline to the European part of the country;

the fifth variant envisages conversion of the Kansk-Achinsk coal in a hydrogenation process and obtaining a synthetic boiler fuel and motor fuels, transportation of the boiler fuel by railroad to the European part of the country with its subsequent burning at electric power plants;

the sixth variant envisages transportation of the Western Siberian oil through a pipeline to the European part of the country, its light processing in order to obtain motor and boiler fuels, and the burning of liquid boiler fuel at electric power plants.

Technical and economic indexes for the variants being compared were calculated on the basis of fuel supply for a condensation electric power plant (KES) of 2400 Mw using its installed capacity for 7000 hours situated either in the mining region of the Kansk-Achinsk coal, or in the European part of the country (conditionally, the city of Ryazan').

The output of electric power at a KES of the above capacity is 16,800 million kwh a year, electric power consumption for the plant needs is 4.1% for plants operating on the run-of-mine Kansk-Achinsk coal, 3.24% for plants using thermocoal or semicoke, and 2.7% for plants using petroleum boiler fuel. The production of 1 kwh of electric energy requires 330 g of reference fuel. The annual consumption of reference fuel at a KES of the above-mentioned capacity is 5,316,000 tons.

Production of Electric Energy at Electric Power Plants Using Run-Of-Mine Coal

In this case, run-of-mine brown coal with 35% moisture content and a combustion heat of 3500 kcal/kg is used as fuel. In order to satisfy the needs of a KES, it will be necessary to mine the coal in the following amounts: 12.2 million tons (if energy is transmitted through an LEP of 2500 kv), 10.9 million tons (if energy is transmitted through a cryogenic LEP), and 11.2 million tons (if the plant is located in Ryazan' and fuel is transported by railroad). In these conditions, the economic indexes of the electric power plants will be characterized by the data given in Table 1.

Production of Electric Energy at Electric Power Plants Located in the European Part of the Country Using Thermocoal or Tarred Semicoke[1]

[1]The process of obtaining thermocoal is being developed in IGI, and process of obtaining semicoke is being developed in ENIN.

Table 1

Economic Indexes of Electric Power Plants Using Run-of-Mine Kansk-Achinsk Coal

Indexes	Variant I: Electric Power Transmission Line — Direct Current, 2500 kv	Variant I: Electric Power Transmission Line — Cryogenic	Variant II: Coal Transported to European part by railroad
Total capital investments, million rubles	704.7	549.2	480.3
Including:			
extraction of brown coal	144.5	129.2	132.7
transportation of energy or fuel	201.4	99.2	39.1
production of energy	314.4	314.4	302.4
additional expenses on power compensation.	44.4	6.4	6.1
Total operation expenses, million rubles	64.5	48.6	115.6
Including:			
extraction of brown coal	13.9	12.4	12.7
transportation of energy or fuel	12.7	4.4	72.2
plant expenses	30.8	30.8	29.7
expenses on power compensation	7.1	1.0	1.0

Thermally treated coal (thermocoal) is a fuel containing over 50% of fine fractions of 0.5 mm in size and lower combustion heat of about 6200 kcal/kg. The yield of thermocoal from the feed coal with a working moisture content of 35% is 52%. Thermocoal in its natural form can be transported in open all-metal freight cars if its surface is covered with a hydromazut film according to the technology developed at IGI. Semicoke, just as thermocoal, is a fine-grained fuel.

According to calculations, operating costs of obtaining thermocoal (without the cost of the raw material) are 1.24 rubles/t n.f.[2].

Through thermal decomposition of the run-of-mine coal with a 32% moisture content it is possible to obtain (%): semicoke 31.6; tar 5.2; high BTU gas 12. The rest is coal dust, gas, and water. The production of one ton of semicoke requires 2.8 rubles of current expenses and 14.3 rubles of capital investments.

2 t n.f. -- tons of natural fuel.

Table 2
Economic Indexes of Electric Power Plants Situated in the European Part of the USSR which Use Thermocoal or Semicoke

Indexes	Transportation Expenses			
	Thermocoal		Semicoke	
	by railroad	by pipeline	by railroad	by pipeline
Total capital investments, million rubles	497.1	532.8	561.4	591.7
Including:				
extraction of brown coal and its improvement	190.6	187.0	256.1	251.4
fuel transportation	19.9	59.2	19.9	54.9
electric power production	285.1	285.1	283.9	293.9
additional expenses on power compensation	1.5	1.5	1.5	1.5
Total operating costs, million rubles	86.4	62.3	97.6	72.4
Including:				
extraction of brown coal and its improvement	20.6	20.3	32.3	31.9
fuel transportation	37.0	13.2	37.0	12.2
plant expenses	28.5	28.5	28.0	28.0
additional expenses on power compensation	0.3	0.3	0.3	0.3

Table 3
Economic Indexes of Electric Power Plants Situated in the European Part of the USSR which Use Liquid Synthetic and Petroleum Fuels

Indexes	Electric Power Plants Using	
	Liquid Synthetic Fuel	Petroleum Boiler Fuel
Total capital investments, million rubles	1239.7 (1721.1)*	990.5 (1979.0)
Including:		
fuel production and transportation	937.3 (1418.7)	724.1 (1712.6)
production of electric power	302.4 (302.4)	266.4 (266.4)
Total operating costs, million rubles	259.4 (320.1)	195.8 (285.9)
Including:		
fuel production and transportatation	226.7 (289.4)	168.7 (258.8)
plant expenses	30.7 (30.7)	27.1 (27.1)

*First figure -- evaluation of petroleum by average expenses for the industry; second figure -- evaluation by the maximum expenses.

Table 4

Economic Indexes of Electric Power Plants Using Various Types of Fuel

Variants of Electric Power Production	Indexes, kopeck/kwh		
	Capital investments	Costs	Reduced costs
In Siberia, transported to Central Region via a 2500 kV LEP;	4.31	0.40	0.92
by a cryogenic LEP	3.36	0.30	0.70
On run-of-mine coal transported to Central Region by railroad	2.94	0.71	1.06
On thermocoal transported to Central Region by railroad:	3.04	0.53	0.90
by pipeline	3.26	0.38	0.77
On semicoke transported to Central Region by railroad;	3.43	0.60	1.01
by pipeline	3.62	0.44	0.87
On liquid synthetic fuel transported to Central Region by railroad	7.58 (10.5)*	1.57 (1.95)*	2.48 (3.20)*
On petroleum fuel transported to Central Region by pipeline	6.06 (12.1)	1.19 (1.75)	1.92 (3.20)
On Moscow area brown coal	4.07	0.72	1.21

*First figure -- evaluation of petroleum by average expenses for the industry; second figure -- evaluation by the maximum expenses.

The operation of electric power plants on thermocoal and semicoke instead of the run-of-mine brown coal will require substantial changes in the engineering design of the electric energy production process, which will lead to a reduction in the need of capital investments in electric power plants. This will be achieved as a result of lower expenses on the defrosting devices, warehousing facilities, drying, and dust preparation.

Specific fuel consumption will also decrease since the burning of thermocoal and semicoke requires less expenses on the evaporation of moisture from the coal and less electric energy for the plant's needs (fuel supply and dust preparation).

The economic indexes of electric power plants using thermocoal and tarred semicoke delivered to the European part of the country by railroad or a pipeline are shown in Table 2.

Production of Electric Energy at Electric Power Plants Using Synthetic or Petroleum Boiler Fuels

The bulk of the synthetic boiler fuel obtained after the hydrogenation conversion of the brown coal of the Kansk-Achinsk basin in combination with the Western Siberian oil at a ratio of 3.6:1 can be used at thermal electric power plants. Studies have shown that combined processing of brown coal and oil can yield (%): gasoline AI-93 -- 4.1; diesel fuel -- 9.0, and low-sulfur boiler fuel -- ~25.0. The combustion heat of synthetic boiler fuel is 9000 kcal/kg. In order to ensure fuel for a KES of 2400 Mw, 4,245,000 tons of such fuel will be required. For this it will be necessary to build a plant in the coal mining area with a capacity of 16.9 million tons of the total raw materials (13.2 million tons of coal and 3.7 million tons of oil). According to calculations, the production costs of one ton of synthetic boiler fuel (including the mining costs) will be (rubles): capital 217.8 and 334.6; operating 4.9 and 61.1[3]. It is assumed that the KES will also use boiler fuel obtained at a petroleum-processing plant (NPZ) as a result of light processing of the Western Siberian oil. The combustion heat of the boiler oil is 9500 kcal/kg. The electric power plant will require 3,881,000 tons a year. The capacity of the NPZ was set at 8.6 million tons for ordinary petroleum. The specific production costs of boiler fuel at the NPZ were determined as follows: capital -- 162.9 and 417.6 rubles, operating -- 40.9 and 64.1 rubles/t n.f. The economic indexes of electric power plants using the types of fuel described above are shown in Table 3.

The results given below make it possible to establish the comparative effectiveness of the variants examined above[4] and to conclude on this basis whether or not they are promising. The common criterion for the evaluation of the variants are the calculated costs of 1 kwh of the delivered electric energy.

The results of the calculations are shown in Table 4.

The analysis of the data given in Table 4 made it possible to make the following conclusions.

1. Among the examined variants of the use of the brown coals of the Kansk-Achinsk basin, the most economical variant was the one providing for the construction of a KES in the coal mining region and the transmission of electric energy to the European part of the country through a cryogenic LEP.

2. The comparison of the variants of the production of electric energy on the basis of improved Kansk-Achinsk coals has shown that the most favorable results will be yielded by the production of electric energy with the use of thermocoal (calculated costs were 0.77-0.90 kopeck/kwh and 11% lower in comparison with semicoke). Pipeline transportation will lower the calculated production cost of 1 kwh of delivered energy by 14% in comparison with railroad transportation.

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3 The first figure gives the evaluation of oil by average costs of the industry, the second figure is the evaluation by the expenditures of the poorest fields.

4 Data for an electric power plant assumed to be using Moscow area coal are given for comparison.

3. The use of the Moscow area coal is less economical in comparison with thermocoal, semicoke, and the run-of-mine Kansk-Achinsk coal.

4. The comparison of the variants of the production of electric energy on the basis of synthetic and petroleum fuel showed the following. When petroleum is evaluated by the average costs of the industry, it is more economical to use petroleum fuel (calculated costs are 23% lower). When evaluating petroleum by the maximum costs, the electric power plants which are being compared will be identically economical (3.20 kopecks/kwh).

5. Considering the shortage of energy-producing fuel in the European part of the country and the limited petroleum fuel resources, the improvement of the Kansk-Achinsk coals by the hydrogenation processing method for the purpose of obtaining liquid boiler fuel should be considered very promising.

10,233
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FUELS AND RELATED EQUIPMENT

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COLLABORATION BETWEEN TATNEFT' AND VNIIBT

Moscow BURENIYE in Russian No 6, Jun 78 pp 3-5

[Article by A. V. Perov (Tatneft' imeni V. D. Shashin): "Fruitful Collaboration"]

[Text] The decisions of the 25th CPSU Congress assigned the country's drillers the task of shortening the construction time of petroleum and gas wells by 25 to 30 percent in the 10th Five-Year Plan.

In the first two years of the five-year plan, Tatneft' [Tatar Petroleum Production Association] shortened the construction time of operational wells by 19.5 percent; this was achieved largely by shortening the well assimilation time.

A certain rise in time outlays has been noted in the drilling stage, due primarily to the fact that Tataria's drillers are carrying out this task under more complicated mining-geological conditions of well drilling as a result of increased volumes of drilling in older areas having higher formation pressures not only in Devonian but also Carboniferous productive deposits.

Drilling there is being carried out from drilling platforms built earlier, and for this reason all of the wells are controlled-directional, with the bottom-holes deviating up to 800 meters from the vertical. The rise in the volume of controlled-directional drilling and the resulting increase in time outlays necessary for additional work are lengthening the well construction times. Hence the necessity of developing the equipment and technology for the drilling of controlled-directional wells with high technical-economic indicators.

In the opening of productive horizons, use is made of loaded muds of up to 1.7 g/cm^3 density. First of all, this reduces the bit performance density indicators; secondly, it requires more reliable insulation of the absorption zones. Outlays of time and resources to combat absorption go up not only because of the additional work necessary to increase the reliability of the well shaft but also because of the increased number of absorption zones to be insulated.

Tataria's fields are multistratal. In the process of their exploitation using perimenter and contour flooding, formation pressures in the oil-bearing strata have not risen uniformly. At present, the difference between formation pressures in water and oil bearing strata ranges up to 80 kgf/cm^2. Where distances between strata are small, the problem of separating them is quite complex.

At present, low-yield, small oil deposits confined to Carboniferous deposits are being put into production in order to maintain a high output level. The quality of exploitation of these deposits is largely determined by the method and conditions of stratum opening.

In order to increase the volume of explored oil reserves, drillers have been assigned the job of detecting deposits in the upper horizons in the process of exploitation drilling. Their tasks include the removal of larger-diameter cores, testing of the strata during the drilling process by means of formation testers inserted in the pipes, and other additional studies.

This is by no means a complete list of the problems that must be resolved in order to carry out the tasks successfully.

As is well known, increasing labor productivity in any sector of industry largely depends on technical progress. The giant leap in the rising drilling rates during the years of Tataria's oil development is due to the constant and systematic adoption of advanced equipment, progressive technology, and organization of drilling operations (the introduction of the turbine drilling method, the use of industrial water for well flushing, conversion to small-diameter bit drilling, the introduction of an array of 214-millimeter diameter bits, the adoption of industrial methods of rig construction, and so on).

The assimilation of new equipment and technology is a complex matter requiring a serious and well-considered approach. It is very important to unite the efforts of the scientific-research and production organizations. This largely determines the amount of time necessary to incorporate the results of scientific-research and design efforts in production.

As a positive example, we may cite the constant close collaboration between Tatneft' and VNIIBT [All-Union Order of Labor Red Banner Scientific-Research Institute of Drilling Technology]. The association's many successes are the fruit of this collaboration.

Tatneft' maintains routine and close ties with practically all divisions and laboratories of VNIIBT. Together they discuss production problems and the findings of scientific-research and design work; they draw up programs for testing experimental models and adopting series machinery. Tatneft' is a huge, complex testing ground for VNIIBT. It is the association's operations which determine the performance and effectiveness of the use of many of VNIIBT's designs, which are then put into production.

At present, all of the country's oil regions are making extensive use of turbine whipstocks, sectional spindle turbodrills, and various low-speed bottom-hole engines, whose designs were perfected during the drilling of wells in the fields of Tataria.

In the course of collaboration, several unified creative groups have been formed, made up of personnel from VNIIBT including A. A. Asan-Nuri, A. G. Kalinin, M. T. Gusman, R. A. Ioannesyan, Yu. S. Vasil'yev, B. M. Kurochkin, N. M. Kas'yanov, I. I. Kuznetsova, and others. During discussions of individual problems, new ideas and original solutions come into being, which later serve as the basis for the development of new designs and the working out of new technology.

Several years ago, for example, Yu. S. Vasil'yev's laboratory recommended regulating the dynamic load on the bit by using wave RBK's [drilling string separators]. Experience in drilling with RBK's has confirmed the usefulness of regulating dynamic load. But the low reliability of the RBK's made it impossible to use them widely. The idea came up of using a KBK [combined drilling string], consisting of steel and low-alloy drill pipes, instead of the RBK. At present, KBK's are being extensively used not only in Tatneft' but also in other oil regions, for example, Permskaya Oblast and Western Siberia. In Tatneft' alone this makes it possible to save more than 2,000 bits per year.

The efforts of the unified creative groups have resulted in the development of a spindle whipstock and an automatic whipstock guide on the borehole bottom. At present, work is underway on the development of nipple intersectional stabilizers, also conical radial supports; the introduction of these will boost effectiveness and increase the range of application of series-produced spindle turbodrills.

An excellent example of close creative collaboration with VNIIBT is the plan of experimental work in Tatneft' areas to seek out ways to improve the technical and economic indicators of drilling operations, to shorten the well construction time. Plans call for using the experimental findings to introduce all of the necessary correctives in the equipment, technology, and organization of drilling operations. Implementation of the experimental findings will help to shorten the well construction times in Tataria to the planned level in 1980.

Let us discuss briefly the implementation of the joint experimental project plan.

As is well known, labor productivity in drilling largely depends on the indicators of bit performance, and so the association is focusing considerable attention on this problem. Researchers are collaborating with VNIIBT on field studies to determine the optimal parameters of drilling operations. These studies have made it possible to determine the rotation speeds and axial loads on the bit making it possible to double the amount of drilling series-produced bits can do.

VNIIBT has developed low-speed D2-172M, TRM-195, 3TSShl-195 bottom-hole engines designed to maintain specified drilling operation specifications. Experience has shown that when the bits are outfitted with helical bottom-hole engines and geared turbodrills, the amount of drilling per bit doubles. Recently, VNIIBT has designed fundamentally new bits with oil-filled support--Sh-215.9MZGNU, Sh-215.9SZNNU, Sh-215.9TKZGNU, and Sh-215.9KGNU. In well drilling operations in Tataria in 1976, 36 bits outfitted with helical engines were used. In 430 hours of mechanical drilling they completed 6,328 meters. Compared with series-produced bits used in combination with helical bottom-hole engines, the amount of drilling per experimental bit was 2.4 times longer; the mechanical drilling speed was 1.16 times greater, and the round-trip speed was 69 percent greater. In 1977, the association's enterprises received and work-tested more than 100 bits with oil-filled hermetically-sealed support, manufactured not only by VNIIBT plants but also by the Kuybyshev Bit Plant. In 1978 the association plans to adopt about 1,600 of these highly-efficient bits, and in 1980 it will convert entirely to these bits. Undoubtedly, complete conversion to drilling with AN series bits will make it possible to substantially increase the speed of well drilling and the effectiveness of drilling operations in Tatneft'.

Very useful joint work has been done to determine the feasibility and the range of application of bits outfitted with synthetic diamonds. It has been found that when drilling below the Carboniferous horizon the best indicators have been achieved through the use of MKTSI-212S6 bits. The mechanical speed in this case is almost double the speed in the cases of using ISM type bits. Especially effective when using MKTSI-212S6 bits is the practice of drilling at intervals of 1,100 to 1,700 meters, flushing by means of loaded clay mud. The number of series-produced three-cone bits needed per well has been reduced by 30, and the time necessary to drill one well has been shortened by four full days. These bits can be used to drill wells utilizing devices to carry out lowering and raising operations and for drilling under conditions of intensive water seepage. When such wells are drilled using series-produced cone bits, after two hours of mechanical drilling or 30 to 35 meters of completed drilling the workers have had to carry out the lowering and hoistings operations while being "showered" by formation water. The use of bits outfitted with synthetic diamonds prevents this, improves working conditions, and boosts productivity.

Further increasing the volume of drilling by means of these highly-effective bits is being hindered by the lack of more powerful and reliable drilling pumps.

The above is by no means everything that has been done in recent years. Encouraging results have been achieved, for example, in drilling accompanied by flushing the borehole bottom with aerated fluid. Positive results have been achieved by the adoption of differentiated specifications--increasing the power transmitted to the bit as it wears down.

In the process of well drilling, the association's workers insulate three thousand absorption zones every year, expending about 75,000 hours of calendar time to combat them.

Considerable difficulties arise in the insulation of zones of intensive absorption. Overall, the quantity of complications is not large--not more than six percent, while time outlays to insulate them in the overall balance of time outlays necessary to combat complications run as high as 30 percent. The association has also accomplished considerable success in this regard. Thus, excellent results have been achieved through the use of a plugging mix with high water-yield, developed by the unified creative group of Tatneft' and VNIIBT. In 1977 this mix was used to insulate more than 30 intensive absorption zones.

The association has collaborated with the VNIIBT on successful efforts to improve the quality of the opening of productive strata and the well casing. A special unit has been built to prepare invert-emulsion muds, and their effectiveness and range of application has been determined.

Summarizing the overall results, we may say that the jointly-conducted experiment has been successful. But a critical stage looms ahead--the massive introduction of discovered reserves. Let us hope that VNIIBT will provide the necessary aid to the association in the series assimilation of all the highly-effective equipment developed by the institute.

6854
CSO: 1822

FUELS AND RELATED EQUIPMENT

UDC: 622.24.08.622.243.23

VNIIBT CONTRIBUTION TO TYUMEN' DRILLING PRACTICES

Moscow BURENIYE in Russian No 6, Jun 78 pp 6-8

[Article by F. G. Arzhanov (Glavtyumenneftegaz): "VNIIBT's Contribution to the Development of Western Siberia's Oil and Gas Fields"]

[Text] Close and extensive collaboration between the drillers of Tyumen' and the scientists of VNIIBT [All-Union Order of Labor Red Banner Scientific-Research Institute of Drilling Technology] began with the development of Western Siberia's oil fields. The first task that had to be resolved was that of substantially improving the equipment and technology of drilling controlled-directional wells, which had to serve as the basis for the development and introduction of cluster drilling. Unless this task were resolved, it would be impossible to hope for the rapid and successful development of the new oil region.

Under the difficult climatic conditions that are typical of Western Siberia, where vast areas are covered by swamps and lakes and are frequently flooded by river runoff, cluster well drilling and exploitation represents if not the only possible then at least undoubtedly the most economical and rational method. One of the most important advantages of cluster drilling under such conditions is the possibility of eliminating the seasonality of drilling operations, thus making it possible to substantially shorten oil field development time and enhance the effectiveness of capital investments accordingly.

However, the first attempts to drill controlled-directional wells there involved substantial difficulties, chiefly due to the lack of the necessary equipment and technology. In order to resolve the problem of extensively adopting cluster drilling in Western Siberia as quickly and efficiently as possible, essential organizational measures were promptly taken in VNIIBT. Thus, a controlled-directional well drilling laboratory was set up and manned with highly-qualified specialists; in effect, it became the center of scientific-research and design work in this domain.

Since that time, the drillers of Western Siberia have shared all their success with the collective of VNIIBT, which has developed, tested, proved, and successfully adopted reliable technical devices for the massive drilling of controlled-directional wells. The success has come about due to the close cooperation between institute scientists and Siberian drillers and their integrated approach to the resolution of this problem: in addition to designing models of new equipment (turbine whipstocks, layouts with calibrators, stabilizers of the STK type, the STT-164 telemetry system), improvements have been made in procedures of designing the profiles of controlled-directional wells, the drilling technology, the technology of making and controlling the quality of the drilling muds, and methods and means of controlling the deviation parameters. All of these measures have brought it about that cluster drilling has been completely mastered and is being used extensively in Western Siberia. Despite considerable deviations from the vertical (2,000 meters or more), and with productive strata lying at 2,200 to 2,400 meters, the cost of drilling controlled-directional wells has now approached that of drilling vertical wells.

At present, the technical means and technology of drilling controlled-directional wells developed by VNIIBT in collaboration with SibNIINP [Siberian branch of the Scientific-Research Institute of Petroleum Industry] and the drilling enterprises of Glavtyumenneftegaz [Main Tyumen' Petroleum and Gas Administration], are the most sophisticated in our country and have practically no equals.

A major and perhaps crucial factor in the successful and really extensive adoption of cluster drilling in Siberia's oil fields has been the fact that VNIIBT has not only developed but also organized, in its own plants, the manufacture of special equipment and drilling tools necessary in all stages of drilling, including items not relating to the institute's profile, and supplied them to the drilling enterprises in the necessary quantities. For example, in order to conduct drilling operations under conditions of high pressure differential on the bit, the institute had its own experimental plant organize the production of high-quality pistons, gaskets, cylinder bushings for the drilling pumps, and also bit nozzles.

Before proceeding to other aspects of collaboration between Western Siberia's drillers and the VNIIBT collective, mention should be made of a basic feature of this collaboration, one which defines the whole style of the institute's work with production enterprises: when addressing a task, the institute as a rule does not ask but gives. This principle of collaboration, in which the institute supports all links of the chain, starting with the idea, its theoretical and experimental study, the designing and stand testing of experimental models of equipment, and ending with the manufacture of the first experimental-industrial batches and subsequent work-testing under conditions of production, is, in our opinion, the most rational. This is backed up by the many years of practical collaboration between VNIIBT and Glavtyumenneftegaz. This principle of collaboration has become possible thanks to the fact that the institute has been working diligently and purposefully for many years on the creation of the necessary production-technical base.

Now the institute has well-equipped laboratories, a large test-stand complex, and an experimental proving ground. VNIIBT includes two machine-building plants and a branch in Perm', which also has a machine-building base and a test-stand facility. A substantial contribution to strengthening ties between VNIIBT and production and accelerating the adoption of new applications is being made by new equipment and technology testing divisions which the institute has in nine basic oil-producing regions.

In summarizing the results of the work of VNIIBT in collaboration with enterprises of Glavtyumenneftegaz with regard to the adoption and improvement of controlled-directional drilling, we may state that at present 95 percent of the operating wells in Tyumen' are being drilled in clusters. Clusters of five to twelve wells or more constitute production-technical facilities in which drilling and oil production are carried out without seasonal interruptions.

Another important problem being resolved with the active participation of VNIIBT is that of increasing the amount of drilling per bit. The fact that during the 9th Five-Year Plan the amount of drilling per bit within Glavtyumenneftegaz rose by 75.5 percent represents a substantial contribution by the institute, which took account of the specific nature of the geological profile of Western Siberia's oil fields in designing the LV-215.9MZG bit. This made it possible to drill wells of 1,800 meters in the Samotlor field with just two bits, and wells of 2,400 meters using just four; this was preceded by the drilling of wells with hydraulic-monitor bits at high pressure (220 to 250 kgf/cm^2. At present, the planned volume of such drilling is 500,000 meters per year.

In order to comprehensively study the effect of mud pressure on drilling effectiveness, the institute has set up a unique test-stand complex. To get an idea of the scale of the work, it is sufficient to note that a special building had to be built to accommodate the complex.

The institute is doing a great deal of work in Glavtyumenneftegaz to perfect turbine drilling equipment. It has proposed and delivered to the drilling enterprises low-speed spindle turbodrills of the 3TSSh-195TL type with precision-cast turbines, which can be replaced by plastic turbines when necessary.

The complex is also testing new types of turbodrills in order to further enhance the effectiveness of drilling operations.

As is well known, successful exploitation of oil and gas fields, also the yields and service life of the wells, to a large extent depends on the reliable segregation of oil, gas, and water bearing strata. Since 1971 the institute has been working to enhance the quality of well cementing by means of hydraulic packers. All of the institute's applications in this domain have been tested in Western Siberia--at the Samotlor, Var'yegan, Mikhnayskoye, Western Surgut, and other fields.

Hydraulic drilling packers of the PPG type for installation outside the string have been adopted, and at present work is underway on the adoption of more sophisticated hydraulic packers of the PGP type.

Acceptance tests have been completed on container packers of the PK type and packers of the PGB type for the hermetic sealing of the casing shoe.

By now, about 300 packers have been used in Glavtyumenneftegaz. In order to meet demand for this type of item, the institute has expended considerable effort on speeding up the practical production of rubber gaskets for packers at the Kazan' Industrial Rubber Goods Plant, also the production of shells and metal components of packers and the Kalush Nefteburm: hremont [Petroleum Drilling Machinery Repair Plant]. VNIIBT is also manufacturing experimental batches at its own plant in Kotovo.

An analysis of the results of operating wells equipped with packers designed for installation inside the casing in Glavtyumenneftegaz fields has confirmed the high effectiveness of using these packers, because they eliminate the negative influence of the plugging mud on the properties of the productive strata and increase well yields and extend the service life. The economic effect due to the use of one packer exceeds 12,000 rubles per year.

New and complex tasks face the drillers in the 10th Five-Year Plan.

One of the most important tasks involving the active participation of VNIIBT scientists is the development of an automated complex for the drilling of controlled-directional wells using bottom-hole engines. This work is coming to be of increasing importance, considering the fact that already it takes two bits to drill a well at Samotlor, and in the future it will take one bit. In order to do this it will be necessary to drill the well along the projected trajectory without lifting the tool and inserting the measuring apparatus to determine the bottom coordinates in order to further correct the direction of the borehole.

Another very important task is that of resolving a complex of problems with regard to perfecting the technology of opening productive strata at the Salmyskoye Field under complex geological conditions. Work is already underway on the selection of special drilling muds, the development of bottom engines (turbodrills and volume engines), and assured possibility of maintaining balance between formation and hydrodynamic pressures.

During the 9th Five-Year Plan, the commercial drilling speed in Glavtyumenneftegaz rose by 27.5 percent. In the current five-year plan, this indicator will continue to rise. The volume of drilling operations, which almost tripled during the 9th Five-Year Plan, will also rise.

Further progress in drilling in Western Siberia is impossible without constant modernization of the equipment and improved technology--that is, without the adoption of new scientific advances. Successful and fruitful collaboration between science and production, an excellent example of which is the many years of joint efforts by Glavtyumenneftegaz and VNIIBT, is the guarantee of successful implementation of the crucial tasks assigned to the drillers by the decisions of the 25th CPSU Congress.

6854
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FUEL AND RELATED EQUIPMENT

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GROZNEFT', VNIIBT COLLABORATION IN DRILLING TECHNOLOGY

Moscow BURENIYE in Russian No 6, Jun 78 pp 8-11

[Article by V. V. Petrov (Grozneft'): "Collaboration Between Science and Production on the Way to Mastering Great Depths"]

[Text] Grozneft' [Groznyy Petroleum Production Association] is one of the oldest in the Soviet Union. Probably many drillers have heard of the complex conditions of drilling wells in that area. Practically all types of complications that can arise in drilling are encountered there (mud absorption, caving, borehole narrowing, seepage, and so on).

Steeply-sloping strata with dip angles of 20 to 80 degrees, the alternation of zones of abnormally-high (AVPD) and abnormally-low (ANPD) formation pressures, and high bottom temperatures sometimes running as high as 160 to 230 degrees C at projected depths, considerably complicate the drilling process as well as the prevention and elimination of complications that arise.

In recent years, chiefly deep wells have been drilled in areas of Grozneft'. It is sufficient to note that of 76 drilling crews operating in the association, 63 are drilling wells with projected depths of more than 4,500 meters.

The maximum depth so far--7,501 meters--was reached in the drilling of well No 1 (Burunnaya).

All of the wells have multi-string construction providing for the insertion of five or six casing strings.

The drilling of deep wells is a complicated process which requires the handling of many problems. Naturally, these problems cannot be resolved without the undertaking of scientific research and experiments on the basis of the abundant production experience of leading collectives and crews. Efforts along these lines are underway in a number of scientific-research institutes.

Let us focus on the results of collaboration between VNIIBT [All-Union Order of Labor Red Banner Scientific-Research Institute of Drilling Technology] and Grozneft' in the domain of deep-well drilling.

In connection with the massive conversion to deep-well drilling, the association's collective faced the task of increasing commercial drilling speeds and sinking boreholes to the projected depths. To do this, they enlisted the help of VNIIBT.

All of the work was carried out in close contact between Grozneft', VNIIBT, and SevkavNIPIneft' [North Caucasus Scientific-Research and Planning Institute of Petroleum]. Together they carried out a profound analysis of the status of the equipment and technology of drilling operations in that region and found a number of basic problems which had to be resolved:

1. The formulation of measures to prevent borehole deviation at all intervals, especially when drilling borehole segments of 394, 190, and 140 millimeters diameter.

2. The development of a highly-productive rock-breaking tool in order to substantially increase the amount of drilling per ram.

3. Development of the technology and technical means for drilling with regulation of the pressure differential in the well-strata system under conditions of AVPD and ANPD.

4. Development of the technical means to make it possible to optimalize drilling specifications using cone bits of new design and bits in series production.

5. Development of the technical means making it possible to improve the quality of the cementing of casing strings under conditions of small annular clearances (six to eight millimeters).

In order to find the most effective technical means to prevent well deviation, Grozneft' collaborated with VNIIBT and SevkavNIPIneft' to draw up a program of projects to test this equipment. The program included layouts of the drill string bottom designed by VNIIBT, including RTB's [jet-turbo drills], TVK-240 turbodrills with rotating body, pilot reamers of the RDU and ROP type in combination with high-torque A9GT, A9GTSh, and TVK-240 turbodrills, and also a number of layouts for rotary drilling.

As a result of these efforts, the optimal ranges of application were found for the technical means and methods of drilling, making it possible to drill boreholes of 394 millimeters diameter down to depths of 3,000 to 3,300 meters under complicated geological conditions with dip angles of up to 80 degrees.

The technical-economic indicators achieved in adopting these technical means and methods of drilling make it possible to assert that the task of preventing deviation of the borehole under the first 324-millimeter intermediate string has been practically resolved. Solutions have also been found for problems of preventing pipe abrasion as a result of bends, failure of the strings to reach the projected depth, and so on.

Between February 1974 and October 1975, the association's drilling enterprises were all outfitted with high-torque sectional turbodrills and jet-turbine drills of the latest design.

It is no less important to maintain borehole verticality when drilling in Cretaceous and Jurassic deposits with bits of 140 and 190 millimeters. The geological-technical conditions are such that in some cases borehole deviation ranged as high as 35 to 40 degrees, and the rate of increase in zenith angle ranged between 8 and 10 degrees per 100 meters. Drilling under such conditions was complicated by the formation of grooves in the walls of the wells, resulting in lagging and jamming of the drill tool.

In order to prevent deviation, the load on the bit was reduced to 3-4 tf for wells of 140 millimeters diameter and 5-6 tf for wells of 190 diameters, but of course, these loads were not optimal.

VNIIBT developed and, in collaboration with the association, tested under industrial conditions a technology of rotary drilling using bits of 140 and 180-190.5 millimeters diameter with on-bit stabilizing devices of the NSU type. On the basis of experimental drilling it was found that in compliance with this technology the load on a conical bit could be increased by 2 to 2.5 times compared with the load created on bits during drilling without the use of NSU's, keeping the intensiveness of deviation of the borehole within the allowable limits and at the same time approximately doubling the amount of drilling per bit and the mechanical drilling speed.

The rotary drilling technology, using NSU's, was recommended for adoption.

The multi-string structure of the wells and the presence of rocks differing sharply in hardness made it necessary to use a large array of bits in well drilling. It is sufficient to note that the diameter of boreholes ranges between 490 and 105 millimeters, and the bit type ranges between M and T.

As is well known, the proper selection of bits substantially speeds up the drilling of deep wells and makes them cheaper; for this reason, much attention has been focused on testing new bits in recent times.

In collaboration with VNIIBT and SevkavNIPIneft', the association tested more than 15 type-sizes of new bits of series AN and AV between 1975 and 1977. During the testing of all the bits, the amount of drilling per bit, mechanical drilling speeds, and durability were increased by 25 to 220 percent compared with series-produced bits.

Within Grozneft', the volume of drilling by means of loaded muds comes to 70 to 72 percent of the total. The solid phase content in these muds ranges between 50 and 60 percent, sometimes reaching 80 percent. Most advantageous under such conditions is the use of cone bits of the 2AN and 3AN series having hermetically-sealed oil-filled support with slide bearings.

3AN-190.5MZG bits were tested in the drilling of Yastrebinaya Well No 106 and Andreyevskaya Well No 1007 in Lower Maykop deposits. In the drilling of well No 106 between 4,560 and 4,942 meters, the amount of drilling per 3AN bit exceeded that of the 1AN bit by 4.5 times while increasing the durability of the support by 2.9 times. In the drilling of well No. 1007, flushed by means of mud with a density of 1.98 g/cm3 the interval 5,055 through 5,120 meters was completed by one 3AN bit in 54 hours. The amount of drilling with a Romanian-made bit was only 13 to 17 meters--that is, 4.5 to 5 times less.

In the drilling of Starogroznenskaya Well No 712 with a 2AN-190.5SZGU bit, 324 meters were drilled in the 3,893--4,217 meters interval in Upper Cretaceous deposits at a mechanical speed of four meters per hour--that is, the work indicators of the series-made bits were exceeded by five times.

Adoption of the 3AN and 2AN series bits now undergoing industrial testing will unquestionably improve the technical-economic indicators of drilling.

Above all, reducing the number of bits used means preventing wear and tear on casing strings, which in turn makes it possible to simplify well construction and to reduce the amount of time spent on casing work as well as auxiliary operations and idleness due to the preparation of casing pipes for insertion. All of these time outlays add up to 25 percent of all calendar drilling time.

In 1976-1977 there was an increase in volumes of drilling using diamond bits outfitted with both natural and artificial diamonds. This is due, on the one hand, to the greater well depths, which more fully reveal the advantages of unsupported bits having tougher implements, and, on the other, the improved technology of drilling for the opening up of Upper Cretaceous deposits characterized by potential absorption.

It should be pointed out that the use of MDR-115ST-1 diamond bits developed by VNIIBT and the Institute of Super Hard Materials made it possible to extend the bottom of Burunnaya Well No 1 to 7,501 meters.

An analyses of the operating results of diamond bits has demonstrated their high potential. Thus, in the drilling of Braguna Well No 73 one MDI-140ST-1 bit completed 410 meters in the Upper Cretaceous deposits (the interval between 4,776 and 5,186 meters). In the drilling of Oktyabr'skaya Well No 250 one bit completed 350 meters in the 4,576--5,068 meter interval in the same deposits. Using just one or two bits it is possible to open up the Upper Cretaceous deposits throughout the entire interval.

However, expansion of the domain of application of diamond bits is being held back by the limited availability of high-strength weighted drill pipes and pipes of 73.89 and 114 millimeters diameter equipped with threaded safety connections.

Among the most promising trends in increasing the technical-economic indicators of deep-well drilling are the work-testing and adoption of drilling technology utilizing regulation of the pressure differential in the well-stratum system. Efforts to resolve this complex problem with regard to the conditions characteristic of Grozneft' oilfields at present are now jointly underway with the collaboration of the association, VNIIBT, SevkavNIPIneft', KOVNIIpromneftegeofizika [Caucasus Department of the All-Union Scientific-Research Institute of Petroleum Industry Geophysics], and Grozneftegeofizika [Groznyy Petroleum Geophysics Trust]. They have drawn up an integrated program of scientific-research work.

In 1976-1977, the technology of drilling with regulation of differential pressure when drilling through AVPD zones was used in part in the drilling of some of the segments of Zamankul Well No 86 and Braguna Well No 76. The results of these efforts are quite encouraging.

In the drilling of Well No 86, in the interval between 4,120 and 4,392 meters, the amount of drilling per bit and the mechanical drilling speed were approximately doubled, while the amount of chemical reagents consumed and other outlays were reduced; overall, this made it possible to save 410 rubles per meter in the interval of application.

In drilling between 1,913 and 4,880 meters in Braguna Well No 76 it became possible, thanks to careful compliance with optimal correlations between pressures in the well-stratum system, to avoid all complications, to substantially raise the technical-economic indicators, and to simplify the well construction compared with the project plan.

It should be mentioned that the technology of drilling with regulated differential pressure has been widely tested in the opening up of Upper Cretaceous deposits, and in some areas the use of this technology alone has made it possible to open up the entire interval of these deposits, making it possible to explore lower strata.

In the process of drilling deep wells within Grozneft' it is necessary to drill through six or seven intervals that differ in terms of drillability, which accounts for the multi-string structure of the wells.

Failure of any of the strings to reach the stipulated depth makes it impossible to sink the well to the projected depth. At the same time, the insertion of strings in cases of small annular clearances and substantial seepage under the shoes requires considerable time to prepare the borehole (repeated gauging and testing of the borehole using complicated layouts). Moreover, the desired results are not always achieved.

Difficulties due to small annular clearances also arise in the cementing of inserted strings.

VNIIBT has proposed an expandable reamer designed to increase the diameter of the borehole over the dimensions of the inserted casing string. The use of this reamer provides a practical solution to the above problems.

Reamers have been designed to fit the conditions of drilling in Grozneft' oilfield areas; they make it possible to enlarge the borehole from 190 to

230 millimeters under the shoe of an inserted 219-millimeter casing string (RRB-190/230), also RRB-243/285 and RRB-295/345, designed to enlarge the borehole prior to inserting casing strings of 219 and 273 millimeters.

The RRB-190/230 has undergone acceptance tests, and the RRB-295/345 is undergoing tests. In all wells where these reamers have been used, the insertion and cementing of 273-millimeter casing strings have gone without complications.

Unquestionably, increasing the volumes of the use of RRB reamers will make it possible to resolve one of the most complex problems involved in casing deep wells.

It should be mentioned that the fruitful collaboration between Grozneft' drillers and VNIIBT has been largely facilitated by the considerable organizational work carried out by the association and the VNIIBT department set up in Groznyy.

At present, the pattern of conducting tests on new equipment works this way:

All UBR's [administrations of drilling operations] receive detailed information concerning the availability and technical specifications of new equipment or concerning the technological process as a whole. On the basis of this information, they make suggestions as to which objects can make the most effective use of this equipment or technology for testing and adoption.

Suggestions made by the UBR's are examined jointly by the association's drilling technology division and the Groznyy division of VNIIBT and are then incorporated in the testing schedule plan to be approved every month by the association's management. Implementation of the scheduled plan is the responsibility of the chiefs of the technology divisions of the UBR's jointly with the Groznyy division of VNIIBT.

The results of the tests are brought to the attention of the engineering-technical personnel of the UBR and discussed at various seminars.

The program of instruction for drillers and assistant drillers in the training-coursework combine now includes a section for the study of new VNIIBT equipment that has completed or is undergoing tests in the association's oilfields.

Thus, extensive creative collaboration between science and production is substantially enhancing the quality of testing of new equipment, speeding up its inauguration into series production, and helping to facilitate the adoption of new technological applications.

According to forecasts, most of the petroleum reserves which will serve as the basis in the current five-year plan and in later years for the development of the republic's oil industry are confined to the interval between 5,500 and 8,000 meters; this gives rise to many problems, the solution to which will assign a key role to scientists of VNIIBT.

6854
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FUELS AND RELATED EQUIPMENT

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DEVELOPMENT, SPREAD OF ELECTRIC DRILLING

Moscow BURENIYE in Russian No 6, Jun 78 pp 17-19

[Article by Ya. A. Gel'fgat, F. N. Fomenko, and A. F. Kononov (VNIIBT): "Status and Prospective Development of Electric Drilling of Oil and Gas Wells"]

[Text] VNIIBT [All-Union Order of Labor Red Banner Scientific-Research Institute of Drilling Technology] has been involved with problems of developing equipment and technology for electric drilling since the institute was created, that is, since 1953.

Until 1964, problems of designing various kinds of electric drills of 164, 170, 215, and 250 millimeters diameter, and their testing under industrial conditions, were the concern of SKTBE [Special Design-Technology Bureau for the Planning of Electrical Equipment], which was set up in the electrical equipment industry system.

Later on these projects were continued in SKTBE while VNIIBT became involved with the development of electric drilling technologies: determining the rational domains .: its application and the power and technology parameters of electric drills, formulating the technical specifications on electric drills and other equipment involved with electric drilling, conducting tests of technical devices, accepting them for series production, and working out the technology of drilling utilizing the new technical devices.

The amount of electric drilling in all oil and gas wells since 1963 throughout the sector as a whole comes to 4.5 million meters. At present, electric drilling is used in Bashneft' [Bashkir Petroleum Production Association], Turkmenneft' [Turkmen Petroleum Production Association], Azneft' [Azerbaydzhan Petroleum Production Association], and Ukrneft' [Ukrainian Petroleum Production Association]; experimental work on its utilization is underway in Glavtyumenneftegaz [Main Tyumen' Petroleum and Gas Administration].

The present inventory of electric bottom engines includes high-torque electric drills of 164, 185, 240, and 290 millimeters diameter with variable bit rotation speeds ranging between 700 and 70 RPM. This broad range of rotation speeds has been achieved through the use of oil-filled geared inserts produced in series along with the electric drills.

The possibility of regulating the bit's rotation speed at high torque and the fact that the power parameters are independent of the type and quality of the working agent circulating in the well make it possible to conduct drilling operations under very complex geological conditions while maintaining the optimal correlations of bit load and number of rotations to achieve good results.

To improve electric drilling indicators, use is made of other technical means:

bottom-hole telesystems which, in conjunction with current feed, make it possible to control and effectively direct the well's trajectory;

deviation mechanisms of 164, 185, and 240 millimeters diameter making it possible to bend the borehole at the rate of one to three degrees for every ten meters;

double-deviation mechanisms of 164 and 240 millimeters diameter making it possible to bend boreholes at the rate of four to seven degrees for every ten meters, to be used in drilling manifold-horizontal wells;

diesel-electric units providing independent power to the electric drill in regions without electrificiation.

The following are in the development stage:

multi-electrode logging probes for carrying out a complex of field-geophysical work in gently-inclined boreholes;

a complex of electric drilling equipment and drilling tools for drilling operations using an electric drill of 127 millimeters diameter in vertical, inclined, and manifold-horizontal wells;

a variable whipstock.

These technological characteristics and technical devices of electric drilling have made it possible in recent years to achieve high technical-economic indicators in well drilling and to motivate a number of oil-producing associations to adopt and further develop this means of drilling.

The following domains of advantageous application of electric drilling have been determined:

the drilling of wells down to 3,000 to 5,000 meters in depth using loaded muds of densities of up to 2.3 g/cm^3;

the drilling of controlled-directional wells;

the drilling of manifold-horizontal wells;

the drilling of wells using gaseous agents;

the drilling of reference-technology wells.

Using the example of Turkmenia it is possible to demonstrate the economic effectiveness of electric drilling under complex geological conditions using loaded muds. At present, electric drills are being used successfully there to drill a number of deep wells in areas with abnormally high formation pressures: Kotur-Tepe No 808 (5,042 meters), Kotur-Tepe No 809 (4,700 meters), and Komsomol'skaya No 27 (4,803 meters). The best results were achieved in drilling the latter well; compared with the best indicators achieved in drilling Barsa-Gel'mes Well No 52 by the rotary method under similar conditions, the commercial speed was increased by 1.8 times (see table).

Indicators	Barsa-Gel'mes Well No 52	Komsomol'skaya Well No 27
Depth, meters	4851	4803
Commercial drilling speed, meters per rig-month	222	400
Technical drilling speed, meters per rig-month	384	600
Mechnical drilling speed, meters per hour*	3.04/3.80	5.80/6.08
Round-trip drilling speed, meters per hour*	1.60/1.70	2.20/2.54
Amount drilled per bit, meters*	33.00/35.00	35.05/43.50

*The numerator indicates the well as a whole (including core bits); the denominator indicates only the bits for full-hole drilling.

High technical-economic indicators have been achieved in the electric drilling in this area, using bits of different diameter--394, 269, 214, and 190 millimeters.

In the drilling of controlled-directional wells, the effectiveness of electric drilling is increased even more; for this reason, almost all such wells in Turkmenneft' are drilled with electric drills in conjunction with bottom-hole telemetry systems.

Electric drilling is being used most extensively for controlled-directional wells in Bashneft'. Thanks to more thorough working of the bits, the advantages of directing the trajectories of controlled-directional wells, and the possibility of using mud fillers when passing through absorption zones (including the use of loaded muds), electric drilling achieves higher commercial speeds at less cost than in the case of turbine drilling.

In 1976, Bashneft' used electric drills to complete 119,000 meters; in 1977, the figure was 130,000; in 1978, the planned figure is 150,000.

Bottom-hole telemetry devices, effective whipstocks, and the possibility of controlling the operating specifications of the bit and carrying out field-geophysical measurements in a gently-inclined borehole have given electric drilling advantages which make it possible to consider this method as being the best possible one for drilling deep controlled-directional wells, especially in complex geological conditions.

It is for this reason that the Dolina UBR [Administration of Drilling Operations] of Ukrneft' is using only electric drills to sink controlled-directional wells, while a number of wells drilled by means of turbodrills had to be converted to electric drilling because of the substantial difficulties involved in deepening operations (Spas No 401 and 74, Dolina No 693, and Severnaya Dolina No 160 and 129).

For the same reason, in 1977 directional deep-well No 77 in Borislav UBR was also converted from the turbine method to electric drilling and was successfully completed at 3,500 meters. Plans also call for converting of more controlled-directional wells to electric drilling, and such wells will now be started by means of electric drilling.

The technological advantages of electric drilling are even more sharply manifested in the drilling of ten manifold-horizontal wells 3,000 meters deep in the Dolina UBR. The drilling of all these wells under complex geological conditions was completed in accordance with the calculated profile. Moreover, a substantial economic effect was achieved. The daily outputs of some of the wells ranged between 70 and 150 tons of oil.

The possibility of using air and foam to clean the bottom hole in electric drilling has made it possible to drill effectively through hard rock and to open up absorbing horizons, thus raising the technical-economic indicators of drilling controlled-directional wells under complex geological conditions through the use of integrated technology.

For example, in Nadvornaya UBR of Ukrneft' the amount of drilling per bit was increased by six to ten times and the mechnical drilling speed was increased by three to five times in the drilling of a number of controlled-directional and vertical wells by means of electric drills and air-blasting in the 0-2,000 meter interval.

For use in the drilling of controlled-directional wells, a telemetry system has been developed that is capable of operating at a high vibration level.

In 1977 in the Zagly-Zeyva area of Azneft', drilling was completed on a cluster of three controlled-directional wells of an average depth of 2,200 meters; two of them involved the foam clearing of the borehole bottom in the 0-1,100 meter interval. Indicators of the drilling of these wells were substantially higher than those achieved earlier with the turbine method, in particular the commercial speed rose by 1.67 times. The economic effect in drilling the experimental cluster amounted to 128,900 rubles. The accuracy of the direction and the quality of the boreholes were considerably improved.

The experimental electric drilling, in 1976, of a cluster of wells in the Ust'-Balyk area gives reason to assert that this method can be utilized effectively in Western Siberia thanks to the high accuracy of drilling wells in this profile, reduction in the amount of time spent on geophysical work thanks to the use of geophysical apparatus inserted into the drill pipes, and higher bit performance indicators.

This latter is due to the fact that the drilling can be accomplished under any technologically essential axial loads and speeds of bit rotation, while differential pressures on the borehole bottom are reduced thanks to lower hydraulic resistances in the annular space, because with electric drilling it is permissible to reduce the amount of mud consumed.

In Western Siberia, the electric drilling method should obviously be used to drill controlled-directional wells more than 2,500 meters deep, when standards of accuracy for the borehole trajectory are higher, and also for the drilling of manifold-horizontal wells.

Considering the results achieved in recent years, it is advisable to continue to increase volumes of electric drilling in regions where it is being used now and to start using it in regions where we may anticipate a substantial economic effect.

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FUELS AND RELATED EQUIPMENT

UKRAINIAN COAL INDUSTRY RESULTS FOR NINE MONTHS

Kiev UGOL' UKRAINY in Russian No 12, Dec 78 pp 50-51

[Article: "Coal Industry of the Ukrainian SSR for 9 Months of 1978"]

[Text] In 9 months of 1978 the miners of the republic brought to the surface 158.09 million tons of coal. The plan for coal mining was successfully fulfilled by the associations Donetskugol', Ordzhonikidzeugol',Torezantratsit, Krasnodonugol', Pavlogradugol' and Ukrzapadugol'. According to the Ukrainian SSR Ministry of the Coal Industry the plan for coal mining for coking was fulfilled by 99.3%.

According to the condition on 1 October 1978 the Ukrainian SSR coal industry had 1,591 active working faces, the average monthly progress of the faces was 37.1 m, and the average daily load on the longwall--373 T (table 1). As compared to the analogous period of 1977 the number of comprehensively mechanized working faces rose from 443 to 462 at the strata with angle of incidence to 35°, and from 41 to 43 at the strata with angle of incidence over 35°. In the comprehensively mechanized longwalls on sloping and inclinded strata 73.03 million T of coal were mined, or 3.3% more than in the analogous period of last year (table 2); in the longwalls equipped with grading units--3.62 million T of coal, or 31.8% less than in January-September of 1977. In the comprehensively mechanized working faces at strata with angle of incidence over 35° 2.21 million T of coal were extracted, or 20.2% more than in the 9 months of 1977.

In the examined period of the current year 2169.9 km of all the preparatory shafts were sunk in the mines of the Ukraine, including 1409.4 km of stripping and preparing (table 3). As compared to the data for 1977 the volume of footage of all the shafts was lower by 3.6 km, while of stripping and preparing shafts--higher by 12.8 km. The volume of footage of the preparatory shafts with mechanized loading of the coal and rock was 1470.6 km, which is 0.1% greater than for the 9 months of 1977 (table 4). A considerable part of the shafts--412.2 km were sunk with the use of more advanced mining drilling technology--combines. At the concentrating factories of the Ukrainian SSR Ministry of the Coal Industry 99.51 million T of coal were processed and 60.41 million T of concentrate were produced (table 5). The

Table 1.

(1) Производственные объединения	(2) Добыча угля, тыс. т	(3) Кол-во действующих очистных забоев	(4) Среднедействующая линия очистных забоев, км	(5) Среднемесячное подвигание действующих очистных забоев, м	(6) Суточная нагрузка, т	
					(7) на действующий забой	(8) на шахту-разрез (адм. единицу)
Донецкуголь (9)	16 319	176	32,18	31,1	361	2914
Макеевуголь (10)	11 708	138	21,75	32,3	328	3330
Красноармейскуголь (11)	10 274	76	12,87	45,4	522	3688
Добропольеуголь (12)	8 280	41	7,41	62,1	854	3645
Артемуголь (13)	8 853	203	21,78	32,8	158	2326
Орджоникидзеуголь (14)	4 707	99	10,86	31,4	179	1859
Шахтерскантрацит (15)	9 376	101	16,83	35,0	372	1960
Торезантрацит (16)	8 288	89	13,70	32,8	366	2031
Ворошиловградуголь (17)	8 763	72	12,03	40,6	469	3132
Стахановуголь (18)	7 558	116	18,99	29,0	248	1560
Первомайскуголь (19)	7 327	84	16,68	28,2	336	1800
Краснодонуголь (20)	6 789	55	7,66	48,0	489	2737
Донбассантрацит (21)	16 830	154	26,33	34,2	439	3030
Свердловантрацит (22)	6 899	36	5,90	58,7	681	2100
Павлоградуголь (23)	6 676	53	7,82	58,6	530	3286
Укрзападуголь (24)	11 220	92	11,59	52,9	537	2236
Александрияуголь (25)	8 161	12	0,96	63,8	271	3976
Минуглепром УССР (26)	158 087	1597	244,37	37,1	373	2571

Key:

1. Production association
2. Coal mining, thousand T
3. Number of active working faces
4. Mean active line of working faces, km
5. Mean monthly advance of active working faces, m
6. Daily load, T
7. for active face
8. for mine pit (adm. unit)
9. Donetskugol'
10. Makeyevugol'
11. Krasnoarmeyskugol'
12. Dobropol'yeugol'
13. Artemugol'
14. Ordzhonikidzeugol'
15. Shakhterskantratsit
16. Torezantratsit
17. Voroshilovgradugol'
18. Stakhanovugol'
19. Pervomayskugol'
20. Krasnodonugol'
21. Donbassantratsit
22. Sverdlovantratsit
23. Pavlogradugol'
24. Ukrzapadugol'
25. Aleksandriyaugol'
26. Ukrainian SSR Ministry of the Coal Industry

plan for processing coal on units of mechanized sorting was fulfilled by 100.7%. The plan for the production of coal briquets was mastered by 101%, and the plan for production of lignite briquets by 84.5%.

Due to the unsatisfactory work of individual enterprises the plans were underfulfilled for a number of economic indices, with the exception of the plan for labor productivity of a worker for mining, which on the whole for the Ukrainian SSR Ministry of the Coal Industry was fulfilled by 100.2%.

Table 2.

(1) Производственные объединения	(2) Комплексно механизированные забои, оборудованные комбайнами и стругами на пластах с углом падения до 35°			
	(3) Количество	(4) Добыча, тыс. т	(5) % к добыче из действующих очистных забоев на пластах с α < 35°	(6) Нагрузка на лаву, т
Донецкуголь (7)	47	7706	48,9	650
Макеевуголь (8)	36	5459	50,4	645
Красноармейскуголь (9)	45	6183	64,9	608
Добропольеуголь (10)	30	6113	79,9	962
Шахтерскантрацит (11)	16	2440	27,0	516
Торезантрацит (12)	32	4193	56,1	561
Ворошиловградуголь (13)	23	3967	53,5	734
Стахановуголь (14)	11	1357	22,5	478
Первомайскуголь (15)	11	1522	23,9	582
Краснодонуголь (16)	31	4668	85,6	715
Донбассантрацит (17)	42	7397	48,8	706
Свердловантрацит (18)	28	5947	92,2	776
Павлоградуголь (19)	45	5805	91,0	583
Укрзападуголь (20)	53	8094	74,2	706
Александрияуголь (21)	12	2178	100,0	871
Минуглепром УССР (22)	402	73 029	57,6	673

Key:

1. Production association
2. Comprehensively mechanized faces, equipped with combines and graders at strata with angle of incidence to 35°
3. Number
4. Mining, thousand T
5. % of mining from active working faces at strata with α< 35°
6. Load on longwall, T
7. Donetskugol'
8. Makeyevugol'
9. Krasnoarmeyskugol'
10. Dobropol'yeugol'
11. Shakhterskantratsit
12. Torezantratsit
13. Voroshilovgradugol'
14. Stakhanovugol'
15. Pervomayskugol'
16. Krasnodonugol'
17. Donbassantratsit
18. Sverdlovantratsit
19. Pavlogradugol'
20. Ukrzapadugol'
21. Aleksandriyaugol'
22. Ukrainian SSR Ministry of the Coal Industry

Many collectives of the leading worker brigades have labored successfully this year. The socialist commitments for the examined period were fulfilled by the mining brigades of A. D. Polishchuk from the mine "Trudovskaya" of the association Donetskugol' that mined 779,700 T of coal, of N. N. Skrypnik from the mine imeni Frunze of the association Donbassantratsit (812,500 T), of V. I. Ignat'yev from the mine "Krasnolimanskaya" of the association Dobropol'yeugol' (459,500 T), of G. I. Motsak from the Kosmonavty mine of the association Donbassantratsit (489,000 T), of V. M. Borisenko from the Lenin mine of the association Voroshilovgradugol' (423,100 T), and others.

Table 3.

Производственные объединения (1)	Проведение подготовительных выработок (2)					
	всех (3)			вскрывающих и подготавливающих (4)		
	План, км (5)	Факт., км (6)	% к плану (7)	План, км (5)	Факт., км (6)	% к плану (7)
Донецкуголь (8)	216,6	219,5	101,3	156,0	157,7	101,1
Макеевуголь (9)	160,0	160,9	100,6	111,5	111,1	99,6
Красноармейскуголь (10)	125,9	111,8	88,8	112,2	96,4	85,9
Добропольеуголь (11)	134,5	128,9	95,8	90,5	79,0	87,3
Артемуголь (12)	253,9	252,9	99,6	123,8	123,9	100,1
Орджоникидзеуголь (13)	103,8	100,3	96,5	54,4	53,1	97,6
Шахтерскантрацит (14)	106,7	107,2	100,5	71,8	72,3	100,7
Торезантрацит (15)	94,0	97,9	104,1	63,3	63,2	99,8
Ворошиловградуголь (16)	131,6	129,4	98,3	73,7	73,8	100,1
Стахановуголь (17)	158,9	161,6	101,7	91,6	93,3	101,9
Первомайскуголь (18)	120,4	113,0	93,9	84,2	81,3	96,5
Краснодонуголь (19)	98,8	96,3	97,4	61,3	59,7	97,4
Донбассантрацит (20)	202,0	198,4	98,2	104,4	103,7	99,3
Свердловантрацит (21)	78,7	80,9	102,8	54,3	52,8	97,1
Павлоградуголь (22)	84,9	82,5	97,2	79,1	77,4	96,6
Укрзападуголь (23)	100,9	103,8	102,9	86,4	88,4	102,3
Александрияуголь (24)	23,1	24,3	105,2	21,2	22,3	105,2
Минуглепром УССР (25)	2194,7	2169,6	98,9	1439,7	1409,4	97,9

Key:

1. Production association
2. Driving of preparatory shafts
3. of all
4. of stripping and preparing
5. Plan, km
6. Actual, km
7. % of plan
8. Donetskugol'
9. Makeyevugol'
10. Krasnoarmeyskugol'
11. Dobropol'yeugol'
12. Artemugol'
13. Ordzhonikidzeugol'
14. Shakhterskantratsit
15. Torezantratsit
16. Voroshilovgradugol'
17. Stakhanovugol'
18. Pervomayskugol'
19. Krasnodonugol'
20. Donbassantratsit
21. Sverdlovantratsit
22. Pavlogradugol'
23. Ukrzapadugol'
24. Aleksandriyaugol'
25. Ukrainian SSR Ministry of the Coal Industry

There has been a significant increase in the number of brigades that are driving preparatory shafts by high-speed methods. In 1977 they numbered 165, and this year 183 brigades drove 318.07 km of shafts. In the 9 months of 1978 the planned volume of state capital investments was assimilated on the whole for the Ukrainian SSR Ministry of the Coal Industry by 98%, including the plan for construction and assembly work by 97%; for facilities of production purpose the plan for the assimilation of capital investments was fulfilled by 98%, including the plan for construction and assembly work by 98%.

Table 4.

(1) Производственные объединения	(2) Проведение подготовительных выработок с механизированной погрузкой угля и породы				
	(3) План, км	(4) Факт, км	(5) % к общей длине проведения выработок, где требуется погрузка	(6) в т. ч. комбайнами: (3) План, км	(4) Факт, км
Донецкуголь (7)	174,8	174,9	79,7	57,3	56,7
Макеевуголь (8)	113,7	114,9	74,7	32,0	32,9
Красноармейскуголь (9)	91,4	83,6	74,8	27,1	26,9
Добропольеуголь (10)	123,7	134,0	96,2	85,8	87,6
Артемуголь (11)	120,7	120,7	99,9	7,0	5,7
Орджоникидзеуголь (12)	49,0	51,1	96,2	0,8	0,8
Шахтерскантрацит (13)	69,0	69,0	64,4	13,1	13,1
Торезантрацит (14)	62,2	62,3	63,6	6,6	3,7
Ворошиловградуголь (15)	92,0	92,0	75,4	16,9	16,9
Стахановуголь (16)	108,0	110,6	80,1	7,0	5,8
Первомайскуголь (17)	77,2	72,3	69,1	5,5	4,3
Краснодонуголь (18)	65,0	65,6	83,8	13,5	12,6
Донбассантрацит (19)	101,8	95,8	55,2	5,4	4,0
Свердловантрацит (20)	51,0	48,5	60,0	1,2	0,1
Павлоградуголь (21)	81,8	80,4	97,7	77,7	76,4
Укрзападуголь (22)	83,0	85,2	82,1	44,4	45,0
Александрияуголь (23)	18,7	19,7	81,1	18,7	19,7
Минуглепром УССР (24)	1483,0	1470,6	77,4	420,0	412,2

Key:

1. Production association
2. Driving of preparatory shafts with mechanized loading of coal and rock
3. Plan, km
4. Actual, km
5. % of total length of driving of shafts where loading is required
6. including with combines
7. Donetskugol'
8. Makeyevugol'
9. Krasnoarmeyskugol'
10. Dobropol'yeugol'
11. Artemugol'
12. Ordzhonikidzeugol'
13. Shakhterskantratsit
14. Torezantratsit
15. Voroshilovgradugol'
16. Stakhanovugol'
17. Pervomayskugol'
18. Krasnodonugol'
19. Donbassantratsit
20. Sverdlovantratsit
21. Pavlogradugol'
22. Ukrzapadugol'
23. Aleksandriyaugol'
24. Ukrainian SSR Ministry of the Coal Industry

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Table 5

(1) Показатели	(2) План, тыс. т	(3) Выполнение плана		
		(4) тыс. т	(5) % к плану	(6) % к 9 мес 1977 г.
Переработка угля на обогатительных фабриках (7)	103 420	99 512	96,2	97,6
Переработка угля на установках механизированной породовыборки (8).	8 469	8 529	100,7	91,8
Выпуск концентрата (9)	62 545	60 407	96,6	97,6
Выпуск углей крупных и средних классов (10)	20 123	18 998	94,4	96,1
В т. ч. антрацитов . (11)	14 310	13 400	93,9	95,7

Key:

1. Indices
2. Plan, thousand T
3. Fulfillment of plan
4. thousand T
5. % of plan
6. % of 9 months of 1977
7. Processing of coal in concentrating factories
8. Processing of coal on mechanized sorting units
9. Output of concentrate
10. Output of coals of large and medium classes
11. Including anthracites

9035
CSO: 1822

END