31 JULY 1979 (FOUO 19/79) 1 OF 1

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31 July 1979

USSR Report

RESOURCES

(FOUO 19/79)

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USSR REPORT

RESOURCES

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FUELS AND RELATED EQUIPMENT

UDC 622.245.123:622.245.6

SWIVEL DEVICE FOR CASING OIL WELLS DESCRIBED

Moscow BURENIYE in Russian No 4, Apr 79 signed to press 15 Aug 78 pp 24-27

[Article by V. V. Vaulin, V. B. Nazarov and G. V. Golovanov of Grozneft' [Groznyy Association of the Petroleum Industry] and SevkavNIPIneft' (North Caucasus Scientific-Research and Design Institute for the Petroleum Industry]: "Casing off Wells with Liners and Casing String Sections with the Use of a Swiveling Suspension Device"]

[Text] A method for casing wells with liners and also for lowering casing string in sections has found wide application in recent years in many petroleum-producing regions of the Soviet Union where deep drilling is going on with the use of wells of multiple-string design. The Grozneft' association calls for, in almost every well design, the lowering of one or two liners and the overwhelming majority of casing strings are being lowered in sections. Because of this, questions of sectional lowering acquire special urgency.

Since the technologies for lowering and cementing sections of casing string and of liners are basically identical, in the following description the concept "sections of casing string" relates also to liners in equal degree The installation of a section of a string that rests on the bottom hole is prohibited by existing instructions [1], to avoid bending and violation of the string's integrity. Casing string sections should be suspended in the well by means of one of the following well-known methods: suspension on wedges, suspension on a support, or suspension on a cement rock [2].

In Grozneft', as in other organizations that are drilling deeply, the method of suspending casing string sections on a cement rock has found widest application.

The main advantages of this method are the potential for suspending a section of the string in any part of a cased or uncased well bore and simplicity of design of the string hanger and the suspension technology.

At present, diverse designs for string hangers for suspending sections on a cement rock are being used, one of which is shown in figure 1.

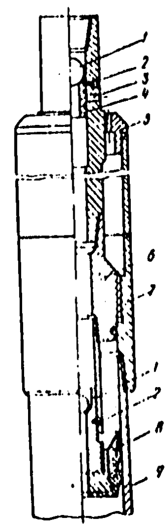


Figure 1. Design Variant for a String Hanger on a Cement Rock.

1. Control balls.
2. Cut stud bolts.
3. Flushing orifice.
4. Sleeve.
5. Cover.
6. Nipple of threaded string disconnector.
7. Coupler of threaded string disconnector.
8. Lower suspension part of two-section disconnector plug.
9. Casing pipe

The devices indicated have common deficiencies.

1. The necessity for leaving the drill pipe, on which the section of casing string is lowered, in a fixed position throughout the whole period of the OZTs [waiting for the cement to harden], and, where there is large section weight and small annular clearance, when reciprocation of the string is not permissible because of the possibility of serious complications, also throughout the whole preceding OZTs period. This can lead to sticking of the drill pipe by the cement solution that is setting and is not driven out from the dead zone where the drill string is stationary, and also to "adhesion" of the drill string at the intervals of deposition of the permeable rocks.

2. The necessity for discharge of a ball for cutting off the suspended upper string of the disconnector plug and a second ball for opening the flushing orifices in the string hanger. This occasions instability of the process and the dependence of it upon chance (the ball getting caught, stoppage of the cementing units, and so on).

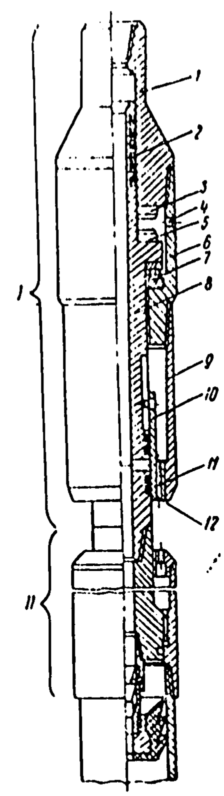
3. Difficulties during disconnection of the drill pipe from the casing; and jamming of the left-handed thread, caused by the complexity of removal of the load from the left-handed thread of the threaded string disconnector at the moment of turning away.

Taking the deficiencies of existing designs into account, devices are being developed that will permit casing string sections to be cemented without resting upon the bottom hole, rotation of the drill pipe string during the OZTs, and, in so doing, flushing of the well above the upper part of the section [2-5].

In Grozneft', work on the creation of similar devices has been going on since the end of the 1960's. A group of Grozneft' workers and SevkavNIPIneft' staff workers has developed a design for a swiveling suspension VPU-1 device with a threaded string disconnector (figure 2).

This device consists of a body 6 with an adapter 1 joined to it and a case 9, a core 8, and a thrust bearing 7, and a movable sleeve 10 that covers a radial flushing orifice in the core 8.

Figure 2. Swiveling Suspended Device VPU-1 (I) with Threaded String Disconnector (II).



On the core 8 and adapter 1 are cams 3 and 5 which, acting mutually, transmit torque to the threaded string disconnector in order to separate the drill pipe from the casing. In the lower part of the case 9 and the movable sleeve 10 there are square threads, along which a screwing movement and axial displacement upwards of the movable sleeve occur during rotation of the drill string and the body of the device. The gap between the core and the adapter is sealed by gaskets 2, and between the core and the movable sleeve are packing rings 11. The inner cavity of the device, which is bounded by the core 8, the adapter 1, the body 6 and the case 9, is filled with a heat-resistant lubricant that is injected by syringe into orifice 4. Vertical channels 12 in the movable sleeve serve to equalize the pressure within and without the device. The drill string is attached to the adapter 1, and the threaded string disconnector (see figure 2) with which the upper portion of the lowered section is is joined to the core 8.

After lowering the casing string section to the planned depth, the well is flushed through the shoe of this string, a plugging agent is pumped in, the upper part of the two-section disconnector plug is forced through in order to cut off the suspended lower part of the two-section disconnector plug, and the pressurizing liquid is injected. In so doing, the drill string remains motionless when it is placed in a part of the well bore that is not dangerous with regard to sticking (the intervals of deposition of the impermeable rocks or of a cased well bore), or they are reciprocated when they are situated in a portion of an uncased well bore that is hazardous from the standpoint of sticking and the weight of the section or casing string and the state of the well permit them to be reciprocated.

After receiving the stop signal, the cementing head is dismantled and the movable sleeve of the device is shifted upwards by rotating the drill string to the right by 8-10 turns, and the flushing orifices are opened. Then direct circulation through the device's flushing orifices is reestablished and all the plugging agent that was raised above the disconnectors is rinsed off, rotating the drill pipe in so doing.

During the OZTs period the drill string is flushed and periodically rotated. At the conclusion of the OZTs period the drill string is lowered with cranking until the cams of the swiveling device are joined. With later rotation the drill string is disconnected from the section of the casing string at the threaded disconnector. The drill string, the swiveling suspension device and the nipple of the threaded string disconnector are lifted to the surface.

Using the VPU-1, a well bore was cased for the first time in accordance with the described technology on 14-15 December 1974 at Gudermes well No 200 with a 340-mm section of casing string 1,518 meters in length and 155 tons in weight. The casing string section was hung on a cement rock in the open well bore at the interval of 3,446-1,928 meters. The plugging agent that was raised above the disconnector was rinsed off in 30 minutes with intensive flushing (through the orifices in the VPU-1) and simultaneous rotation of the drill string. Later, 8 hours after the mixing of the last portion of the plugging agent (when setting had ended), the drill string was disconnected from the casing string, and this operation went successfully thanks to the absence of a loading on the zone of the left-handed threads of the string disconnector. It should be noted that at Gudermes well No 200, after complete lowering of the string section and prior to receiving the stop signal, the drill pipe was motionless, since it was located in a portion of the open well bore that was not hazardous from the standpoint of sticking. However, in many wells the drill pipe must not remain motionless in an uncased well bore during the entire casing period because of the danger of adhesion but the great weight of the lowered pipe, the small radial clearance and the condition of the well bore do not permit it to be reciprocated. In this case, beginning with the moment the section is lowered all the way and until the drill pipe is disconnected, it must be rotated periodically.

For the sectional casing of a well, where these prerequisites are being observed, a threadless sleeve that tightly covers the flushing orifices is installed, instead of the movable sleeve 10, and attached with pins on the swiveling suspension device, and a device similar to that shown in figure 1 is joined to the well bore.

This is how the well bore of Braguny well No 68 was first cased at the 2,591-1,561 meter interval with a 324-mm section of casing string. After lowering the section, which was 1,030 meters long and weighed 103 tons, the well was flushed and cemented through a special cementing head that was installed on the swivel that was joined to the drill string, which was rotated periodically to avoid sticking. Cutoff of the suspended disconnector plug and opening of the flushing orifice (see figure 1) were accomplished by discharging balls 65 and 75 mm in diameter from the cementing head into the drill pipes. After the flushing orifices were opened, intensive flushing was executed with continuous rotation of the drill pipe in order to rinse off plugging agent above the upper part of the section. Later, before setting of the plugging agent, the drill string was rotated periodically during the flushing process. The drill pipe was disconnected from the casing string successfully.

At present VPU-1-355 devices are being used to lower 426-, 377-, 351-, 340- and 324-mm strings, VPU-1-238's to lower 299-, 273-, 245- and 219-mm strings. Also, a VPU-1-176 device has been developed to lower 194-, 178- and 168-mm strings.

The devices' specifications are shown in table 1.

Table 1

Characteristics	VPU-1-355	VPU-1-238	VPU-1-176
Standard diameters of lowered casing string, mm	426, 377, 351, 340, 324	299, 273, 245, 219	194, 178, 168
Maximum load-lifting capacity, tons-force	150	100	35
Maximum operating pressure, kilograms-force/square centimeter	200	200	250
Pressurization, kilograms-force/square centimeter	300	300	375
Maximum environmental temperature during operation, degrees C	150	150	150
Diameter of the device, mm:			
Outer, maximum	355	238	176
Inner, minimum	102	60	50
Connecting threads:			
Upper	Z-147	Z-147	Z-121
Lower	Z-147	Z-147	Z-101

The swiveling suspension device is used repeatedly. Thus, 12 sections of casing string have been lowered with the use of one VPU-1-355.

Data on wells in which casing string sections were lowered with use of the VPU-1 installation are shown in table 2. Not once was a failure of the VPU-1 to operate noted.

Thus, operation of VPU-1 devices has indicated their efficiency, high effectiveness and reliability.

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Table 2

Well No	Area	Well bore dia., mm	Column section dia. mm	Interval of installation of section of string, m	Length of section, m	Weight of section in air, (tons)	Rotation time of drill pipe prior to cementing, hours	Time from start of pressurizing the agent until disconnection of drill pipe, hours
200	Gudermes	394	340	3,446-1,928	1,518	155	—	8
251	Oktyabr'skaya	394	340	3,013-2,011	1,002	107	—	—
68	Braguny	394	324	2,591-1,561	1,030	103	8.0	14
2	Chir-Yurt	445	340	2,311-1,158	1,153	125	4.0	23
86	Zamankul	394	340	3,684-2,937	747	84	7.0	10
1	Druzhba	394	340*	3,505-2,432	1,073	124	19.0	14
1	Druzhba	394	340**	2,432-1,498	934	108	—	9
131	Pravoberezhnaya	394	340	2,908-1,536	1,372	160	5.0	8
128	Pravoberezhnaya	394	340	2,938-1,612	1,326	155	2.5	11
109	Yastrebinaya	394	324	1,648-867	781	74	9.0	8
129	Pravoberezhnaya	394	340*	2,970-2,094	876	109	10.0	10
129	Pravoberezhnaya	394	340**	2,094-989	1,105	129	7.0	15
1	Druzhba	295	273	4,623-3,987	636	52	22.0	8

*Section I.

**Section II.

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11409
CSO: 1822

FUELS AND RELATED EQUIPMENT

UDC 622.244.62

METHOD FOR FORMATION-TESTING OF CASED WELLS DESCRIBED

Moscow BURENIYE in Russian No 4, Apr 49 signed to press 20 Jun 77 pp 27-30

[Article by V. D. Banchenko, L. A. Kuznetsova and Yu. M. Mesnyankin (VolgogradNIPIneft' [Volgograd Scientific-Research and Design Institute for the Oil Industry]: "Experiment in Testing Reservoirs at Cased Wells at Lower Volga Fields"]

[Text] Testing of wells during drilling enables oil and gas deposits to be observed and reservoir characteristics of the productive beds to be assessed. However, by virtue of the short time in which testing is conducted in an uncased well, this evaluation is not always trustworthy. The testing of wells with cased production strings can be one of the methods for obtaining exhaustive information about a bed. Along with fulfillment of the main task--evaluation of the productivity of the beds being studied--it is possible, in so doing, to solve various problems that arise frequently during testing, for example, those connected with failure of the casing string seal, complexity of the installation of the cement plugs and others. The solution of all these problems complicates testing and requires large time expenditure. The Nizhnevolzhskneft' [All-Union Petroleum Association of the Lower Volta] testing of exploratory wells by means of formation testers that are lowered on the pipe is finding wide application; as a result of this, an industrial flow of oil or gas has been obtained from a number of explorational wells with testing by means of KII.

The results of the testing of certain wells are shown in table 1.

Cased wells have been tested by means of KII in several instances. The work done at exploratory well No 67 of the Semenov area can serve as an example of such a test.

This well was drilled to a depth of 4,870 meters and was cased by a 168-mm production string to a depth of 4,847 meters. Testing was conducted at the interval of occurrence of the Sargayev strata.

On completion the well gave 150,000 m^3 per day of crude (with a 25-mm flow bean) at a well-head pressure of 60-80 kgs [kilograms-force]/cm^2. After a short time interval, the well's output was flooded and soon it began to show only water. The well-head pressure at this time fell to zero. In testing the Sargayev strata for inflow in this region, water saturation thereof had not been noted previously, so the suggestion arose that the flow of water was connected with loss of seal of the casing string. In order to clarify the causes of flooding of the well's output, it was decided to test the well with a KII2-95 with a support on the casing-string wall, using a YaM 95/168 anchor. A packer was installed at a depth of 4,760 meters. As a result of a test for inflow that lasted 2.5 hours, it was established that the well flow was 20 m^3 per day at a differential pressure of 152 kgs/cm^2. The output was a mix of drilling mud and oil. The productivity coefficient during the test turned out to be 0.165 $m^3 \cdot cm^2/day \cdot kgs$, the coefficient of hydraulic conductivity was $4.32 \frac{D \cdot cm}{cII}$, reservoir pressure was 636 kgs/cm^2, and coefficient of the status of the bore zone--2.2, that is, the bed was somewhat polluted. During testing, water did not appear from the well.

Table 2

Well No	Area, horizon	Depth interval, meters	Duration of test, hrs-min	Testing results	
				Output	Flow, m^3/day
2	Narimanovskaya, Sakmara-Arti....................	2,153-2,185	1-38	Gas	100,000
50	Kamyshinskaya, Sargayev...	4,731-4,827	4-00	Oil	70
74	Yuzhno-Umetovskaya, Sargayev...............	4,794-4,803	0-36	Oil	372
236	Tingutinskaya, Jurassic	1,384-1,415	1-21	Oil	480
262	Lobodinskaya, Nizhnyy Bashkir................	4,294-4,304	1-00	Gas	187,000
67	Semenov, Sargayev.........	4,847-4,870	7-00	Oil	60
5	Novo-Korobkovskaya, Yevlanovsko-Livenskiy........	2,568-2,590	2-08	Oil	600
1	Krapovskaya, Vereyan......	2,980-3,087	1-12	Gas	190,000

For purposes of lengthier observation over well operation, the testing was repeated with the use of a simplified configuration of the bottom hole equipment.

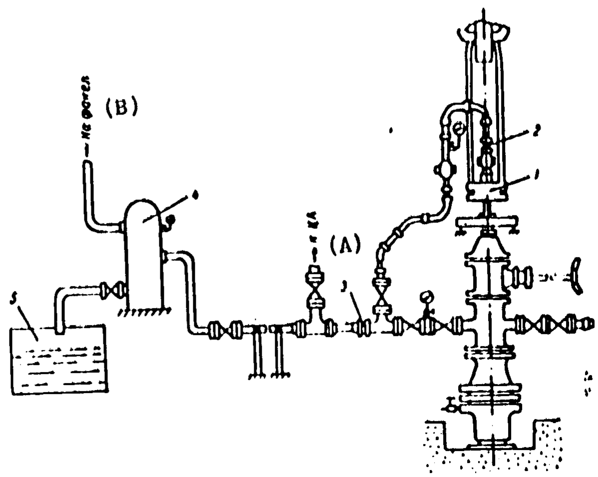
The well-head connections during the test are shown in figure 1.

A filter, a YaM 95/168 anchor, a packer and a pressure equalizer, the arrangement of which is shown in figure 2, were lowered into the well. The use of the pressure equalizer in this case had a definite advantage: an acceleration in filling the pipe during descent and replacement of the drilling mud with water in the pipe in order to create a differential pressure without the use of a packer, and also the possibility for killing the well during installation of the packer.

Figure 1. Diagram of Well-Head Connections During Formation Testing of a Well by Means of KII.

1. Elevator.
2. Swivel head.
3. Flow-bean set.
4. Separator.
5. Measuring tank.

A. To the TsA.
B. To the flare.



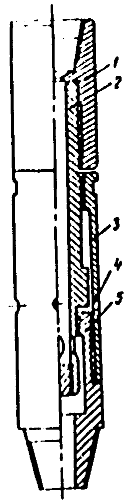


Figure 2. Pressure Equalizer.

1. Upper adapter.
2. Rod.
3. Housing.
4. Orifice for flushing.
5. Lower adapter with seals.

After the pipe was filled with water, the packer was installed and the drain line opened. The well operated with increasing intensity. In 3.5 hours, when all the water had come out of the pipe, the well began to flow, giving crude with a large gas content. The well-head pressure fluctuated within the 10-30 kgs/cm^2 range; the average flow was 60 m^3/day (according to tank measurements). The gas, which was isolated in the separator, was discharged in a flare. Since a 12-mm diameter flow bean was installed at the well head, the pressure differential was greater than occasioned by the substantial gas factor.

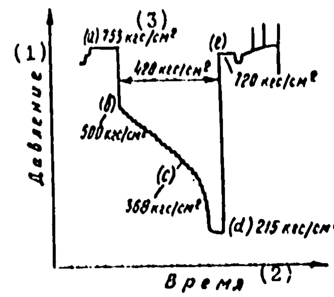
Figure 3 shows the change in bottom hole pressure when the well worked with the installed packers. It is evident from Figure 3 that the maximum differential pressure was 420 kgs/cm^2, and the pressure drop at the packer was 538 kgs/cm^2. Because of this, the packer's seal was broken after 7 hours of operation and the test was cut short.

Operation of the well at a high pressure differential confirmed the lack of inflow of water from the Sargayev strata and indicated a high resistance of the components of their rocks, which had not been destroyed and were not carried to the surface.

Figure 3. Diagram of Change of Bottom-Hole Pressure During Operation of Semenov Well No 67, with Packer Installed.

a. Completion of descent of packer and its installation.
b. Start of well operation.
c. End of output of water.
d. Moment of loss of packer seal.
e. Plugging of the well.

1. Pressure.
2. Time.
3. Kgs/cm^2 [kilograms-force/square centimeter].



After replacement of the packing element, the packer operated at an optimum regime with a 5-mm diameter flow bean and with the same configuration of bottom hole equipment. Well-head pressure fluctuated within the range of 30-40 kgs/cm^2; withdrawal of the oil was 18 m^3/day, gas withdrawal was 2,100 m^3/day. There was no water in the samples of the well's output selected at the surface, but it contained barite in the form of settlings.

The work that was done not only indicated the absence of water in the productive bed but, moreover, it helped to reveal deterioration of the reservoir properties of the rock in the bore zone, which gave a basis for recommending appropriate treatment thereof.

After conducting hydrochloric-acid treatment (SKO) for this purpose, the well was completed.

Table 2 shows the results of tests of productive wells (including Semenov well No 67).

It is evident from table 2 that, according to KII testing data, the productivity coefficient and the reservoir pressure have higher values than given by the results of research by oilfield methods. Apparently, this is explained by the effect of the method of well injection, the substantial increase of the reservoir drainage zone during the prolonged study thereof by the sustained-withdrawals method, and, possibly, by the great volumetric capacity of the whole reservoir.

Hydrochloric-acid treatment of the bed during the testing of Semenov well No 67 indicated the correctness of the reservoir's productiveness, since the coefficient of productivity after treatment doubled. At Kamyshinskaya well No 50, SKO proved ineffective, since forcing the acid into the reservoir was not successful.

Consequently, when testing cased wells, the use of formation testers that are lowered on pipe will permit reliable information to be obtained about the collector characteristics of the reservoir being studied.

Table 2

Method of testing (or study)	Reservoir pressure, #kgs/cm^2	Pressure differential during test, #kgs/cm^2	Productivity coefficient, $\frac{m^3 \cdot cm^2}{days \cdot kgs\#}$	Well flow, m^3/day	Flow bean dia. mm
Well 50--Kamyshinskaya					
KII.................	591	170	0.41	70	--
Sustained withdrawals (after SKO*)..	520	255	0.23	57.8	8
Ditto...............	520	190	0.25	46.5	6
Ditto...............	520	136	0.27	37.5	4
Well 67--Semenov					
By means of KII.....	636	152	0.165	20	10
Oilfield development (after SKO*)......	340	106	0.32	34	5
Ditto...............	340	120	0.37	42	7
Well 74--Yuzhno-Umetovskaya					
KII.................	620	87	4.3	372	8
Sustained withdrawals	621	90	1.5	130	4
Ditto...............	621	125	1.6	198	6

*SKO [hydrochloric-acid treatment].
#kgs [kilograms-force].

The bore zone of the tested reservoir is evaluated as a result of the test. This enables substantiated recommendations to be made relative to the use of inflow intensification measures.

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FUELS AND RELATED EQUIPMENT

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RECENT PROGRESS IN BUILDING SURGUT-POLOTSK PIPELINE RECOUNTED

Moscow STROITEL'STVO TRUBOPROVODOV in Russian No 5, May 79 p 5

[Article by A. A. Plotkin: "On the Surgut-Polotsk Route"]

[Text] The introduction into operation of the Surgut-Polotsk oil pipeline is of exceptional importance for developing West Siberia's petroleum industry and for providing a new outlet for Tyumen' crude to the country's center. Minneftegazstroy [Ministry of Construction of Petroleum and Gas Industry Enterprises] subordinate units undertook increased commitments to erect this trunk line ahead of schedule. They decided to finish in April the main installing and insulating operations on a 1,257-km section of the pipeline (from Surgut to Perm'). More than 700 km of the oil pipeline pass through Tyumenskaya Oblast, which is marked by difficult climatic conditions.

The oil pipeline's diameter is 1,220 mm. The route traverses marsh (260 km), large rivers, lakes and other natural and artifical obstacles.

The pipeline's construction has been conducted by subunits of Glavsibtruboprovodstroy [Main Administration for the Construction of Pipelines in Siberia] (0-401 km), Glavtruboprovodstroy [Main Administration for Pipeline Construction] (400-518 km) and Glavvostoktruboprovodstroy [Main Administration for the Construction of Pipelines in the Eastern Economic Region] (518-1,257 km).

A large amount of land-clearing work and construction of log roads was performed during the winter months. Further construction progress depended upon the timely fulfillment of these key operations. A slowing of preparatory operations last year held back construction of the first strand of the Vyngapur-Chelyabinsk gas pipeline. The oil-pipeline builders studied the experience of earlier construction projects and invested maximum efforts in executing on time those operations that would provide a work front for the field-welding and insulation-application columns.

Great attention was devoted to timely delivery of pipe sections to the route. Nevertheless, some collectives were slow in developing this work. Thus, Soyuzgazspetsstroy Trust managers still had not, by the middle of

February, concentrated the necessary number of pipe carriers at the brigades. Work on sending out sections of the Lengazspetsstroy subunit had not been promoted in due measure by this time.

Rational organization of the work plays a special role under the severe northern winter working conditions. Correct disposition of forces and precision and coordination in the actions of interdependent collectives will enable high labor indices to be achieved even in the winter. Despite the severe cold, subunits of Surguttruboprovodstroy [Surgut Pipeline Construction Trust] and Priob'truboprovodstroy [Ob' Region Pipeline Construction Trust] did shock work in the winter. Integrated flow-line type groups of SU-20 [Construction Administration No 20] and SU-8 of these trusts were socialist competition winners during the period 12 January to 12 February 1979.

In March the oil pipeline construction pace increased greatly.

Collectives of Vostoknefteprovodstroy [Oil Pipeline Construction Trust of the Eastern Economic Region], Omsknefteprovodstroy [Omskaya Oblast Oil Pipeline Construction Trust] and Uralneftegazstroy [Trust for the Construction of Oil and Gas Industry Enterprises in the Urals Economic Region] achieved the highest indices in the last week of March. Overhead-welder brigades of these trusts did 18-26 km of pipeline work during the week, insulator brigades 19-29 km, earthmoving units 23-34 km.

The field-welding brigade of SU-20 of Priob'truboprovodstroy that is supervised by Yu. A. Khramov fulfilled its socialist commitments (72 km of pipeline by 1 April) 5 days ahead of the deadline, having supported a work pace of about 1.5 km per day. Highly qualified welders I. A. Andriyanov and F. M. Mavlyutov work in this brigade. Both have been working on the pipeline routes for almost two decades, and both have been recognized with government awards for labor successes.

There were high indices also in the overhead-welders' brigade supervised by Ye. I. Piskaykin (SMU-74 [Construction and Installing Administration No 74]) of Nefteprovodmontazh [Trust for the Erection of Oil Pipelines].

Insulation work during the concluding stage was carried out successfully in SU-20 columns of Priob'truboprovodstroy (the brigade leader is V. P. Koryazhkin) and SU-2 of Vostoknefteprovodstroy (the brigade leader is R. F. Bayanov).

On the unpaid communist Saturday workday (31 March 1979), the oil pipeline builders exceeded the socialist commitments undertaken for that day for all types of work. More than 1,500 people participated in the unpaid workday. More than 760,000 rubles' worth of construction and installing work was done on that day.

The collectives that are erecting pipelines provided on 31 March for the following output: the excavation of more than 14 km of trenching, about 13 km of overhead welding, and 27 km of insulation work.

The end of the winter construction season--the most favorable time for workers on the route--was marked on most pipeline sections by shock work. However, various subdivisions could not organize the work well. Construction and installing brigades of Soyuzgazspetsstroy and Lengazspetsstroy advanced along the route at a slow pace, although a work front had been provided for them, and the supply of pipe sections was ahead of the main construction operations.

Lengazspetsstroy collectives were poorly prepared for hard work in the marshes. The reliability of the construction machinery had not been assured by SMU-2 of this trust prior to the start of the main operations. As a result, pipelayers went out of operation when traversing marshes. Insulating machines had not been repaired in time. All this testified to poor work organization and an underassessment of the importance of the preparatory period. The remaining trusts had to come to the aid of the outstanding unit. Thus, Prib'truboprovodstroy subunits, on finishing their tasks ahead of time, transferred to the section where work was advancing slowly.

A carefully thought-out disposition of forces and the use of all available reserves enabled fulfillment of the main field-welding and insulating work on the marshy sections of the Surgut-Polotsk oil pipeline prior to the spring flooding.

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FUELS AND RELATED EQUIPMENT

UDC 624.012.004.18

PRECAST CONCRETE ITEMS HEAT-TREATED IN NATURAL-GAS COMBUSTION PRODUCTS

Moscow STROITEL'STVO TRUBOPROVODOV in Russian No 5, May 79 p 11

[Article: "For a Reduction in the Consumption of Standard Fuel Equiva - lent"]

[Text] In carrying out the decisions of the November 1978 CPSU Central Committee Plenum, the branch's workers have been aiming their efforts at the rational use of raw materials, other materials and fuel and power resources. Minneftegazstroy [Ministry of Construction of Petroleum and Gas Industry Enterprises] subunits are expanding the movement to save construction materials, electricity and standard-fuel equivalent. Collectives of the ministry's enterprises and organizations have committed themselves to saving at least 10,000 tons of metal, 17,000 tons of cement, 11 million kw-hr of electricity, and 20,000 tons of standard fuel equivalent in 1979.

One of the major reserves for reducing standard-equivalent fuel consumption in the branch is to introduce at construction industry enterprises the replacement of steam-curing of prefabricated reinforced-concrete items by heat-treatment directly in natural-gas combustion products. This method was developed by VNIIST [All-Union Scientific-Research Institute for the Construction of Trunk Pipelines] in collaboration with the Soyuzpromgaz Association and the All-Union Correspondence Construction-Engineering Institute.

Heat treatment of items made of reinforced-concrete in natural-gas combustion products enables a cut in fuel consumption to one-fourth to one-sixth, a rise in product quality, an improvement in sanitary and hygienic working conditions and a reduction in costs for producing the output. Therefore, the task of disseminating this progressive heat-treatment technology wide impends.

At the Ukhta Reinforced-Concrete Products Plant (ZhBI) of the Stroyindustriya association more than 200,000 cubic meters of keramzit-concrete structure were manufactured under the new technology. Natural gas consumption per cubic meter of output was reduced to 10 cubic meters, and expenses were reduced by 2.8 rubles.

The results of research and experimental work conducted by the Northern Branch of VNIIST has enabled the new heat-treating technology to be introduced during the production of products made of heavy reinforced concrete. About 10,000 cubic meters of heavy reinforced concrete were treated in natural-gas combustion products at enterprises of Glavkomigazneftestroy [Main Administration for the Construction of Gas and Oil Industry Enterprises in the Komi ASSR] and Glavtyumenneftegazstroy [Main Administration for the Construction of Oil and Gas Industry Enterprises in Tyumenskaya Oblast] and Sibzhilstroy [Siberian Housing Construction Association].

Plants for prefabricated reinforced concrete with a total production volume of 1.7 million cubic meters can be converted to the new technology. This will permit 113,000 tons of standard fuel equivalent and, accordingly, 4.76 million rubles to be saved annually.

For speeded-up dissemination of the effective method for heat-treating products made of prefabricated reinforced concrete, the Main Administration for Capital Construction developed, jointly with the Main Engineering Administration of Minneftegazstroy, a set of measures for introducing the new heat-treatment technology in 1979-1980. The use of heat-treatment for reinforced-concrete items in natural-gas combustion products is called for primarily at ZhBI plants of the Stroyindustriya production associations at the Ukhta and Surgut Housing Construction combines, the Nadym Large-Panel Housing-Construction Plant, the Neftekamsk Large-Panel Housing Construction Combine, the Al'met-yevsk and Otradnyy reinforced-concrete products plants, the Serpukhov Construction Industries Combine and the Oktyabr' Reinforced-Concrete Structure Plant. Later the new technology must be introduced at all the industry's enterprises that are located in communities that have been converted to the consumption of natural gas.

A school for advanced experience is being organized at Ukhta, based upon plants of the Stroyindustriya production association, to teach workers, engineers and technicians methods for heat-treating products made of prefabricated reinforced concrete in natural-gas combustion products.

11409
CSO: 1822

FUELS AND RELATED EQUIPMENT

UDC 621.643.002.2(571.1)+658

WEST SIBERIAN PIPELINE CONSTRUCTION SPEEDED BY REORGANIZATION

Moscow STROITEL'STVO TRUBOPROVODOV in Russian No 5, May 79 pp 12-15

[Article by V. V. Postnikov and A. A. Paramonov of Glavsibtruboprovodstroy [Main Administration for the Construction of Pipelines in Siberia] (Tyumen'): "Improvement in the Management and Organization of Pipeline Construction in West Siberia"]

[Text] The development of the oil and gas complex in West Siberia is one of the important tasks set by the 25th CPSU Congress.

In order to make a major contribution to the solution of this task, Minneftegazstroy [Ministry of Construction of Petroleum and Gas Industry Enterprises] organizations that are at work in Tyumenskaya Oblast are doing everything possible to cut the time required for turning facilities over for operation and for increasing their reliability.

Further improvement in work organization on pipeline routes and the introduction of progressive technical solutions at surface-structures sites will help to increase the pace of construction and improve its quality.

The problem of improving the management of construction and the organization of work is of special urgency for pipeline construction in West Siberia. The period favorable for carrying out basic line work here is one-third as long as that of the middle latitudes, and the upkeep of labor resources is three times as costly. The inevitable idle operating time of people and equipment in this region involves more substantial losses.

During Glavsibtruboprovodstroy's existence, organization and management have been improved in three main stages. The first of these is conversion to the main-administration organizational structure, which provides for a compromise between the demands of complexity and of operating specialization.

Technological specialization creates conditions for a high degree of readiness of special technical equipment and broad flexibility in the use thereof and the introduction of the newest achievements of scientific and technical progress.

At the same time, deep specialization, under which each type of work is carried out by separate subunits of a specialized trust, complicates the matter of coordinating organizational decisions at the operating interfaces.

Glavsibtruboprovodstroy has come out with an initiative to introduce a new managerial structure for the erection of pipelines, the basis of which is the integrated trust, which performs all basic, concomitant and servicing operations.

The typical structure of such a trust includes three general contracting construction and installing administrations (SMU's), each of which does field welding, insulation-application and ballasting work (figure 1). The engineering preparation of the route and the laying and upkeep of winter roads are performed by road-construction administrations (DSU's), earth-moving work by specialized administrations (SU's), and transport operations by motor pools (AB's). Materials are supplied by the administration for production operations outfitting (UPTK). Each trust has a construction administration for its in-house construction work (StU) and an educational combine.

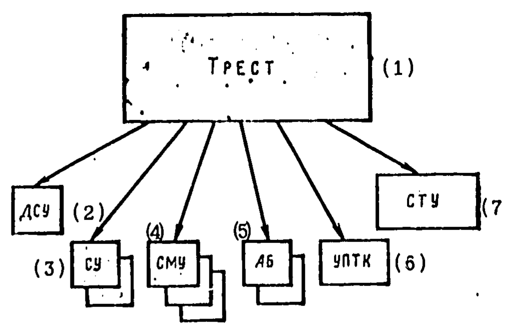


Figure 1. Structure of an Integrated Trust for Pipeline Construction.

Key:
1. The trust.
2. DSU [road-building administration].
3. SU [specialized administration].
4. SMU [construction and installing administration].
5. AB [motor pool].
6. UPTK [administration for production operations outfitting].
7. STU [construction administration for in-house construction].

The organization of integrated trusts has improved considerably the controllability of low-level subunits. It can now be said with confidence that the integrated pipeline construction trust is the basis for the production associations of the near future.

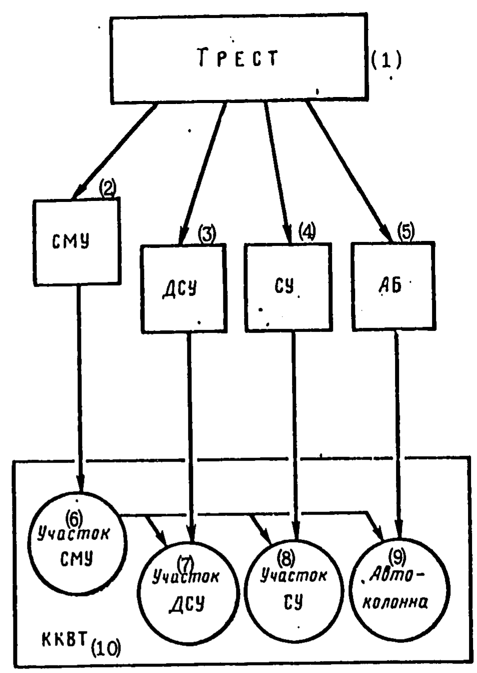
The second step is the development of principles, methods and special organizational forms for closer coordination of the activity of participants in the production process during the winter, which is more favorable for the conduct of line operations.

During erection of the Ust'-Balik-Ufa-Kurgan-Al'met'yevsk oil pipeline and the first phase of the Nadym-Punga gas pipeline, all the resources of specialized elements were concentrated in large integrated columns. By manipulating resources over the work front, this enabled a sharp reduction of the idle time that occurs through the fault of interdependent elements. Thus, a new form of work organization--the so-called integrated high-speed column (KKVT)--was created.

The KKVT united all the brigades and columns engaged during the winter in laying pipeline sections of great length, starting with 40 km. The "nucleus" of the KKVT (see figure 2) is the SMU section, which does welding and insulating work. Sections of the DSU and SU, as well as of the motor pool, are transferred to operational subordination to it. One of the trust supervisors or the chief of a general-contracting SMU is in charge.

Figure 2. Organization of an Integrated High-Speed Column.

Key:
1. The trust.
2. SMU [construction and installing administration].
3. DSU [road-building administration].
4. SU [specialized administration].
5. AB [motor pool].
6. SMU section.
7. DSU section.
8. SU section.
9. Motor-vehicle column.
10. KKVT [integrated high-speed column].



Such a structure provides for optimal relationships between specialization and complexity where the specifics of a region impose limitations. The concentration of resources in a single administration locally permits construction to be conducted at a fast pace, without elongating the work front. Nonproduction-time losses caused by the delayed work of interdependent elements that advance of the operating chain are shortened. Strengthening of the construction capacity of specialized subunits will help to reduce specific expenditures for servicing the complex. The pace of pipeline construction is increasing 3-fold to 5-fold at a time when resources expenditures are increasing 2.5-fold to 3-fold.

More than 500 people are working in one high-speed column (of whom 400 are workers of the basic trades. They serve about 200 units of construction and special equipment, including 19 heavy pipelayers and 20 excavators. The column operates around the clock, in two shifts.

Since 1974 the number of KKTV's in Glavsibtruboprovodstroy has increased from 2 to 7, and the total output per KKVT for the season has risen from 174 to 484 km of finished pipeline.

At the same time, expansion of the scale of use of KKVT's is related to the limitation of certain specialized resources (for transporting, earthmoving and ballasting work). Therefore, an increase in the amount of work done by the KKVT's is followed by a definite reduction in the daily and seasonal pace.

Redeploying the main resources from the Nadym-Punga region, which has already been conquered, to the new Urengoy-Nadym and Urengoy-Surgut construction corridors also has been telling here.

Since the redeploying was being accomplished in mid-season, the possibility of conducting the necessary preparatory work in the summer, without which high-speed flow-line construction cannot be organized, was lost. In order to reduce the risk of losses from incomplete use of the resources that had been concentrated, it was necessary to be oriented toward reduced output per column.

The experience of Glavsibtruboprovodstroy will enable the following practical rule to be formulated: if questions of the preparatory period (the complete outfitting of the columns with machinery, transport, housing, and fuel and lubricants; the fabrication of weights; the delivery of pipe and rewelding; and the fabrication of curved inserts) are solved before the start of the season, one KKVT can string 90-140 km of pipeline. However, if the work of the preliminary period has not been executed completely, it is risky to charge a column with a route section more than 60 km long.

In the first years of KKVT activity, for purposes of organizing a single management for the column, the KKVT was assigned to one of the trust supervisors, and administrative methods were the basis for managing the complicated complex. As the number of columns grew, SMU chiefs and chief engineers began to be advanced to the role of supervisors of the complexes. The possibility for administrative input in this case was, naturally, reduced. The solution was to seek out a method for intensifying the degree of self-organization within the KKVT. This required a search for effective methods of economic management that stimulate the coordinated work of specialized elements.

In 1977 the third stage in improvement of the administration and organization of work on the line was started. Its purpose was to perfect an effective system for economic accountability within the framework of the integrated high-speed column. The following series of experiments was conducted.

While under the brigade contract an agreement is concluded between the administration and the brigade, in our case the negotiating parties are the trust and the soviet of brigade leaders. The brigade leaders' soviet includes all the supervisors of brigades and columns, as well as representatives of public organizations.

In order to provide the necessary incentive not only for raising the effectiveness of the work of various operational elements, but also of all the elements as a whole, various variants of a system for economic incentives were worked out. Special attention was paid, in so doing, to an interplay among interdependent elements.

Thus, for example, for the element that does preparatory work, the task is set not in amounts of log roads built or ground-clearing work done but in achieving the amount of strip and log-road work that was set for the field welding operations on the route. For the element that excavates trench, the whole principle is formulated as achieving a set backlog of completed work for the insulation-application operations. The system of bonuses is shown in table 1.

Table 1

System of Bonuses for an Integrated High-Speed Column

Bonus group	Type of bonus	Size of bonus, % of earning schedule
1. According to work results for the week and the month	A. Bonus for overfulfilling weekly and monthly tasks.	25-50
	Б. Advance bonus granted to interdependent element for a definite backlog of completed work.	15-30
2. According to work results for the season	B. Postponed bonus for job-contract-plus-bonus system for work quality and timely presentation of a backlog of completed work set for the interdependent element.	45-55
	Г. Bonus for savings achieved by reducing costs for the work performed.	30-45
	Д. Bonus for introducing the facility being built into operation.	50-60

Bonuses are to be awarded under the job-order system for the timely fulfillment of a defined backlog of completed work. In this case, a part of the prize is paid by an advance during the construction process itself (see table 1, Б), and the rest upon turnover of the pipeline (see table 1, B). Moreover, a special bonus is introduced for reducing the operating cost of construction and installing operations and for saving supply and equipment resources, taking into account the quality of the work from the standpoint of the interdependent element (see table 1, Г). This bonus is distributed on the basis of a computation in accordance with the formula

$$\Pi_i = \Pi \frac{H_i K_i}{\sum_{i=1}^{n} H_i K_i},$$

where Π_i is the size of the bonuses of the i-th brigade, in rubles;

- Π is the total sum of the bonus for savings obtained by reducing the estimated cost of performing the work, in rubles;
- H_i is the standard labor intensiveness for the work performed by the i-th brigade, in norm hours;
- K_i is the coefficient of the quality of the i-th brigade's work; and
- n is the number of brigades that participate in the contract for the facility.

An arbitrary example of distribution of this bonus in the amount of 30,000 rubles is shown in table 2.

Table 2

Determination of the Amount of a Bonus for Individual Brigades

Brigades	K_i	H_i	$H_i K_i$	Π_i
Field welding	4	87,000	348,000	11,589
Insulation-application	4	24,860	99,440	3,312
Equipment-operators	3	56,810	170,430	5,676
Pipe-carrier drivers	3	46,990	140,970	4,696
Weight-transporting drivers	1	26,480	26,480	885
Repairmen	3	38,450	115,350	3,842

With introduction of the indicated system for distributing bonuses, each brigade received an adequate incentive for the timely support of the work front for the brigade that followed it in the operational chain. The total size of the bonuses in which the quality of the work from the standpoint of the interdependent element is considered is 90-130 percent of the schedule of earnings.

Such a bonus distribution reflects more completely the requirement for self-organization in the production process.

It is premature to assume that the proposed system will enable economic questions of managing speedy flow-line construction to be solved completely. The role of the brigade leaders' soviet should be increased. Their participation is necessary in formulating annual plans and developing organizational and technical measures aimed at meeting production goals. In order to coordinate and monitor progress in fulfilling contract agreements, disputed questions and claims of both sides must be reviewed at special parity arbitration commissions.

A system of mutual responsibility for client and contractor on an uncompromising basis, similar to that called for by the contract for the facility, must be created. Where the terms of an agreement are violated, forfeitures, penalties or fines should be listed, without submission of a suit, on the SMU's settlement account in reimbursement for losses caused, for example, by failures to deliver equipment, errors in design documentation, and so on. Naturally, the sizes of the forfeitures and so on should be set as a function of the amount of the actual losses of labor and equipment resources. The currently existing system of sanctions established by the Regulations on Contract Agreements is actually a brake on the development of economic accountability relationships. The penalizing sanctions do not compensate for the material losses of the investment-process participants, and the procedure for imposing sanctions is complicated irrationally.

The system of measures being executed in Glavsibtruboprovodstroy has enabled a large national-economic benefit to be obtained. The general strategy of northern construction, "Not with quantity but with skill," has received graphic confirmation.

If the 1974 level is taken as 100 percent, then in 1978 the amount of linear construction rose by 57 percent, but the number of field welding brigades and insulating-applying columns was reduced, respectively, by 41 and 39 percent. In so doing, the number of electrical welders rose by 42 percent, but the number of workers engaged in insulating-application work was reduced by 53 percent.

The successful work of the KKVT's enabled Glavsibtruboprovodstroy to introduce a number of important trunk pipelines into operation ahead of schedule in 1975-1978.

Thus, practice has confirmed the effectiveness of the measures adopted to improve the management and organization of pipeline construction in West Siberia.

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CSO: 1822

FUELS AND RELATED EQUIPMENT

OIL, GAS, WATER COLLECTION AND PREPARATION DISCUSSED

Moscow SBOR I PODGOTOVKA NEFTI, GAZA I VODY (Collection and Preparation of Oil, Gas and Water) in Russian 1979 pp 2, 317-319

[Annotation and table of contents from book by G. S. Lutoshkin, Izdatel'stvo Nedra, 319 pages]

[Text] The textbook discusses the basic directions in line with comprehensive plans for working petroleum deposits, modern scientific ideas on organizing the collection and preparation of oil, gas and water at the fields, and also the equipment and industrial processes for preparing them for transport.

It discusses the problems of hydraulic calculations of simple and complex pipelines transporting both single-phase and multi-phase fluids (gas + oil + + water), separation units, their installation and calculations of the throughput and units to prepare the petroleum.

Problems of the formation of both reverse and direct petroleum emulsions are discussed and methods of breaking them down efficiently are covered. A great deal of attention is paid to the preparation of fresh and stratal water for their injection into productive beds in order to maintain the pressure and increase the petroleum yield coefficient.

The contents of the textbook correspond to the program for the course in "Collection and Preparation of Oil, Gas and Water at the Fields." The textbook is designed for students majoring in the specialization 0205, "Technology and Complete Mechanization of Working Oil and Gas Deposits," at petroleum VUZ's and the petroleum departments of polytechnical and industrial institutes.

Tables--11, illustrations--125, bibliography--19 entries.

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CSO: 1822

FUELS AND RELATED EQUIPMENT

UDC 622.143(075.3)

WELL-DRILLING FUNDAMENTALS DISCUSSED

Moscow OSNOVY BURENIYA (Fundamentals of Drilling) in Russian 1978
pp 2, 371-373

[Annotation and table of contents from book by Yu. I. Volodin, Izdatel'stvo Nedra, 373 pages]

[Text] The second edition of the textbook takes into account all the changes in the equipment and industrial processes for constructing geological exploratory wells that have occurred since the first edition (1972).

The book describes the equipment and industrial processes of modern methods of drilling wells for various purposes. Particular attention is paid to the methods that are used in seeking out and prospecting solid mineral deposits and ground waters, as well as in geological engineering surveys. Boring equipment and drilling instruments are discussed. Problems of labor safety procedures and safety measures when drilling work is performed are set forth.

The book is designed as a textbook for students at geological prospecting tekhnikums.

Tables--41; illustrations--136, bibliography--24 entries.

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CSO: 182?

FUELS AND RELATED EQUIPMENT

UDC 622.7.01

COAL CONCENTRATION DEVELOPMENT IN UKRAINE

Kiev UGOL' UKRAINY in Russian No 5, May 79 pp 12-14

[Article by P. N. Ivanov, UkSSR deputy minister of the Coal Industry: "The Development of Coal Concentration in the Ukraine"]

[Text] The growing role played by solid fuel minerals in developing productive forces and providing a reliable source of energy for the fuel-energy complex and raw materials for metallurgy and chemistry dictates a need for steady development of the coal industry. Modern methods of extracting coal and quality requirements have established the importance of the concluding stage of commercial coal production--its preparation for use in accordance with the requirements of the consumers. The most efficient method of preparing coal is its mechanical concentration and sorting, which has brought about intensive development of scientific research in this field and of equipment, industrial processes and engineering practices in all the coal-extractive countries of the world, and has also made necessary efficient scientific-technical exchange of information and collaboration.

The demands of practical work and the specific problems of the science and technology of coal concentration were the basis for organizing the International Congresses on Coal Concentration. The First Congress was held in Paris in 1950, and the following ones were held in these cities: Essen (FRG), Liege (Belgium), Harrogate (England), Pittsburg (United States), Paris (France) and Sydney (Australia). The Eighth International Congress on Coal Concentration will be held from 21 to 26 May in Donetsk, with the slogan, "For Coal Concentration--Advanced Equipment and Technology!"

Scientists and specialists from many countries in the world, working on coal concentration and in related fields, will take part in the work of the congress. Topics of the condition and perspective for development of coal concentration and environmental conservation will be discussed at the meetings. The most recent scientific achievements in the equipment and technology of concentration for various processes and operations will be thoroughly discussed, as well as topics devoted to the use of coal and concentration wastes, the study and quality control of coals and model study and planning of production processes. Taking place at the same time will be the exhibition, "Machines and Equipment for Coal Concentration," which will familiarize the participants in the congress and the specialists with the best new models of machines, equipment and mechanisms from domestic production and foreign firms. Excursions providing for visits to scientific research institutes and the Komsomol'skaya, Krasnaya Zvezda and Voroshilovgradskaya concentration works will be organized.

Coal concentration in the Ukraine has been developed most intensively in the last 25 years. It is distinguished by its comprehensiveness (development of scientific research, design and manufacture of concentrating equipment; planning and constructing powerful concentration works; improving the engineering techniques and industrial process in the operation of the works). The large number of concentration mills makes it possible to include over 80 percent of the coal extracted in machine concentration, including all the coals for coking and industrial needs, and anthracites.

In the Donetsk basin, hard coals of the entire metamorphic series are being extracted, and the coals that cake well, of the middle stage of metamorphism (the raw materials base for coking) and anthracites (raw materials base for the electrode industry and iron ore agglomeration) are particularly valuable. Gas and caking coals for coking and anthracites have the highest relative proportion of the total balance of Donbass hard coals.

With the development of mechanization of coal extraction and transport, the tendency appeared to increase the output of the fine grades and increase the content of harmful and inert impurities (rock, moisture). At the same time, the demands for the high quality of the coal output increased.

The varying conditions for the use of Donetsk hard coals and anthracites as an industrial component or fuel require a differentiated approach to their preparation. This has brought about the development in the Ukraine of concentration that outstrips the increase in the extraction of hard coals (Table 1). In 1965-1978 the processing volume of run-of-mine coals at the concentration works of the UkSSR Ministry of the Coal Industry increased 1.63-fold; the highest (7.1 percent) average yearly growth rates were in 1971-1975. As the result of the outstripping development of concentration, the ash content of the coals shipped to the consumers in 1978 was reduced by 11.6 percent as compared with the ash content of the coals extracted, while in 1965 the reduction in the ash content was 5 percent.

Table 1

Indicators	1965	1970	1975	1978
Extraction, in %	100	107.1	110.8	109.2
Processing (total), in %	100	119.7	145.6	147.6
Included by processing, in %	60.8	68.0	79.9	82.2

The general direction in the development of the republic's coal concentration is technical reequipment of the existing enterprises on the basis of the results of scientific research and design developments. This ensures a constant improvement in the equipment and industrial processes at the enterprises and a rise in their capacity and industrial efficiency. The increase in the processing of run-of-mine coals at the existing works of the Ministry of the Coal Industry of the Ukraine due to raising the technical and industrial level of the concentration and carrying out organizational measures in the last 10 years is over 32 percent, i.e., is two-thirds of the total increase in the volume of concentration in this period.

Using the results of research, design developments and the achievements of practical work in planning new enterprises made it possible to design new, highly productive concentration works to process the coals. In 1966-1978 powerful works with a high level of technical equipment were put into operation: to process anthracites--the Komendantskaya (yearly productivity of 6 million tons) and the Krasnaya Zvezda (3.5 million tons); for hard coal concentration--imeni Komsomol Ukrainy (3.1 million tons), Pavlogradskaya (5.25 million tons), Komsomol'skaya (4.5 million tons) and others. The total yearly capacity of the concentration works of the UkSSR Ministry of the Coal Industry rose by 22 percent because of these enterprises. The increase in the productivity of the existing works and putting new ones into operation made it possible to increase the average yearly capacity of a single mill by 1.7-fold.

At the works of the UkSSR Ministry of the Coal Industry, the labor-intensiveness of the set of operations to produce concentrate in this period dropped by 38 percent. The trend toward outstripping development of the capacities for coal concentration will also be maintained in the future. In the 10th and following five-year plans new works will be put into operation, including large ones such as the Chervonogradskaya with a productivity of 9.6 million tons a year, for concentration of gas coals in the L'vov-Volynsk basin, the Dolzhanskaya-Kapital'naya (6.8 million tons) for concentration of anthracites of all size categories, the Shakhterskaya-Novaya (4.5 million tons) in the Donbass and others. This will make it possible for the total capacity of the concentration works to be increased 1.2-fold.

At the same time, more efficient industrial processes were used at the works, making it possible to reduce the losses of coal and wastes by an average of 400,000 tons a year and to raise the quality and improve the assortment of the marketable commodities. The volume of concentration of coal in the heavy mediums increased 5-fold, of flotation--2.5-fold (Table 2). The ash content of the wastes rose from 70.5 percent in 1965 to 74 percent in 1978. The low-efficiency process of concentrating coal in trough washers was eliminated.

Table 2

Method	Relative proportion, in %	
	1965	1978
Concentration in heavy media	8.2	18.9
Jigging	46.6	64.1
Concentration in rheolaveurs	29.8	0.8
Flotation	12.6	15.2
Concentration in hydraulic cyclones . . .	1.4	1.0
Others	1.4	--

An important indicator is the essentially complete inclusion by the processing of all the anthracites extracted. At the same time, one of the main problems is solved--manual concentration is eliminated and 52 mine screeners were shut down. Due to improving the equipment and the process for concentrating the anthracite, its losses with wastes were substantially reduced and its stamping at the concentration works and surface complexes of the mines was reduced. Despite a considerable, steady deterioration in the quality of the raw material, the level of output of high-quality anthracite remains stable. The development of a method of flotation of anthracite sludge at the Komendantskaya and Krasnaya Zvezda works made it possible to convert to concentrating anthracite in its entire range of coarseness and to implement the stable output of fine concentrate, satisfying the demands of the iron ore agglomeration process.

The development of anthracite concentration and thorough study of its physical-chemical and thermomechanical properties ensured a favorable balance of resources and consumption in the output of electrode products. The problems of satisfying special demands for coal for the production of silicon-aluminum alloys using the electrothermal process and of sulfonated coal and synthetic corundum were successfully solved.

Problems of increasing the industrial efficiency of the concentration processes and designing new equipment in the Ukraine are solved by the scientific efforts of the Ukrainian Scientific Research Institute of Coal Concentration, the designers of the State Institute for the Planning of Coal Concentration Machines and the State Institute for the Planning of Concentration Machines, the Voroshilovgrad Coal Machine Building Plant imeni Parkhomenko, and others. As the result of the consistent increase in the capacity of the works, putting new industrial processes into operation and designing new equipment, the coal concentration level in the Ukraine is in accordance with the present-day state of science and practical work. Heavy-media wheeled separators are used to process coarse grades. There is widespread use of the method of concentrating fine grades of coal and anthracite in heavy-media hydraulic cyclones, including the cascade, triple-product cyclone, designed by the Ukrainian Scientific Research Institute of Coal Concentration and the IOTT.

Double and triple product cyclones and auxiliary equipment in a wear-resistant version with a lining made of monolithic polycrystalline silicon carbide (MPK), as well as an industrial process for concentration with separate regeneration of the suspension have been developed and are being put into use in practical industrial work. The jigging equipment and process are being steadily improved. At most of the works the existing jigging machines have been modernized: rotary pulsators have been replaced by valve pulsators, rotary unloaders have been installed and the flowline section has been improved. Series output of type OM-24 jigging machines with a jigging screen area of 24 square meters has begun.

The widescale development and introduction of flotation at the concentration works is ensured by designing highly efficient equipment to condition the pulp before flotation and mechanical flotation machines, and by improving the operating conditions and reagents used. A new AKP-1600 unit has been designed which achieves rapid and uniform saturation of the pulp with the reagents and their efficient contact with the coal particles being floated. The unit helps to increase the flotation rate and reduce the losses of coal with the wastes, and it is being series-manufactured and is now being installed at enterprises.

The MFU-12 flotation machine with a chamber capacity of 12 cubic meters, on a par with the best foreign models, has been designed in the USSR and is being widely used in industry. Its distinguishing features are the principle of layer aeration of the pulp along the height of the chamber and the increased area of contact of the pulp-air medium. The basic parts (impellers, stator, aeration chamber, etc.), which operate under conditions of intensive abrasive action, are manufactured from wear-resistant materials. The productivity of the MFU-12 machine is twice as high as that of the MFU2-6.3 machine.

In the last few years the problem has been solved of providing the works with efficient flotation reagents, as the result of making the transition from using by-products and wastes from various production facilities to specific specialized products in uniform and optimum condition. Widescale use of new apolar aromatized reagents (AAR-1 and AAR-2) has made it possible to improve the flotation indicators and cut their wastes by 30-40 percent. Specialized industrial production of reagent AAR-2 has been put into effect in an amount satisfying the demands of the concentration works not only in the Ukraine, but also in the Kuzbass.

At a number of works of the UkSSR Ministry of the Coal Industry, the problem of efficient storage and utilization of concentration wastes is being solved. The particular difficulties and high expenditures stem from the flotation wastes, which are finely dispersed clay material. This problem is connected with protecting the environment against pollution with industrial wastes and disposals. Along with organizing disposal-free and waste-free production, a solution is being found to the problem of comprehensive use of mineral resources, since the prerequisites are being created for processing and utilizing dehydrated flotation wastes in manufacturing various building materials.

The study and development of the technology, operating conditions and the equipment to concentrate the flotation wastes and have them reach a state suitable for combined storage with the wastes of other coal concentration processes or for use in the production of ceramic wall materials have in general determined two directions for their processing. The first of them, which has been put to practical use at a number of works, is processing the flotation wastes in cyclones, with subsequent dehydration of the concentrated granular product on belt vacuum-filters. Practical experience in operating industrial systems using small-diameter hydraulic cyclones and belt vacuum-filters indicated their high efficiency: the amount of wastes sent to the sludge accumulators is reduced by 40-60 percent. Belt filters with a filtering surface of 4-10 square meters serve as waste dehydrators. A filter with an effective surface of 15-20 square meters is now being developed. This industrial system is used at the Bryankovskaya, Krivorozhskaya, Uzlovskaya and Belorechenskaya concentration works, and at others.

The second direction in processing flotation wastes is concentrating them in conical cylindrical thickeners with a sediment thickener, and dehydrating the thickened sediment in filter-presses. This process ensures the final products (pure recycled water and dehydrated sediment) being obtained and makes it possible to recover all the flotation wastes within the confines of the works, but requires greater capital and operating expenditures.

A conical cylindrical thickener with a sediment catcher, ensuring the obtaining of a product with a concentration of 600-800 grams per liter, to process flotation wastes, was designed and tested industrially. The Kal'miusskaya Central Concentration Plant is carrying out industrial development of a procedure to process flotation wastes, using thickeners and filter-presses with a dehydration surface of 600 square meters.

Solving the problems of dehydrating flotation wastes considerably simplifies the problem of their storage and use in the building materials industry. In 1978 the Ukraine's brick plants used over 70,000 tons of flotation wastes in brick production. Many of the republic's organizations are studying the utilization, optimum processing and storage of concentration wastes. The scale of development of the coal industry, the increasing degree of mechanization of the extractive work and the deterioration in the quality of the beds being worked require a constant improvement in the concentration equipment and industrial processes. The reduction in the efficient utilization of the fixed capital of the coal-concentration works stems from a lagging behind in improving the auxiliary equipment (pumps, centrifuges, shut-off devices, etc.), and insufficient reliability and wear-resistance of the basic equipment. Therefore there must be an expansion of the volume of specialized machine building, ensuring the satisfaction of the demands of coal concentration for equipment with high operational reliability. Problems of studying the qualitative characteristics of coals and their differentiated use, particularly expansion of the coking raw materials basis, require concentrated attention and solution.

The questions of correct price-setting for coal and concentration products in many ways determine the economic efficiency of the coal industry's work. The existing prices do not correspond to the socially necessary labor input under today's conditions. The development of research and experimental-design work, in consideration of scientific information and the results of practical work in coal concentration, which will be discussed at the sessions of the Eighth International Congress, will be a new stimulus to increasing coal concentration efficiency in the Ukraine.

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MINERALS

PRESENT STATE AND PROSPECTS OF INTRODUCING COMPACTED AND UNDERGROUND LEACHING OF ORES

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/Article by A. S. Poplaukhin, B. D. Khalezov and A. A. Babadzhan: "Problems of the Tenth Five-Year Plan: Status and Prospects of Introducing Compacted and Underground Leaching of Ores"/

/Text/ In the plans for the development of nonferrous metallurgy the problem of the compacted and underground leaching or ores is viewed as a crucial task that provides a completeness in processing ore deposits.

These deposits were taken as objects of research: Kal'makyrskoye, Kounradskoye, Volkovskoye, Nikolayevskoye (compacted leaching), Blyavinskoye, Kafanskoye and Krasnogvardeyskoye (underground leaching).

Compacted Leaching

At present the technology for compacted leaching has been assimilated on four rigs and tests have been made on underground leaching on two rigs. * Prior to 1978 several thousand tons of copper had been obtained at the stage of industrial experimentation and introduction.

The assimilation of the technology for underground leaching still requires that an economically feasible method of preparing deposits for leaching be developed.

From 1972 through 1977 several thousand tons of copper were obtained on the compacted leaching rig of the Nikolayevskoye mine of the Eastern Kazakhstan copper-chemical combine; moreover, the expenditures for one ton of copper were less when compared with other methods.

During this time 82 percent of the copper was extracted from the bank of oxidized ores and 29 percent was extracted from the banks of sulfide ores. Less than a thousand tons remained to be extracted from the banks of balanced ore. According to exploitation data, the leaching of copper from

* Leaching rigs were built in accordance with scientific designs of Unipromed'.

reflux sectors of oxidized ore amounted to 22-26 percent a year, and from sulfide ore 17-19 percent, which characterizes the process as sufficiently intensive.

The problem of assimilating the technology for leaching the bank of balanced metacolloidal ores and the extraction of zinc and cadmium from solutions by means of sodium hydrosulfide are being solved at the combine.

In subsequent stages it is planned to seek ways to raise the overall use of raw materials by extracting lead and precious metals. In 1977 and 1978 industrial experiments were conducted on the technology for processing the bank of metacolloidal ores. In conjunction with this a zinc concentrate was obtained that contained 45-47 percent zinc and which corresponded to OST /branch standard/-48-31-72. The further expansion of copper and zinc production on the combine's rig is possible chiefly by using metacolloidal ores.

The yearly extraction of metacolloidal ores at the Nikolayevskoye deposit is increasing and their processing can provide for the obtaining of copper and zinc.

A significant source for the production of copper and zinc at the combine is the preliminary leaching of oxidized and hard-to-concentrate forms of copper and zinc from all ore that is extracted before they are processed at the concentrating plant. The combine and Unipromed' /Ural Scientific-Research and Planning Institute of the Copper Industry/ are conducting joint research in this area.

At the Kounradskoye BGMK mine an experimental-industrial compacted leaching rig has been in operation since 1975 on a natural basis; this rig has already produced several hundred tons of copper with a relatively low average production cost. In 1978 the productivity of the rig doubled.

It has been established that it is possible to extract no less than 70-80 percent of the copper contained in banks of oxidized ores, based on the extraction of three seasons of exploitation. It should be noted that the ores of the Kounradskoye deposit are very favorable according to properties of leaching; the supplies of such ores in the banks and in the contour of the open-cut mine are significant.

A plan has been made for the construction of an industrial compacted leaching rig for processing balanced ores of current extraction.

During the three years that the first section of the compacted leaching rig has been in use in the banks of the Volkovskoye KUMK mine several hundred tons of copper has been obtained with a low average production cost. Since June 1978 leaching at the site is done in two units. A gradual increase in capacity is planned by 1980, and maximum productivity is to be achieved by 1981.

The compacted leaching section of the Kal'makyrskoye AGMK mine was planned on a base of balanced ores of current extraction. However, in connection with the sharp reduction of these supplies in the open-cut mine the rig is used for leaching of balanced mixed ores of bank No. 10 of the last years of extraction, in which several million tons of ore are stockpiled.

In connection with the fact that these ores differ significantly in nature from the ores of current extraction, difficulties were encountered in the industrial assimilation of leaching. Ways must be sought to improve the percolation of solutions through the ore. During the initial adjustment work at the industrial bank in 1977 and the beginning of 1978 along with design shortcomings and the poor quality fulfillment of individual subassemblies of the system it came to light that the speed of the permeating of solutions was half and less than required (0.15 - 0.2 meters per 24 hours instead of 0.4 - 0.5) for accomplishing optimal modes of leaching according to the density of the reflux and the pause between refluxes. Solutions that are fed into the bank take 10 to 14 24-hour periods to permeate instead of 4 - 5. The poor permeability is connected with the presence of a large number of shallow fractions (up to 30 percent of the 5 mm grade), which are basically represented by micaceous, hydromicaceous and clayey minerals, which swell when they come in contact with aqueous solutions, becoming a pliable mass, and the number of which increases in the process of leaching due to the breaking down into initial aluminosilicates (potassium feldspars, plagioclases, and dark-colored minerals); the upper layer of the ore is decrepitated most rapidly.

To prevent the silting of ore and ensure the required speed of permeation measures are planned, which call for:

-the loosening of the surface of pools using tractor cultivators;

-a layout of ditches the length of the pools with a distance between them of 1.5 to 2.0 meters and a depth of 0.5 to 1.0 meters;

-the drilling of wells with a diameter of 200 to 250 millimeters to a depth of half the height of the bank with the subsequent casing by perforated polyethelene or plywood tubes;

-the shaking of the bank by the use of explosions in accordance with a specially estimated system;

-the monitoring of the status of the bank by the use of wells drilled and cased the entire depth of the bank.

By realizing a portion of the planned measures the percolation of the solutions through the bank was speeded up 2- to 2.5-fold; and the optimal density of the refluxing (to 40 liters per ton) was reached and solutions containing up to 0.4 to 0.5 grams per liter of copper were obtained.

The first experiment in using the working bank showed that the results obtained in models did not fully transfer to the industrial rig. A serious engineering adjustment of the process as it applied to the unique nature of the conditions of an actual bank was needed.

The efforts of the researchers and production workers were directed at developing the technology and modes of working equipment for bringing it to a profitable production level.

The supplies of ore in bank No. 10 will make it possible to significantly raise productivity and ensure profitable operation.

In the process of assimilating and using existing compacted leaching rigs basic technical solutions were developed and significant practical experience was gained, which make it possible to recommend compacted leaching for extensive industrial introduction:

-it was established that existing banks of several mines can be expediently developed at the place of the stockpiling without reloading into special substrata, and that it is also possible for the layout of other hydrotechnical installations to be installed directly in the soil without special hydroinsulation; this significantly lowers the cost of building leaching rigs;

-various methods of refluxing ores and declivities of banks were tested, which ensured the more complete use of raw materials, that is required for processing by leaching;

-methods of sampling banks by drilling and loosening by explosions were developed, which makes it possible in the first case to reliably establish the content of copper in the ore, and in the second case to improve the percolation properties of the banks;

—a hydrometallurgical system that is applicable to any ores was developed fully: leaching - the extraction of copper in a rotating cementer to 90 - 98 percent - the complete recovery of the residue of cement copper - the turnover of residual solutions;

-it was demonstrated that the use of acid solutions and wastes of sulfuric acid for leaching ores lowers the cost of the process;

-positive results were obtained in extracting zinc from solutions of leaching by means of sodium hydrosulfide along with the quality concentrate from the leaching of copper-zinc ores of the Nikolayevskoye mine.

Underground Leaching

In 1971 through 1977 tests were conducted on the experimental-industrial rigs of the Degtyarskoye and Blyavinskoye deposits.

A technical-working plan for an experimental underground leaching of the flexure zone of the Zbis mine was drawn up for the Dzhezkazganskoye deposit in 1974; however, the construction of the section was stopped. This decision does not take into consideration the basic purpose for creating the rig - to gain experience in leaching in Dzhezkazgan.

At the Blyavinskoye deposit they are leaching ore in two sections: in the southern lens the losses of broken ore and in the northern lens the block of ore that was disturbed by mining operations.

As a result the following data was obtained:

-in three and half years of operation the extraction of copper from the southern lens amounted to 53 percent and from the northern lens 74 percent. The average annual extraction of copper from ore was 15 to 17 percent;

-the production cost of one tone of copper was high as a consequence of the small scales of production.

Through tests of underground leaching at the Degtyarskoye and Blyavinskoye deposits fundamental questions were solved concerning the application of hydrometallurgical methods of underground leaching in actual conditions of a mine.

The reason that underground leaching has not yet reached the level of industrial introduction is that there is no economical method for preparing deposits for leaching. Traditional methods of ore preparation, which were used in in experimental-industrial sections and in technical economic justifications, require significant expenditures, which are not recovered by the obtained effect when the scales of operations are small.

The basic trends of research for solving the problem of compacted and underground leaching must be:

a) a reliable economical mining preparation of deposits for underground leaching and the correct formation of banks (in height, configuration, method of pouring off, etc.). Very little attention has been devoted to these matters until recently, which at present is delaying the industrial introduction of underground leaching;

b) the extraction from ore and solutions of not only copper, but also of zinc, cadmium, cobalt, molybdenum and precious metals, which should significantly improve the economicalness of the process;

c) the intensification of the leaching of copper from sulfide ores, particularly in conditions of underground leaching.

In order to successfully solve the problem leading Soviet scientific organizations must be drawn into performing scientific research, semi-industrial experiments and adjustment work.

The Institute of Mining of the Kazakhstan SSR Academy of Sciences and the Dzhezkazgan Scientific-Research and Planning Institute of Nonferrous Metallurgy are doing basic research on leaching the sulfide ores of Dzhezkazgan.

Unipromed' and the Moscow Order of Lenin and Order of the Labor Red Banner Chemical and Technological Institute imeni D. I. Mendeleyev are studying thickening tank electroleaching of copper from ores; in 1980 further experiments on this method are planned.

The Institute of Metallurgy and Concentration of the Kazakhstan SSR Academy of Sciences is researching the leaching of the copper and zinc ores of Tekeli and the copper-lead-zinc deposits of Koksu.

The State Scientific-Research Institute of Nonferrous Metals, Unipromed' and the AGMK are performing industrial experiments on the extraction of copper from solutions of compacted leaching in Almalyk. The suitability of the ABF extractant for extracting copper from solutions has been established and the parameters of the process have been determined. Tests in 1978 were directed at obtaining comparative data on the extraction in apparatuses such as the displacer-settling tank and pulsation columns, as well as data on the continual uninterrupted operation of the system.

The Unipromed' institute is completing semi-commercial tests on sorption technology of extracting copper, zinc and cadmium from solutions of leaching Blyavinskoye ores.

The Central Asian Scientific-Research and Planning Institute of Nonferrous Metallurgy, the Armenian Scientific-Research and Planning Institute of Nonferrous Metallurgy are performing research on extracting molybdenum from the ores of the Sorskoye deposit and the copper-molybdenum ores of Armenia.

The Central Asian Scientific-Research and Planning Institute of Nonferrous Metallurgy and the Institute of Microbiology of the Uzbek SSR Academy of Sciences are studying the leaching of persistent sulfide balanced ores of the AGMK by the use of bacteria. The performing of this work must be speeded up, bearing in mind to bring in the banks of sulfide ores of the AGMK for processing.

The Institute of Steel and Alloys is performing work on thickening-tank leaching of gold-arsenic and tin-arsenic materials of the Solnechnoye Mining and Ore Enriching Combine, the Kokpatasskoye and Bakyrchikskoye deposits. In order to successfully complete this work it is necessary to create an experimental rig at the base of Gidrotsvetmet /State Institute for the Hydrological Processing of Nonferrous Metals/ and an experimental industrial rig at the Bakyrchk deposit for leaching gold-arsenic concentrates. The Northern Caucasus Mining and Metallurgical Institute is performing work at the Sadonskoye combine on the leaching of lead and zinc.

Irgiredmet [Irgiz Institute of Rare Metals] and Vniprozoloto [All-Union Scientific Research of Industrial Gold] are studying the compacted leaching of gold from ores and sand.

Based on the results of work performed in 1976 and 1977 by Unipromed' on microbiological examination of existing compacted and underground leaching rigs it has been shown that the volume of microorganizms in solutions varies between 10^2 and 10^5 units per cubic meter. However, the level of their activity is not great. The problems of the microbiological intensification of the process of leaching requires the active participation of specialized institutes, the conducting of selection work in discovering highly-active strains of microorganizms. It is expedient to combine all research on the use of bacteria in a systematic manner under the unified management of the Institute of Microbiology of the USSR Academy of Sciences.

Unipromed' is conducting work on the leaching of gold and silver by means of solutions of chlorine and thiocarbamide. The complexity of this task lies in the low content of gold in balanced ores, the expensiveness of thiocarbamide and the complexity of extracting gold from solutions when its content, as a rule, does not exceed 0.1 to 0.2 milligrams per liter. Previously conducted research on a semi-commercial scale in a sample of AGMK ore with a thickness of 400 millimeters demonstrated that for 15 months 70 percent of the gold is extracted. At present research is being performed on ore of bank No. 10 of the AGMK. From ore with a thickness of 300 millimeters within 70 24-hour periods the extraction of gold amounted to 22 percent.

The Dzhezkazgan Scientific-Research and Planning Institute of Nonferrous Metals and the Institute of Mining of the Kazakhstan SSR Academy of Sciences must concentrate their basic efforts on developing methods of preparing ore.

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