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THE FIRST RESULTS OF RE-EQUIPMENT AT KADZHARAN CONCENTRATING PLANT

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Kadzharan concentrating plant is the part of "Zangezur MMK" JSC. It processes the copper-molybdenum ores. Kadzharan copper-molybdenum deposit is the raw mineral base of the combine. The deposit is located near the town Kadzharan at the height more than 2000 meters above sea level. The ore is mined at the open-pit. The ore minerals, presented in the mined ore, are chalcopyrite, molybdenite, chalcosine, malachite, covellite, azurite. The isomorphous admixtures are rare and rare earth elements: rhenium, bismuth, selenium, tellurium, gold and silver. The elements are extracted partly into molybdenum and copper concentrates. Plenty of the clayey components and ferric hydroxides, uneven dissemination of the ore minerals are the features of the ores of the deposit.

Initial project of the concentrating plant has been worked up by the institutes Gyprotsvetmet (general designer) and Mekhanobr. The technologies have been worked up in the different periods by the institutes Mekhanobr, "Mining-metallurgical institute" JSC (Armenia) and others.

The plant has been put into operation in 1952. It has been reconstructed and expanded in subsequent years with simultaneous perfecting of the technology.

Initial project productivity of the plant was 1.7 million tons per year (5 thousand tons per day). According to the second and third projects productivity has been increased to 5.1 million tons per year (15 thousand tons every day). It has been reached to 1966. In accordance with the project of 1972 productivity of the plant has been increased up to 7.1 million tons per year (21 thousand tons every day). It has been reached to 1977. The new technical project has been worked up in 1978. According to the project productivity has been increased up to 8.5 million tons per year (25 thousand tons per day) (fig. 1).

Before beginning of reconstruction in 2004 the plant processed 8.2 million tons of the ore containing 0.0519% of molybdenum and 0.186% of copper. In the same period it has been reached following technological parameters: content of molybdenum and copper in the concentrates of the same name — 49.98 and 27.64% correspondingly; extraction of molybdenum and copper into the concentrates of the same name — 82 and 70.73% correspondingly; content of molybdenum and copper in the tails — 0.00889 and 0.054% correspondingly.

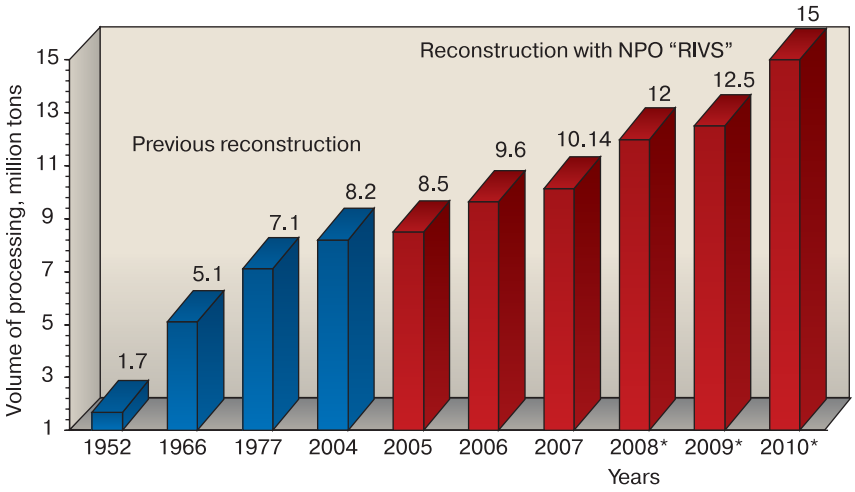

Fig. 1. Change of the volume of processing at the Kadzharansky concentrating plant by years (* — planned parameters)

It has been risen the tasks for collective of "Zangezur MMK" JSC to increase output of the final products, to improve qualitative and quantitative parameters, to decrease production costs including repairs of equipment and power inputs, to increase profitability of the works.

Administration of ZMMK has chosen NPO "RIVS" as the partner. NPO "RIVS" has committed itself to combine functions of the general designer and general contractor in working up of the project, making of equipment and delivery of the last one, construction and transfer of the object to the customer.

The project of expansion of the concentrating plant, carried our by NPO "RIVS", foresees increase of annual productivity of the works by the ore processing up to 12.5 million tons at existing areas with construction of industrial building of the semi-self-comminuting.

Construction and modernization of the plant demanded combination of the stages of the working projecting, construction, making and delivery of equipment, technological adjustment and by-turn putting of the sections into operation without decrease of the volumes of current output of the plant.

With that end in view the specialists of NPO "RIVS" have carried out the audit of the concentrating plant with issue of recommendations concerning to sequence of the stages of projection and modernization of equipment. It has been worked up strategy of reconstruction till 2000:

- to begin putting into operation of flotation facility in the first place with the complete replacement of the obsolete and depreciated equipment by the flotation machines RIF of the new generation with the greater solitary capacity;
- to perfect the technology of the ore preparing with usage of semi-self-comminuting mills of the great volume (405 m^3) at the first stage, ball mills (260 m^3) at the second stage with by-stage removal from the operation of the obsolete crushing-comminuting equipment;
- to replace the drum vacuum filters by the press-filters in the section of filtering of the copper concentrate;
- to put into practice the new technologies with application of high efficient flotation reactants;
- to work up and to make ACSTP of the plant;

NPO "RIVS" has carried out the following works in the course of preparing of technological regulations for projecting:

- study of substantial composition of the ores and technological products of processing;
- study of technological properties (ability of the products to comminuting, concentrating, thickening) of the ores of perspective mining;
- working up of the regime of the ore preparing with application of semi-self-comminuting;
- perfecting of the reactant regime and scheme of the ore concentrating;
- forming of the schemes and regimes of comminuting and flotation of the ore of prospecting mining;
- definition of specific loads on the equipment;
- calculation and selection of the principal technological equipment.

The collective-selective scheme of processing of the copper-molybdenum ore has been approved in technological regulations of the project. Flotation scheme foresees obtain of the copper-molybdenum concentrate in the operations of the main and control flotation, finishing of the rough collective concentrate including three stages of re-cleaning, cycles of selection of the molybdenum concentrate and operations of the sand and mud flotation with obtain of the final 50% molybdenum and 27.5% copper concentrates.

NPO "RIVS" uses the most advanced world achievements in the field of processing in working out of technological regulations and in selection of the principal equipment: perspective reactants of the firm Caytec, the mills of semi-self-comminuting and ball comminuting of the great volumes produced by the firm Fuller, automatic machinery of the firm Outokumpu and American firms, press-filters Larox, vertical mills Vertimill and others. Some designs are worked up jointly with the foreign partners.

Side by side with this it is installed technological equipment produced by NPO "RIVS" (flotation machines, systems for dosing of flotation reactants, vibro-screens). It demonstrates convincingly in practice advantages of the equipment.

Modernization of flotation facility of the main building

Feature of modernization of flotation equipment of the main building is increase of volumes of the ore processing and output of the final products without stopping of production. Putting into practice of facilities of flotation section has been delayed significantly because of lack of the free areas and small dimensions of existing building of flotation section of the plant (project of 1952).

Installation of the initial eight chambers of pneumatic flotation machines RIF 25 for collective copper-molybdenum flotation has permitted to release 80 chambers of flotation machines FPM-3.2. The first section of the collective flotation (24 chambers RIF 25) has been mounted at released areas.

Pneumatic mechanical flotation machines RIF 25 and RIF 45 have been installed at the same industrial

areas in the collective flotation cycle at the six sections after by-stage dismantling of the flotation machines FPM-3.2 and FPM-16 (about 200 chambers). The operations of finishing of the rough collective concentrate have been equipped with flotation machines RIF 8.5. The machines RIF 3.5 and RIF 0.5 have been installed in molybdenum flotation cycle, the machines RIF 3.5 — in the cycle of the sand-copper flotation; RIF 8.5 — in the mud flotation. There are two lines molybdenum and copper flotation at the plant: working line and reserve one. Some flotation machines RIF 8.5, RIF 3.5, RIF 0.5 are equipped with the suction mechanical blocks for exclusion of the great number of the pumps for pumping of the products of flotation. Special contact vats KCh 40 and KCh 25 RIF are used for conditioning and steaming of the pulp before flotation.

Now it has been installed flotation machines of the collective cycle (five sections), the cycles for selection of molybdenum concentrates and for copper flotation (working lines). It has been installed 315 chambers of the flotation machines RIF of the different types at the plant as a whole (fig. 2). All flotation machines are equipped with the systems ASSUP-RV for automatic adjusting and maintenance of level of the pulp and air consumption in the chambers of flotation machines.

Two mills MShC-3200x3100 (one for every line of re-cleaning) were installed in the main building of the plant for additional comminuting of the rough copper-molybdenum concentrate. The mills are equipped with automated battery pump-hydro-cyclone units. The last ones are equipped with the hydro-cyclones constructed by NPO "RIVS" (fig. 3).

The mill VTM-60 (Vertimill) is installed in the operation of additional comminuting of the concentrate of the first molybdenum re-cleaning.

Four force-pump CNV800-1.6 (three working and one reserve pumps) were mounted and put into operation for supply of the pneumatic-mechanical flotation machines of the type RIF with the air of low pressure in amount 1700 m^3/min. The force-pumps are located in the separate building not far from the main building of the concentrating plant. Air feeding from the force-pumps to the main building is carried out through the two air-flows 1200 mm diameter.

Fig. 2. Flotation section with flotation machines RIF

Fig. 3. Automated pump-hydro-cyclone unit involving twelve hydro-cyclones NPO "RIVS"

All parameters of operation of the force-pumps, control sensors, starting and stopping of the equipment are controlled automatically from the operator post.

Water-cooling tower has been installed for economy of the drinking water used for cooling of the force-pumps. Its productivity is 150 m^3/h.

Owing to by-stage construction and putting into practice of the new capacities of the plant it has been reached increased extraction of the metals: copper — up to 72.8%, molybdenum — up to 82.6%. The summary extraction of the metals has increased by 3% and more.

Quality of the copper and molybdenum concentrate for all this has not decreased in spite of constant (by the years) decrease of content of molybdenum in initial ore. Technological parameters of operation of the concentrating plant before and after reconstruction are given at the fig. 4 and 5.

The project of increase of productivity of Kadzharan plant by the ore to more than 12.5 million tons per year and reconstruction of the plant foresees the complete transfer of the plant to the low-stage scheme of comminuting of the coarse crushed ore (–350 mm). It has been installed for the first time in non-ferrous metallurgy of CIS the mills of semi-self-comminuting

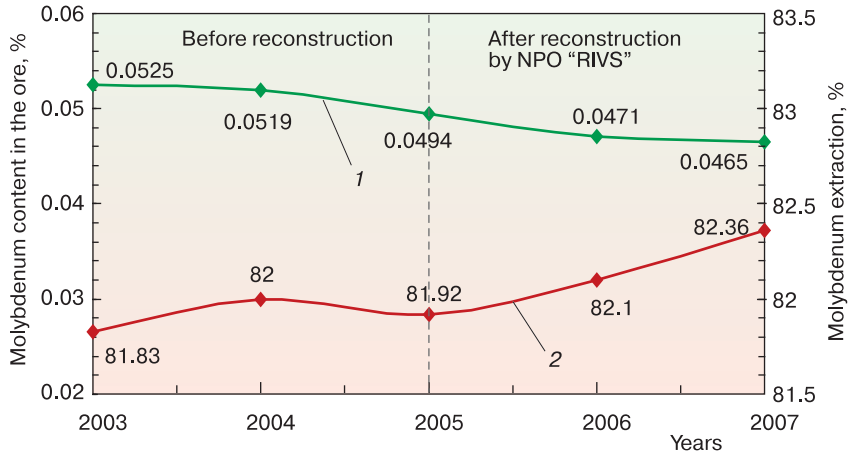

Fig.4. Technological parameters of operation of Kadzharan concentrating plant by molybdenum:
1 — molybdenum content in the ore; *2* — molybdenum extraction

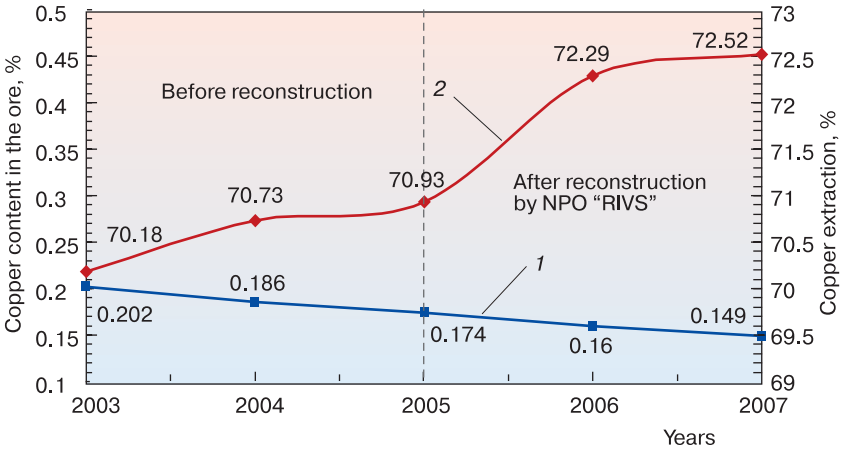

Fig. 5. Technological parameters of operation of Kadzharan concentrating plant by copper:
1 — copper content in the ore; *2* — copper extraction

10.34 meters diameter and mills MShC-6100x9500. On completion of the project productivity of the plant by processing of initial ore will be increased more than 1.5 times.

Today it is fulfilled mounting of the mills of semi-self-comminuting and ball mills of the firm Fuller, pump-hydro-cyclone units, the pumps for pumping of the high abrasive materials. Equipment for facility of semi-self-comminuting was made during two years. Productivity of the facility of semi-self-comminuting on initial ore will be 7 million tons yearly at the first stage. After mounting of the second ball mill output of the facility will increase to 10 million tons per year. It will permit to realize gradual putting out of operation of existing mills MShR-3200x3800 and MShC-3200x3100.

It is foreseen construction of the stock-yard of the floor type (without the bunkers) for coarse-crushed ore feeding to the mills of semi-self-comminuting. The ore will be sent to the stock-yard through the transport gallery by the belt conveyor.

The project foresees installation of the three press-filters with filtering area 61.2 m^2 (one press-filter — in the reserve) instead of seven drum vacuum-filters. Installed press-filters, produced by the firm Larox, work in automatic regime and produce the product with the moisture not more than 8% and with content of solid components in the feeding material 60–65%.

It is envisages to install two belt vacuum-filters LON-4.5 (one is the reserve) for filtering of molybdenum concentrate.

Automation of reconstructed concentrating plant will be realized within the bonds of creating of the single automated system of control of technological process (ASCTP).

It is offered to carry out continuous control of content of the metals in the products of concentrating on the base of the complex of analyzers Courier 6SL for 27 points.

Two compressors of high pressure of the firm Atlas Copco have been put into operation for ensuring of work of executive mechanisms and devices of control-measuring devices and apparatus.

The project foresees creating of the modern ASCTP for concentrating plant, ensuring centralized control of state of the equipment and technological process.

Investments for concentrating plant as a whole will increase 100 million USD.

Completion of construction and modernization of the plant will lead to decrease of cost of the product by 0.77 $/t. Expected cost will be 4.39 $/t, without depreciation charges — 2.88 $/t.

Period of covering of investments for the project will be 3 years and 8 months.

The reached real technical-economic parameters of initial stages of reconstruction of Kadzharan have confirmed the correctness of the technical solutions of the project. EM