The results of the investigations described above were used also for designing the Kambarata No. 2 hydrostation.

The effectiveness of constructing the Kambarata hydrostations Nos. 1 and 2 with homogeneous blast-fill dams is established by comparing with other variants of the cascade proposing the use of traditional-type structures (Table 3).

As is seen from the data presented, the variant of the cascade with homogeneous blast-fill dams has a considerable advantage with respect to all indices considered over competing variants.

The design studies of future construction projects carried out a Sredazgidroproekt show that blast-fill dams can be used successfully for constructing: the Karabulun hydrostation on the Naryn River, the Susamyr hydrostation on the Kokomeren River, the cascade of hydrostations on the Pyandzh River, the Kafkarguzar hydrostation on the Odi-Khingou River, the Barkrak hydrostation on the Chatkal River, Aravan hydro development on the Aravan River, and others.

LITERATURE CITED


COMBINED CONSTRUCTION METHOD

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The requirements imposed on increasing the effectiveness of massive earthworks in hydro-power construction make it expedient to use more widely hydraulicking with the high technical and economic indices inherent to this method. However, when excavating heavy soils, particularly gravel, pebble, and boulder soils containing off-size inclusions for dredge pumps, the effectiveness of the usual means of hydraulicking markedly drop and their use often becomes impossible.

The so-called combined method, in which soil is excavated by the dry-excavation method and placement in the structuers by the hydraulicking method, makes it possible to expand the use of hydraulicking under such conditions.

The combined method in a number of cases is most effective, it has a multitude of modifications and it is expedient to use it in various situations (Fig. 1). Individual elements of earthworks are performed by mechanisms optimal for the given conditions without violating the principle of continuity. In these cases sluice feeders or rock chutes with hydraulic loading can be used in addition to dredge pumps for hydraulic transport.

The combined method also makes it possible to transport soil to individual sections by the dry method and to include a sorting complex and, if necessary, crushing devices in the technological chain. The method under consideration can be used successfully for constructing large dams and other embankments, for performing large grading works, excavating canals, etc. At the same time, the use of this method, as a rule, is not expedient on objects with a volume of works less than 500,000-800,000 m³.

The combined construction method can be effectively included also in the technology of excavating and processing sand–gravel materials and other useful materials. In certain cases it is the only acceptable method with respect to technical and economic indices. The combined method of hydraulicking operations makes it possible to markedly reduce the need for scarce heavy-duty vehicles: diesel fuel is saved accordingly. The new hydraulic transport equipment for the combined method is not complex and can be manufactured by plants of the construction ministries.

There are a number of examples of using the combined method [1], where problems of...
slurry preparation are also examined. They are being solved successfully with the use of sluice feeders or rock chutes with hydraulic unloading. The material being transported hydraulically is loaded into the chamber 1 of the feeder (Fig. 2). After filling the chamber the valve 2 is closed, slide valve 3 is opened, and water begins to be fed through pipe 4 into the chamber. After filling the chamber and creating in it a pressure exceeding the sum of all hydraulic and geometric losses in the slurry pipeline 5, the water, carrying the material along with it, begins to flow into pipe 6, two or three loading chambers are joined into a single battery for providing uniform loading of the slurry pipeline with material to be transported. The cyclogram of the operation of the three-chamber feeder specified by the design [2] is automatically provided by the simplest command apparatus.

The sluice feeders make it possible to combine in one apparatus the preparation of the slurry and the creation of the head necessary for hydraulic transport. Compared with dredge pumps, the feeders have the following advantages: less wear, and they make it possible to increase the size of the material being transported by 2-2.5 times with respect to the capacity of dredge pumps of the same output. The range of transport in this case is determined by the pressure being developed, which is established from technical-economic calculations related to the choice of the pump operating on pure water. The consistency of the slurry being pumped is distinguished by constancy, is easily regulated, and can be higher than in the case of using dredge pumps. This important characteristic markedly reduces the possibility of clogging of the slurry pipelines. The efficiency of the hydraulic transport systems with the sluice feeders, as a rule, is 15-20% higher than analogous systems with dredge pumps.

The rock chute with hydraulic unloading (Fig. 3) consists in a loading device, pipe, and slurry-forming device. The latter is analogous to the device in the sluice feeder. The fundamental difference between the rock chute and the sluice feeder is that the head in the zone of slurry formation is obtained due to the hydrostatic counterpressure H of the column of water being injected by a pump into the rock chute. During continuous loading of the chute it is continuously unloaded. Water under pressure is fed through pipe 1 and fills the bore until the head H is sufficient to overcome the sum of geometric and hydraulic losses in the slurry pipeline, after which the slurry begins to flow into elbow 2 and the slurry pipeline connected to it. The consistency of the slurry can be changed in wide limits by adjusting slide-valves 3 and 4.

While retaining all the advantages of sluice feeders, rock chutes with hydraulic unloading are distinguished by maximum simplicity of design. A shortcoming of the rock chutes is that they can be used only under appropriate topographic conditions.

The advantages of the combined method of performing earthworks and, at the same time, its extremely rare use in hydrotechnical construction compels us to analyze the cause of such a situation. In our opinion, it consists in the following: the absence at hydraulic-transport trusts of dry-excavating mechanisms and transport means leads to complex organizational structures in which the responsibility for the operation of individual links in the continuous soils during hydraulic filling, which can lead to a decrease in the density of the fill; the fear of technical and organizational difficulties which can arise when construction the abutment of the part of the embankment being hydraulically filled to the part simultaneously being constructed by the dry method.

It can be stated that these circumstances can be eliminated with appropriate engineering provision of the works.

It is first of all necessary to devote attention to supplying hydraulic-transporting trusts with dry-excavation equipment. This would not only promote the development of combined methods but would also eliminate organizational difficulties related to preparation of the foundation, grading of hydraulic-fill structures, excavation of borrow pits, etc. Variants are possible when hydraulic-transport and dry operations are performed by different organizations, but in this case the mutual obligations should be thoroughly worked out and the spheres of responsibility determined.

Fractionation is clearly manifested when hydraulic filling sand and sand–gravel soils. Investigations of recent years showed that during hydraulic filling of coarse gravel–pebble soils containing boulders with an average size reaching 300 mm, i.e., those for which the use of the combined method has been demonstrated, fractionation is practically absent (hydraulic filling of the experimental portion of the dam at the construction site of the Rogun hydrostation).