2. The combined solution of design and technological problems on the basis of a thorough study of available experience made it possible to create a design of panels technologically easy to manufacture and install, which provided the high quality of the work on constructing and sealing the dam.

LITERATURE CITED


MONITORING DURING CONSTRUCTION OF THE MIATLA DAM

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During construction of the Miatla dam the introduction of the new tiered technology of concreting with requirements imposed on the temperature regime of the concrete and measures on regulating it which were considerably changed in comparison with the design, required conducting broad-scale investigations for checking those principles underlying the developed technology for preventing thermal cracking.

The program of these investigations was developed by the All-Union Institute for Planning and Organizing Power Construction (Orgénergostroi), which carried out methodological and technical supervision, and was fulfilled by the construction monitoring service, which carried out on-site measurements and their primary processing.

For the investigations, a large number of monitoring and measuring instruments were installed in the dam: 140 DDSch-6 remote gap meters (developed by Orgénergostroi) and 470 PPT-60 thermistor temperature transducers (All-Union Institute for Automation of Power Plants (Soyuzénergoavtomatika)). The temperature transducers were installed in 135 of the 290 blocks with a height of 1.5 m in a number from 1 to 14 instruments in a block. The gap meters were installed at one or two sites over the height in each grouting segment in all section joints, from 1 to 3 instruments in a block. By the time of sealing the grouting segments, from 50 to 88% of the temperature transducers and from 40 to 80% of the gap meters remained in an operating state.

The large volume of works related to the need for accomplishing the research program, along with providing the builders with prompt information and checking the observance of the technological regulations, required good organization of the construction monitoring service. This service at the construction site of the Miatla dam kept a record of the installation and special works, prepared and installed the transducers, took and processed measurements, and issued information about the temperature regime 3 times a week. The efficient operation of the service made it possible to control the temperature regime of the concrete and to promptly maneuver the means of temperature regulation being used on the dam and, as a result of this, to effect the following measures: to replace deep cooling of the aggregates with air in a special device at the concrete plant by cooling the aggregates by delivering river water to the screens; to considerably shorten the time of winterizing the faces of the dam and area of the surfaces being winterized; to intensify the process of cooling of the concrete after the temperature peak and to reduce the time of pipe’cooling of the concrete masonry when preparing the dam for sealing.

The introduction of a new modification of an instrument for measuring the deformation of the joints, developed by Orgénergostroi (Kuibyshev city), promoted to a considerable extent the prompt obtainment of information about the state of the section joints of the dam. This portable instrument with a self-contained power supply represents a microprocessor with a strict program of functioning entered in its memory. Together with the connected transducer, the instrument realizes a...
was predicted. This prediction was very accurate, which provided rapid turning over of the tiers for grouting and timely rapid
being sealed and reducing the expenditures on these works. The construction situation at the Miatla dam turned out to be
The entire cycle of measurement and calculation is 10-12 sea:. The information does not need additional processing. The
4-cycle test algorithm for increasing the accuracy of the measurement. Four given combinations of the quantity being measured
and of the reference standards are formed in the transducer according to the instructions of the instrument. The output
frequency signal of the transducer corresponding to each of the combinations is converted by the measuring circuit of the
instrument into a code and is entered in the main storage of the microprocessor. After the end of the four cycles of
measurement, calculation and indication of the opening of the joint are automatically carried out on the basis of their results.
The maximum error made by the instrument is 50 μm, the measurement range is 7 mm.

The construction monitoring service performed considerable work on preparing the tiers of the dam for grouting the
section joints. The results of this work are of interest, since they offer the prospect of shortening the time of cooling of dams
being sealed and reducing the expenditures on these works. The construction situation at the Miatla dam turned out to be
such that it was necessary to cool the dam to 7°C with water from a refrigeration station within 5.5 months instead of 18
months according to the design. Under these conditions, the builders increased the capacity of the refrigeration station by 2.5
times and organized strict monitoring of the operation of the pipe cooling system and refrigeration station. Constant
measurements of the temperatures and flow rate of the water in the system and checking of the operation of each coil were
carried out. On the basis of analyzing the data on the rate of cooling of the concrete masonry, volumes and temperatures of
the water in the pipe cooling system, and possibilities of the refrigeration station, recommendations were promptly made with
respect to the time of connecting the coils to the refrigeration station and the necessary duration of cooling the grouting tiers
was predicted. This prediction was very accurate, which provided rapid turning over of the tiers for grouting and timely rapid
connection and disconnection not only of the next grouting tiers but also individual blocks or groups of blocks.

A positive role in the operation of the pipe cooling system was played by arranging on one of the balconies an open
water drain from the coils into collectors.

The experience of operating pipe cooling showed the need for the quantity production of transportable instruments for
prompt measuring of the water flow rate in the coils.

For the construction of the Miatla arch dam, Orgenergo stroi developed recommendations on the regimes of pipe
cooling of the concrete. A group of specialists of the institute at the construction site performed routine control of the
operation of the pipe cooling system. Strict monitoring during the use of water cooled at the refrigeration station and, which
proved to be especially important, during cooling with river water provided a high rate of cooling of the dam. Whereas the
average rate of cooling of the Chirkey dam was 5-7°C/month, the Miatla dam was cooled with an average rate of 9°C/month.

It was established that the absence of the normal operation of cooling during the first 20 days after placing the
concrete leads to lagging of the decrease of temperature (to 7°C) in comparison with blocks with well-operating pipe cooling.
In the case of a high rate of constructing a dam, when at the upper tiers of grouting the water is delivered from the
refrigeration station to the blocks 20-45 days after placing the concrete, this lag would lead to an increase of the time of
cooling with cold water by 20-25 days. Since this additional time did not occur during construction of the Miatla dam, primary
grouting of the joints would have to be carried out at temperatures substantially higher than specified by the design. Thanks
to the organization of the efficient work of the construction monitoring service, it was possible to avoid this. The dam was
sealed at temperatures of 6.8-9.2°C versus 7°C required according to the design.

The cooling rate to a considerable extent depends on the uniformity of the distribution of temperature throughout the
concrete being cooled. Blocks having a higher temperature cool longer. It is obvious that the circulation of water through
cold blocks while warmer ones are being cooled is not effective. Furthermore, up to 40-50% of the cold is lost on the path of
delivering the water from the refrigeration station to the dam and back. Therefore, the blocks of one grouting segment should
have similar temperatures by the time of switching cooling from river water to the water arriving from the refrigeration station.
In this case, the duration of the circulation of cold water and energy expenditures will be minimum.

Thus, as a result of the uniform distribution of temperatures in the dam, which is a characteristic feature of the tiered
technology, strict monitoring of the operation of pipe cooling, and prompt control of the process of cooling the grouting
segments and individual blocks, the dam was cooled in a record short time, 3 times more rapidly than assumed in the design.
In this case, the actual use of the capacities of the refrigeration station in comparison with the original design increased by
only 50%. The grouting segments in the upper part of the dam were cooled from 20 to 7°C within 40-45 days. The speed of
the water in the coils was 0.6-1 m/sec. The temperature of the water entering the coils was 3-4°C.

It is especially necessary to note that the additional expenditures for installing a large number of monitoring and
measuring instruments were completely paid back by the results of the successful operation of the construction monitoring
service.