

Fig. 3. The flow pattern in the torus-shaped swirl

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THE SECURITY OF SPILLWAY STRUCTURES OF MEDEY MUD DAM

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Analysis of emergencies on hydraulic structures of RK shows that the contingency operation of spillways causes the erosion of dam. Some meas-

ures to improve dam safety monitoring systems, including those based on the new automated control system of technological process of hydraulic structures (ACSTP HS) with the features of animated and visualized computer simulation of operation modes of spillways that are created on the basis of laser robotic total station TOPCON GPT 3100N.

At the beginning of 90's there were more than 650 significant hydraulic structures. The total water volume of the biggest conservation reservoir equals to 80 billion cubic meters which is used for producing electricity, water supply and irrigation. At present time these structures has been used for 30–40 years.

The restructuring of ownership on the hydraulic structures has led to the fact that almost half of the hydraulic structures of the Republic of Kazakhstan is privately owned or unwonted. Oversight and monitoring function in the regions of the mudflow is performed by services SE «Kazmudflowprotection of Emergency Ministry», the rest of the region is under state monitoring in the line of hydraulic inventory of the Republic of Kazakhstan (Fig. 1).

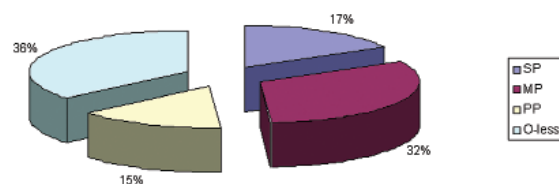


Fig. 1. Diagram of distribution of dams by ownership types, where SP – state property; MP – municipal property; PP – private property; O – less-ownerless

The problems of the aging hydraulic structures were keenly discussed at a training workshop on the organization of the International Training Centre for the safety of hydraulic structures on the basis of the Kazakh Research Institute of Water Resources (February 11–15, 2013, city of Taraz, Kazakhstan). A number of important decisions were included to the resolution of the workshop:

1. Accelerate the development and adoption of the Law on dam safety in the Republic of Kazakhstan;

2. Ask the Committee for Water Resources of Ministry of Environmental Protection to speed up the preparatory and organizational work on Kazakhstan's accession to the International Commission on Large Dams;

3. Request the Executive Committee of the International Fund for saving the Aral Sea (Mr. Ibatullin S.R.) to apply to the UNECE to provide financial support for the purchase of instruments and equipment for the laboratories of the Training Center of Taraz.

At the same time, on March 11, 2010 due to the breakout of private dams in the village of Kyzylagash there occurred one of the most devastating floods in the history of modern Kazakhstan. On the night of March 12, 2011 above the village Kyzylagash in Aksu district of Almaty region the flood claimed 40 lives, destroyed 70% of the villages, 146 households were demolished completely, 251 house destroyed, 42 in need of repair. The total number of the affected population was equal to 3,767 people (in the villages Kyzylagash – 2240, Aktogan – 562, Koltaban – 296, Eginsu – 626 and at the junction Kumtobe – 43). According to preliminary data, in order to recover damages in the village Kyzylagash caused by flooding 7,2 billion is required, 6,2 billion tenge of which will go to the construction of 686 new housing units in four locations (Kyzylagash, Eginsu, Alazhide, Aktogan). All families will receive 500 thousand tenge for each victim paid from the regional budget. Each member of the family affected by the floods (who lost their homes, livestock and other property), the Kazakh government has paid compensation in the amount of 121 thousand tenge. The cause of the accident is the same: heavy rainfall and poor performance of the spillway gate.

The poor state of the stock of hydraulic structures in Kazakhstan actualizes work to improve monitoring techniques of hydraulic structures, one of those is the use of computer simulation based on the three-dimensional laser scanner with GPS, on the basis of these data the computer models of the state of the hydraulic structures is made.

Analysis of Emergency Situations of hydraulic structures in Kazakhstan shows that the most common cause of accidents on the hydraulic structures of the Republic of Kazakhstan is associated with the level of monitoring of the state of the dam and spillway.

The emergency situation in 1973 at Medey dam spillways occurred due to the unplanned work since

the capacity of the mudflow storage reservoir is 6 million cubic meters, and approximate volume of the mudslide in 1973 was 5 000 000 cubic meters, therefore of mudflow mass flunked the entrance of the upper water intake of the first line of the dam spillways of Medey [1]. Due to the lack of water discharge into the river Small Almaty, mudflow storage reservoir started to overflow and there were only five meters left to the crest of the dam. The problem was eliminated only through the organization of drainage of water over the crest of the dam by means of construction of a temporary culvert with mobile pump performance.

After the catastrophic mudslide in 1973 in order to improve the safety of the dam spillways of Medey in the second phase of the dam there were built spillway redundant facilities, the total length of the tunnel which is 460 meters. Sectional area of the inlet tunnel 16 square meters, vertical shaft spillway has a diameter of 3,5 meters with a tangential swirl design by Slisskiy S.M., Akhmetov T.K. A distinctive feature of the second line are the high capacity of mudflow storage reservoir (12.6 million cubic meters) and new water intakes that are located on the bottom of mudflow storage reservoir to the crest of the dam (Fig. 2). It should be noted that after the construction and commissioning of the dam Medey, hydraulic studies of the dam were not conducted [2].

In 1999, a similar situation occurred during outbreak at the Small Ulba (East Kazakhstan region, Maloulbinsk Leninogorsk reservoir cascade), in 2010 in the village of Samara (East Kazakhstan region, Kokpekti district), in 2011 in village of Balkashino (Akmola region). The total damage is more than 10 billion. In all these situations, the root cause of the emergency was the off-design work of spillways due to heavy floods. All of the above reservoir recovered, but the monitoring system was expanded only in means of video surveillance.

The development of adequate computer models of spillways is relevant and practically important research [3], therefore, based on the «Research Institute of Mathematics and Mechanics» of the Kazakh National University after Al-Farabi there is a research work № 162/SF3 of Ministry of Environmental Protection «Computer simulation of the spillway» being performed which is funded by state budgetary, thematic work plan of this research requires the following activities:

1. Analysis of the technical documentation of the spillway, conducting workshops for the research group to study the characteristics of the design and hydrodynamics in the shaft spillway, studying and testing specifications and features of the software laser robotic total station Topcon GPT 3100N [4].

2. Identification of the main indicators of quality of the spillway of the dam of Medey as hydraulic structure.

3. Development of a computer model of three-dimensional visualization modes of hydraulic structures.

4. Development of a mathematical model of the system in real-time alerts about modes of the spillway.

5. Construction of mathematical models to predict emergency situation.

6. Trial operation of the subsystem of automated workstation (AWS) «capacity of the spillway».

7. Development of guidelines for the implementation and operation of the AWS «spillway» with its hardware and software adaptations to existing automated control systems of technological processes of hydraulic systems and video surveillance.

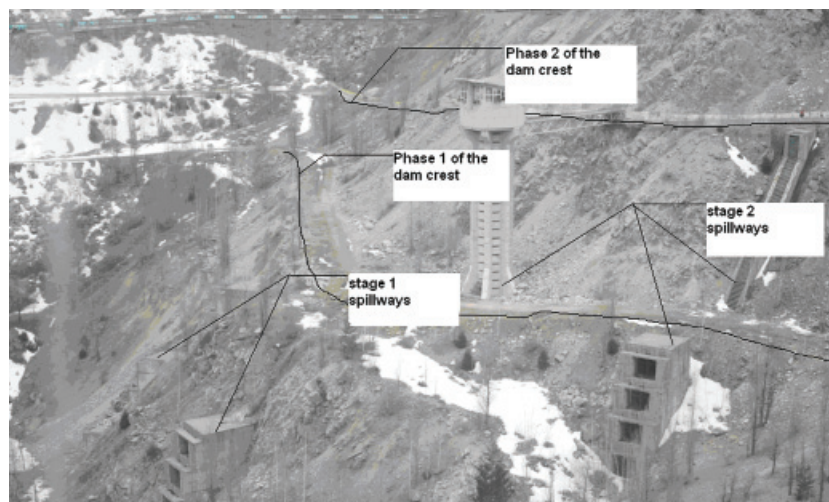


Fig. 2. Medeo mudflow dam and spillway structures of 1st and 2nd line

These studies are planned for the period from April 2013 to December 2015. The results will be introduced to the units of Emergency Ministry and Ministry of Environmental Protection.

In conclusion, on the basis of the developed automated workstations «spillway» there can be performed an on-line computer monitoring of dams and spillways of hydraulic structures of Kazakhstan, additionally there is an opportunity of expansion of security of unified management, analysis, and operational guidance to the mudflow dams and drainage structures of the Republic of Kazakhstan .

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