Materials of Conferences

LONG-TERM ASPECT OF THE KAMA RESERVOIR WATER BALANCE

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Water balance and concerned with it water exchange define in a greater or lesser degree all elements of a regime of natural and artificial reservoirs. Since level fluctuations are connected with change of water balance elements it has affect on variance of morphometric characteristics. Although water balance of reservoirs is identical in structure with water balance of lakes it differ a number of specific features in a behavior and proportion of input and output elements. Singularity water balance of reservoir is caused first of all by repercussions of complex interaction between natural and anthropogenesis factors. Anthropogenesis factors define nature of water input and water output in reservoirs with cascade of hydroelectric power stations.

For the first time the average of mean annual sizes of water balance elements for a long term for the Kama Reservoir was defined by V.I.Ponomarev, E.A.Snegirev, L.I.Ponomareva in Recurs Poverkhnostnyx Void SSSR (part 2) (Recourses of a Surface Water of the USSR). The information from 1956 to 1967 had been generalized by the authors.

In concordance with data of water balance from 1956 to 1993 annual reservoir inflow from master river (Kama) was 29,76 cubic kilometers (53,18% from water input). This value is just over the similar size based on data for shorter period of estimation from 1956 to 1967. This information is presented in Recurs Poverkhnostnyx Void SSSR (Recourses of a Surface Water of the USSR). Lateral inflow for longer period is 24,08 cubic kilometers (43% from input). Lateral inflow for shorter period is 24,56 cubic kilometers (46,3% from input). The unchanged cumulative value of water from master river and from lateral inflows is 54 cubic kilometers. The meteorological precipitation value is also unchanged. In concordance with data from 1956 to 1967 it is 0,92 cubic kilometers or 1,6% from hydrologic equilibrium input. In concordance with data from 1956 to 1993 it is 0,93 cubic kilometers or 1.66%.The annual water from floating ice and from snow for a long period (0,47 cubic kilometers or 0,84% from input) is less than for short period (0,50 cubic kilometers or 1,0% from input). In concordance with data from 1978 to 1993 annual trade waste discharge value is 0,72 cubic kilometers or 1,29% from water migration into reservoir. Because of lack of trade waste discharge data, it is impassible to compare two periods.

The total reservoir inflow for a long period (55.96 cubic kilometers) is higher than the total reservoir inflow for a short period (55.41 cubic kilometers). The difference is caused by accounting of water entry from industrial sewage. If this element was considered in annual water balance for a shorter period, total reservoir inflow for a short period and total reservoir inflow for a longer period would be the same.

The basic account component of water balance of a reservoir is the size of water spill through hydroelectric power station turbines. During 1956-1967 its size has constituted in an annual balance 51,68 cubic kilometers (97,6% from a water-resources output part of balance). For the long period it became higher – 52,78 cubic kilometers (95,89% from input to a reservoir). The size of water loss by evapotranspiration from a reservoir surface for both compared periods are identical and constitute 0,79 cubic kilometers (1,5% from the discharge for the short period and 1,4% – for the long period). The stranded ice loss for the long period became shade less (0,46 cubic kilometers or 0,83% from the discharge), than during the short period (0,51 cubic kilometers or 0,9% from the discharge).

Since 1978 making up of water balance began to consider a value of a travel of water through a dam (Ф). During 1978-1993 its annual size has constituted 0,51 cubic kilometers or 0,92% from a discharge part of balance. Even more, during the same period began to consider lockage losses (Ш) (the annual size has constituted 0,08 cubic kilometers or 0,14% from the discharge) and size of a water draft for municipal demand (З) (0,76 cubic kilometers or 1,37% from the discharge). Comparison of these characteristics for the long and short periods of record is impossible.

Total reservoir losses of water during 1956-1967 in annual aspect (52, 92 cubic kilometers) are less than for longer period (55, 38 cubic kilometers). This is first of all connected with allowance for new components (Ф, Ш, З). If not to consider these components water losses for the long period will be also higher (54, 03 cubic kilometers), than for the short period (52, 92 cubic kilometers). Comparing input and discharge parts of water balance of a reservoir for short and longer periods of record it will be observed the following:

size of inflow in a reservoir for a short period (55,41 cubic kilometers) and for a long period (55,96 cubic kilometers) are sufficiently close (if to consider industrial discharge for the short period they will be almost identical);

size of water loss from a reservoir for the short period (52,92 cubic kilometers) and for the long period (55,38 cubic kilometers) are different.

Annual sizes of input and discharge parts of water balance for the long period are sufficiently close (55, 96 cubic kilometers and 55, 38 cubic kilometers), for the short period they are essentially different (55, 41 cubic kilometers and 52, 92 cubic kilometers).

Above mentioned differences are first of all connected with allowance of new components of balance for a long period ($П_с$, З, Ш, Ф) and also with more precise determination of size water evacuation through tailrace structure.

The conclusions

Research of water balance components of the Kama Reservoir (1956-1993) has conclusions:

1) the basic components input parts of the Kama Reservoir balance is a reservoir inflow from the Kama River (53,18% in annual aspect), lateral inflow – 43,03%, meteorological precipitation from reservoir surface – 1,66%, industrial discharge – 1,29%, water from emerged ice and from emerged snow – 0,84%.

2) the basic components of water-resources output: water evacuation through the Kama hydroelectric power station turbine– 95,31%, evaporation from a reservoir surface– 1,43%, a water draft for municipal demand – 1,37%, a water filtration through a dam – 0,92%, stranded ice losses– 0,83%, lockage losses – 0,14%.

Comparison of components input part sizes and discharge parts sizes for short (1956-1967) and longer period has shown that on the Kama Reservoir inflow from the Kama River has increased from 29,44 cubic kilometers to 29,76 cubic kilometers, lateral inflow has decreased from 24,56 cubic kilometers to 24,08 cubic kilometers). The amount of precipitation has not changed, water from emerged ice has decreased from 0,50 cubic kilometers to 0,47 cubic kilometers. Water evacuation through the Kama hydroelectric power station turbine has increased from 51,68 cubic kilometers to 52,78 cubic kilometers, evaporation from a reservoir surface has not changed, stranded ice losses are decreased from 0,51 cubic kilometers to 0,46 cubic kilometers.

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