IOP Conference Series: Materials Science and Engineering



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**Abstract**. The use of water metering devices operating on hydraulic energy for open canals of on-farm irrigation systems, the error in measuring water flow is substantiated. In addition, the article provides an analysis of the water metering in main canals, the possibility of using hydraulic structures. In modern conditions of agricultural development, a special role is assigned to hydro-reclamation, as one of the main factors that guarantee high stable yields of agricultural crops. At present, when water has become an expensive commodity, for the rational and efficient operation of irrigation systems, operational and objective water metering must be carried out, and hydraulic structures on the canals must ensure the supply of specified costs. To control the consumption of water in open canals of irrigation systems, mobile and stationary gauging stations are used - water metering points.

## 1. Introduction

At present, in Uzbekistan, unlike other countries in Central Asia, most of the meteorological stations and hydrological posts have been preserved and are functioning. Meteorological, hydrological and agrometeorological observations have been carried out on the territory of the republic since 1921. Environmental observations of the state of water bodies, air, soil have been carried out since 1972. In Uzbekistan, the hydrological network has 66 river and 3 lake posts related to 16 hydrological stations, 12 river and 5 lake posts related to 3 lake stations, 38 river and 2 lake posts related to 13 territorial hydrometeorological departments, transboundary monitoring posts 10.... Posts whose information is used in the preparation of hydrological forecasts and international exchange 16, information posts 25, the rest 80 [1; 2; 3; 4, 5].

In recent years, there has been a significant decrease in the number and level of technical condition of water metering points (WUP). For the period from 1995 to 2018, the number of water metering points in the Republic of Uzbekistan decreased; gauging stations are equipped only with gauging rods and have outdated measuring instruments, the rest do not have measuring instruments at all. Only 17% of water metering points are provided with power supply, about 90% of water metering points do not have measurement automation and elementary communication with the dispatching point. Existing devices and devices for measuring water flow, domestic and foreign manufacturers, are of limited use in irrigation canals due to the following reasons: low measurement accuracy, lack of power supply at water metering posts, high cost of devices and complexity in operation. The introduction of paid water use requires water management organizations to equip the water metering point with technical means that provide a modern level of commercial water metering, the introduction of simple, reliable and non-volatile measuring instruments [1; 2; 3; 4, 5].

## 2. Methods

In the course of studying the process of water distribution in the irrigation systems of the Republic of Uzbekistan, including the Naryn-Karadarya Department of Hydroscopes, it was found that the main contradictions between the consumer and the supplier arise in water accounting. Overcoming these contradictions is possible by using such a water metering technology on the irrigation system that would ensure high objectivity and independence of water metering, and such water metering devices, the measurement accuracy of which could satisfy the consumer and the supplier. According to the results of the survey of the canals, it can be noted that the canals have small bottom slopes and flow velocity, a large length, the movement of water in the canals is calm, the backwater and decline curves are of considerable length. The canal routes mainly run in a semi-ditch - semi-fill [17;18; 19; 20].

In this case, the channels have the following hydraulic and hydrometric features:

1. There are no water-measuring structures on irrigation systems, and calibration of the structures on the canals, as a rule, does not give satisfactory results, since it is difficult to judge the costs when the canals operate in retaining modes by the installed rails in the pits;

2. Determination of water consumption in canals is carried out using hydrometric rotors, which is rather laborious and not promptly, information on costs comes with a great delay from need;

3. On low-order canals, water discharge, as a rule, is not determined at all.

Analysis and assessment of the equipment of irrigation systems with water metering means shows that until now the organization of water metering has not been given due importance. Practically only on telemechanized irrigation systems, gauging stations at the points of water intake from irrigation sources, at water distribution centers and points of water outlets of the economy were equipped with devices for measuring flow and water level [6; 7; 8; 9; 10].

Implementation in practice of hydraulic methods is possible by installing at the necessary points specially designed structures for water metering or by using existing hydraulic structures by calibrating them. From the point of view of efficiency and expediency, the method of calibrating existing hydraulic structures, when the location of the latter coincides with the metering point, has a significant advantage over all other methods. Therefore, when drawing up a master plan for a network of metering points, first of all, the issue of the possibility of using hydraulic structures is solved, which, in terms of their condition, design and operating conditions, ensure the accuracy of the calibration itself and subsequent water metering.

The calibration method and scope of work during its implementation is as follows [6; 7; 8; 9; 10].

The flow rate of water passed by a hydraulic structure, in addition to its direct measurement, can be determined using the flow formulas known in hydraulics, establishing a relationship between the flow rates and flow elements in the structure:

$$\boldsymbol{Q = m\omega\sqrt{2gh}}$$

There: $\boldsymbol{Q}$- required water flow; $\boldsymbol{\omega}$- the area of the opening of a structure through which a stream flows or the area of the free flow into a structure; $\boldsymbol{g}$- acceleration of gravity; $\boldsymbol{h}$- actual head, determined differently depending on the flow conditions.

All elements included in this formula, with the exception of the value m, for each individual case can be determined locally without much difficulty. For instance: (o - measuring the width and height of the hole or the width of the hole and the height of the overflowing layer of water above the threshold of the structure, d - measuring the depth of water in the area of the structure. More difficult is the correct choice of the value of m, taking into account the resistance of the flow when it moves through the structure, since the value of the flow coefficient is different not only for different types of structures, but also for a given structure under different conditions of its operation [11; 12; 14; 16].

## 3. Results and Discussion

The use of tabular values of t to determine the flow rate according to the given formula can lead to errors that are unacceptable for practice, since the theoretical flow coefficients do not cover all possible operating conditions of the structure and the choice of the coefficient in some cases will always be somewhat arbitrary. The task of calibrating this structure is the experimental determination of the coefficient by directly measuring all the elements included in the flow formula and calculating the desired value from them. But the degree of complexity of the production of calibrated works and the accuracy of water accounting according to the calibration data depends on the nature, design of the structure and on the conditions of its operation. Sufficient accuracy of water accounting with a moderate amount of calibrated work determines the degree of the so-called water measurement of the structure. We processed several field data of the hydraulic structure of the 4-trunk canal of the large Fergana canal [2; 3; 13; 15].

To calibrate the hydraulic structures of the main canal, the relationship between the flow of water and the depth above the threshold was made (Figure 1).

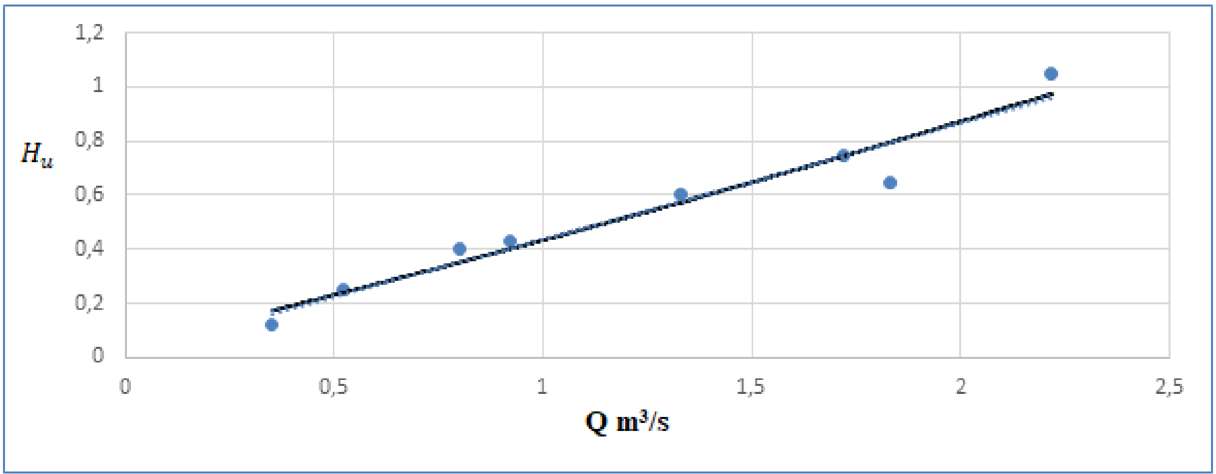


**Figure 1.** Dependence of water discharge and water depth above the sill in the upper pool

The flow coefficient is calculated using the flow rate formulas of V.N.Yartsev, which have the following expression for a different nature of the flow:

With free flow through the threshold:

$$m = \frac{Q}{b\sqrt{2g}\,H_u^{3/2}}$$

There: m- the required flow coefficient;
*b*- clear span width, m;
$H_u$- depth of water above the threshold in the upper reach of the structure; $\sqrt{2g}$ =4,43

With a flooded outflow

$$m = \frac{Q}{b\sqrt{2g}\,H_u^{3/2}\sigma_f}$$

There: $\sigma_f$- flooding factor;
$H_t$- tailwater.

$$\sigma_f = \frac{\frac{H_t}{H_u}\sqrt{1-\frac{H_t}{H_u}}}{0,385}$$

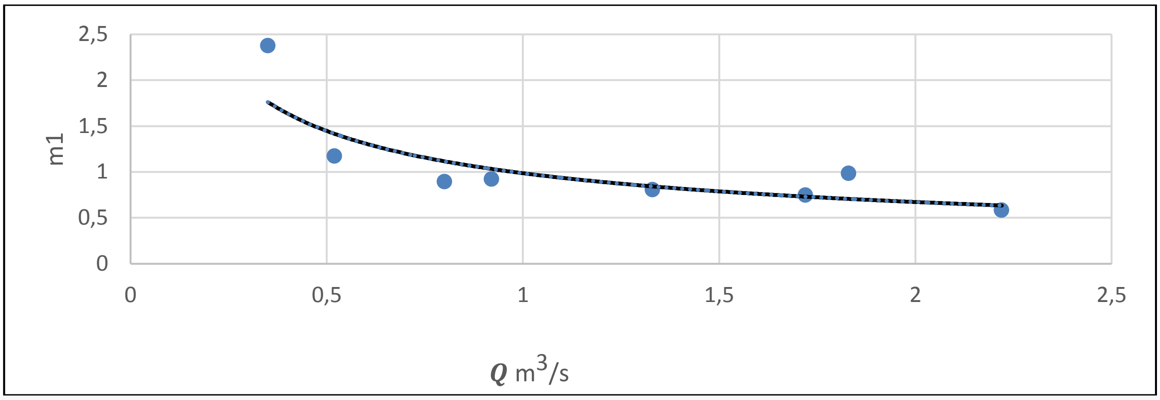


**Figure. 2.** Dependence of **Q** and **m** at free flow

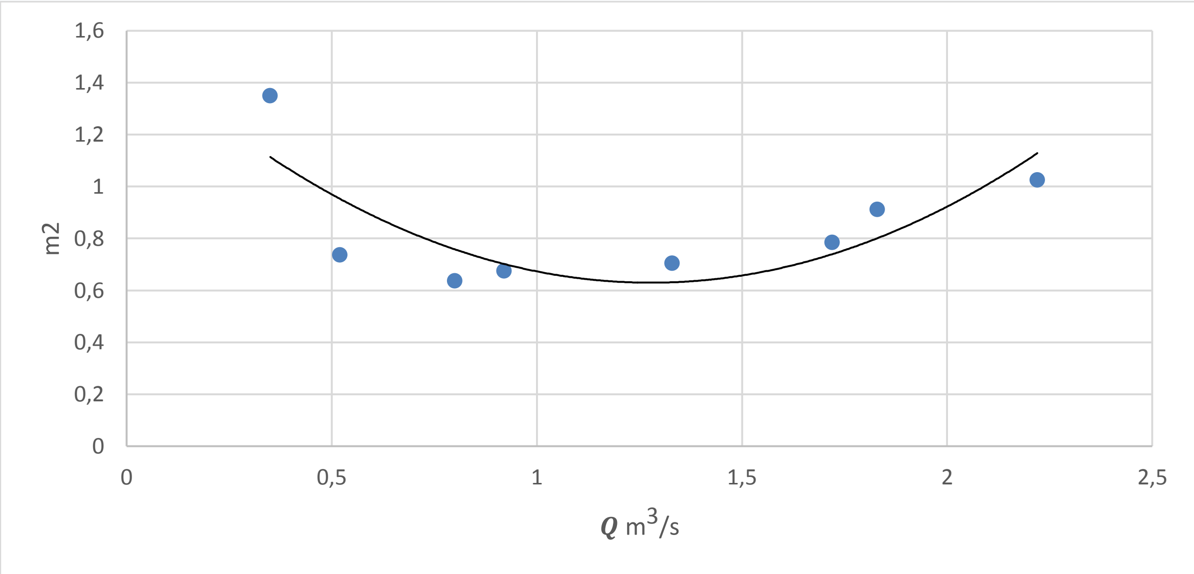


**Figure. 3.** Dependence of **Q** and **m** for a flooded outflow

If, after checking, no dependence in the change in m about one of the indicated values can be established, then, obviously, gross errors were made during field measurements or the structure is operating in unfavorable conditions (Fig. 2, 3). In the first case, the calibration must be repeated; in the second, it is necessary to refuse to meter water using this structure.

Analysis and assessment of the equipment of irrigation systems in the 4-main canal of the large Fergana canal shows that until now the organization of water accounting has not been given due importance. Practically only on telemechanized irrigation systems, gauging stations at the points of water intake from irrigation sources, at water distribution centers and points of water outlets of the economy were equipped with devices for measuring flow and water level. At the same time, the tasks of the operational management of water distribution were mainly solved, and not the accounting of water resources.

## 4. Conclusions

1. Water metering devices should be simple in design, resistant to weathering and work reliably, should not require special highly qualified training of service personnel and significant time spent on hydrometric works, which is very important for private water use;

2. Irrigation systems, as a rule, do not have power supply, therefore, it is advisable to use water-measuring devices operating on hydraulic energy;
3. The use of water-measuring devices should not change the operating hydraulic regime in the canals, stably fit into the technological process of water distribution;
4. The measurement error of water metering devices on canals of irrigation systems should be no more than 4% during water metering.

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