USING THE DIMENSIONAL ANALYSIS METHOD IN THE CALCULATION OF THE SHRINGING CHANNEL

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Abstract: *The method of dimensional analysis is used to solve certain complex hydraulic problems. When this method is used in conjunction with experimental work, it yields more reliable and effective results. This method provides a correct and reliable direction for identifying the main factors influencing the hydraulic process under study. Dimensional analysis fully represents the phenomenon under consideration and provides useful steps aimed at expression.*

Keyword: *Physical properties of a liquid, dimensions of sharp contraction, geometric parameters, velocity, pressure, energy dissipation*

When studying the impact of sharp contractions on energy distribution in open-channel hydraulic structures, dimensional analysis can be considered a necessary tool for understanding processes with a physical basis and for quantifying their impact. The problematic variables in this problem are:

- dimensions and geometric parameters of sharp contraction;
- physical properties of the liquid (e.g., viscosity and density);
- states of upstream and downstream currents (e.g., velocity and pressure), - propagating energy.

Measurement analysis also helps to compare and summarize the results of various experiments or calculations. By determining the most important dimensionless criteria, it will be possible to perform a parameter swap and determine the influence of various factors on energy losses in open channels with sudden narrowing.

The main characteristic of dimensional analysis is that any physical quantity is expressed by such basic dimensions as length (λ), mass (λ), and time (λ). Each physical quantity can be written as a product of the basic dimensions in certain degrees. In general, the dimensional analysis method is an effective method in scientific research and engineering practice, allowing for the study of relationships between variable factors and the understanding of the fundamental laws governing physical systems.

The general relationship of the main parameters affecting energy losses can be expressed as follows:

$$\Delta E = f(Q, \rho, g, B, b, h, L_c) \quad (1.1)$$

From this, we see that the number of variables is n = 8:

$$f_1(Q, \rho, g, B, b, h, L_c, \Delta E) = 0 \quad (1.2)$$

The experimental model used in the study and all parameters affecting channel narrowing are summarized in Table 1.1:

Table 1.1.

Dimensional analysis of current research parameters in the international system of units

Variable	Definition	Unit of measurement
Q	Water consumption	m^3/s
ρ	Fluid density	kg/m^3
g	Free-fall acceleration	m/s^2
B	Channel width	m

b	Width of constricted segment	*m*
ΔE	Energy loss	*m*
L_c	Narrowing length	*m*
h	Water flow depth	*m*

Since during the experimental work it was assumed that the flow is in a non-stationary mode, the depth of the flow in front of the narrowing section (h) total consumption (Q) is considered as a function. Channel width during the experimental study B is constant, the percentage of energy loss can be estimated using an empirical equation related to formula (4.1), which is expressed as follows:

$$\Delta E = f(Q, b, L_c) \quad (1.3)$$

Experimentally, energy losses are determined as follows:

$$\Delta E = E_1 - E_2 = \left(h_1 + \frac{v_1^2}{2g}\right) - \left(h_2 + \frac{v_2^2}{2g}\right) \quad (1.4)$$

The indicators obtained from experimental data (Table 1.2) were mathematically processed, and the correlation of flow parameters was determined using the regression analysis method. Regression analysis flow rate υ, flow depth h, constriction length L_c and the relative channel width coefficient $\frac{b_c}{B}$ aimed at determining the functional relationship between

Based on the results obtained using the regression model, the energy and hydraulic flow losses in narrowing channels were forecasted. This approach allows for the analytical modeling of flow processes and increases the accuracy of calculations in non-stationary situations.

Each variable has a different effect on energy loss. Therefore, the influence of each parameter considered in the studies conducted in this section on energy losses is highlighted and analyzed separately.

Table 1.2.

Dimensions of parameters affecting energy loss

Narrowing width (cm) |	Narrowing length (cm)	|Water consumption (m^3/ watch) |
25, 30, 35, 40	60, 90, 120	10, 15, 20, 25,30

Initially, the value of the energy loss in the narrowing channel, expressed in Equation 1.1, is determined by the difference in total energy in the pre-narrowing (upper) and post-narrowing (lower) flow states. Based on this, the relative amount of energy loss resulting from contraction (as a percentage) is determined by the following expression:

$$\Delta E = \frac{E_1 - E_2}{E_2} * 100\% \qquad (1.5)$$

SUMMARY

1. The study of the effect of sharp contraction on energy losses in channels with a variable cross-sectional area showed that it is important in two main respects. First, it helps to better understand the mechanisms of energy loss in open channels. Secondly, it makes it possible to predict the amount of energy loss occurring in the channel under certain conditions. Therefore, according to the analysis of the research results, the basis for the effective and stable design and operation of flow systems of the narrowing channel has been created.

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