

MATHEMATICAL MODELING OF THE FLOW PROCESS FOR A HYDRAULIC SYSTEM OF AUTOMATIC REGULATION

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In this paper is calculated the dynamical model of the filling-discharging of two tanks with constant cross section: S_1 and S_2 , with the fluid level L_1 and L_2 in the two tanks. The supply flow is Q_a and the evacuation flow is: Q_e . The two tanks communicate through a pipe witch is inclined by an α angle, and has the cross section S . The influence of the regulated and the execution measures is simulated with the mathematical software Maple. The calculus of the mathematical model of the inclined pipe with the α angle: the reaction force is the friction force of the fluid with the pipe's walls; the flow rate depends of the length L_0 of the pipe, the friction coefficient k of the fluid with the pipe:

$$Q = L_0^2 \sqrt{\frac{\Delta P}{\rho k}} - \rho S L_0 g \cos \alpha$$

For the stationary regime of the flow process, using the equilibration of the forces we have:

$$\Delta P_0 S - k \rho L_0 S \frac{Q_0^2}{L_0^5} + \rho S L_0 g \cos \alpha = 0$$

For the dynamical regime :

$$S \Delta P(t) - k \rho L_0 S \frac{Q(t)^2}{L_0^5} + \rho S L_0 g \cos \alpha = \frac{d}{dt} (M v(t))$$

Mathematical modeling of the flow from the tank (1) to the tank (2) through the pipe L_0

For the stationary regime of the process flow are valuable the next relations:

$$\rho Q_{a0} - \rho Q_0 = 0$$

$$\rho Q_0 - \rho Q_{e0} = 0$$

In the case of the dynamical regime the difference between the input and output quantities are:

$$\rho Q_a(t) - \rho Q(t) = \frac{dM_1(t)}{dt} = \rho S \frac{d}{dt} (L_1(t))$$