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 :

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

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:

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