National University of Food Technology, Ukraine

PRACTICAL ASPECTS OF MODELING HYDRODYNAMIC CHARACTERISTICS IN THE SYSTEM OF PIPELINE VALVES

Prof. Valerii Myronchuk, DcS
Sergii Volodin, graduate student

Abstract: Proper operation of control valves allows you to maintain the parameters of technological processes and increase the effect of juice purification and sugar yield, reduce the sugar content in molasses, reduce fuel consumption and milk of lime. Search for rational parameters. The technology of the control valve selection is offered in the work, on the basis of the analysis of the static characteristic of the working object.
Empirical methods have been used to calculate the cost characteristics for evaluating the operation of control valves and shut-off elements. Models of the object of regulation on the experimental stand are investigated. When reproducing the operation of the regulator without a muffler - the transient time is twice less.
Keywords: control valves, parameters, technological processes, sugar yield.
The object of research is - shut-off control devices with electric-pneumatic drive and pneumatic drive of the tracking type.
The subject of research - design and operational parameters of locking control elements with electro pneumatic and pneumatic actuators as part of the technological equipment of sugar production.

TASKS

1. Perform an analysis of modern problems of selection and integration of shut-off control devices in the hardware-technological scheme of sugar production.
2. On the basis of scientific analysis of known methods and techniques of mathematical, physical modeling of shut-off control devices, Build optimization mathematical models and implement using the developed algorithms and methods, synthesis of tracking and positional control modules of shut-off control devices.

Mathematical model

To model the transients in the electropneumatic control subsystem of the shut-off plunger of the control valve, a number of assumptions were made: as a power element of the drive used a double-acting pneumatic cylinder; the coefficients of flow and recovery of pressure in the pneumatic booster, supply pressure and drain are constant values; the temperature and viscosity of the working fluid (product) in the pipeline during the considered dynamic process do not change; the volume losses in the supply pneumolines of the pneumatic cylinder are small and can be neglected. Based on the accepted assumptions, the mathematical model has the following form.

1. The equation of the electrical circuit of an electromechanical converter.

$$\left(U_{\partial p} - k_{\text{ос}} \cdot Q_K(t)\right) \cdot K_y = R_{\partial p} \cdot i_{\partial p}(t) + L_{\partial p} \cdot \frac{di_{\partial p}}{dt} + K_{\text{Кр е}} \cdot \frac{dh(t)}{dt},$$

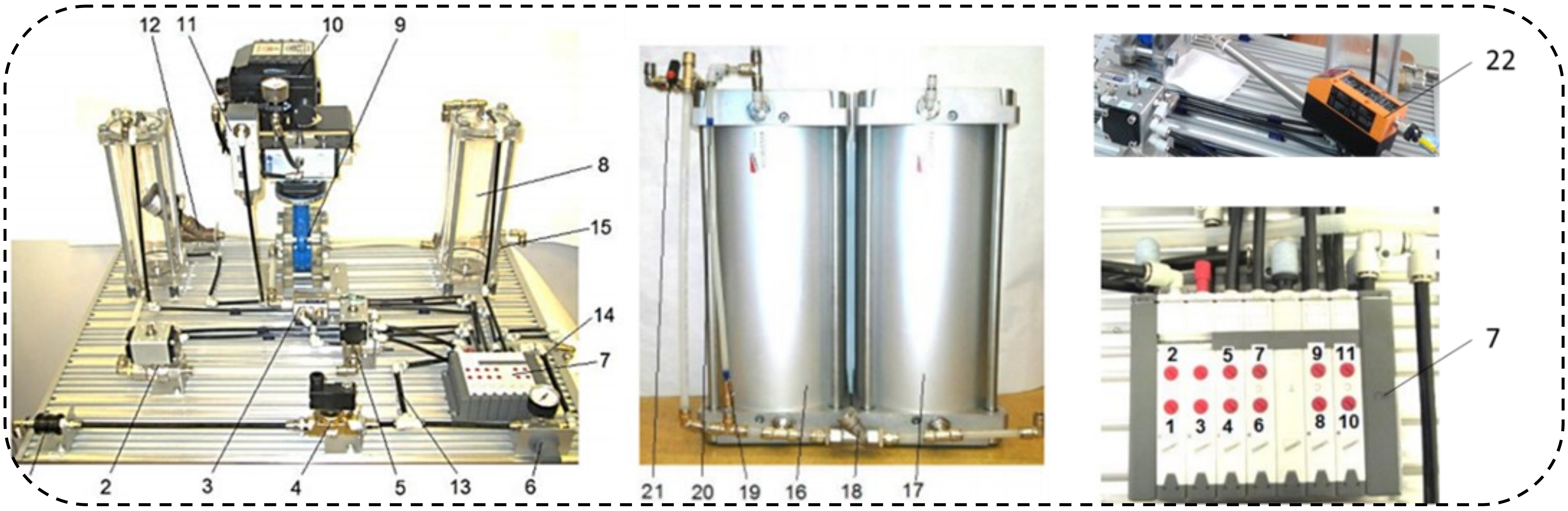
where Udr is the voltage in the control winding of the electromagnet, B; Rdr - active resistance of the control winding of the electromagnet, Ohm; idr (t) - the dependence of the current in the control winding on time, A; Ldr - inductive resistance of the control winding of the electromagnet, Gn, Kp e- coefficient against the electromotive force of the electrical circuit of the electromechanical converter, V · s / m; h(t) is the dependence of the movement of the throttle control valve on time, m

2. Equation of motion of the control valve of the shut-off valve.

$$m_{\partial p} \cdot \frac{d^2 h(t)}{dt^2} = K_{fi\partial} \cdot i_{\partial p}(t) - b_{v\partial\partial} \cdot \frac{dh(t)}{dt} - c_{\partial p} \cdot h(t),$$

where mdr is the mass of the throttle control valve, kg; Kfid - current ratio in the electrical circuit of the electromechanical converter, N / A; bvdr - coefficient of viscous friction in the throttle, N · s / m; sdr - spring stiffness coefficient in the throttle, N / m

Experimental installation for research of kinematic and dynamic parameters of shut-off and regulating devices in the conditions of variable productivity:



1- valve VMS-114-1 / 4 compressed air supply; 2 - the crane spherical two-running D100H004; 3 - coaxial valve VNC10003; 4 - solenoid valve; 5 - the crane spherical three-running L-port; 6 - pressure regulator; 7 - pneumatic island-ditch; 8 - receiver for collecting liquid, 10 l; 9 - disc latch interflange D376, 10 - electropneumatic positioner (4..20 mA); 11 - coalescent filter; 12 - the valve seat NC; 13 - high pressure line; 14 - low pressure line; 15 - check valve; 16 - liquid supply receiver - 30 l); b) circulating module of continuous supply of product (water) (17 - receiver of liquid collection - 30 l; 18 - check valve G1 / 2 "XVNR-212-1 / 2; 19 - control of the lower level of filling of the receiver; 20 - control of the upper level filling the receiver; 21 - ball valve A202-3 / 8); c) control module (22 - digital flow meter; 7 - pneumatic island)

Conclusion:

The conducted researches caused: improvement of transients in the drive, reduction of time of transient process and a maximum of dynamic error.
The error of the performance of the moving part of the drive, at constant modes, is largely determined by the accuracy of the pressure regulator. The objects of study are related to each other through dynamic characteristics and margin of safety

References