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SAFE MANAGEMENT OF HAZARDOUS INDUSTRIAL FACILITIES ON THE BASIS OF CONDITION OBSERVERS AND REDUCED ENVIRONMENTAL IMPACT

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ANNOTATION

The article discusses the safety problems of the gas processing industry. Methods for the prevention of emergency situations at hazardous production facilities (HPF), through the use of automated control systems, are proposed. A dynamic model of the control object is built. The application of the developed systems will reduce accident rate and maintain technological equipment, thereby increasing resistance to the damaging factors of emergencies.

Key words: gas processing industry, accident, automatic control, state observers, safety, control object, dynamic system.

INTRODUCTION

A decrease in oxygen and an increase in carbon dioxide, in turn, will affect climate change. The so-called "greenhouse effect" arises, and the mean planetary temperature rises. Emissions are especially high at gas processing enterprises in the event of emergency situations on main gas pipelines and during their scheduled repair. In this regard, environmental requirements for industrial facilities of the country are becoming more stringent every year. The main direction of the decree of the President of the Republic of Uzbekistan dated October 3, 2018 No. PP-3956 "On additional measures to improve the public administration system in the field of ecology and environmental protection" is the introduction of innovative technologies that reduce the negative impact on the environment and public health.

Results and its discussion. The technological processes of the gas processing industry related to hazardous production facilities (HIF) are carried out at high temperatures and pressures capable of creating emergency situations (ES), i.e. create explosion, fire and gas poisoning. Accidents at the enterprises of the gas processing industry entail great material damage and lead to significant costs in the restoration of production. To increase the resistance to the damaging factors of emergencies, it is necessary to carry out a number of measures to prevent fires and explosions and reduce their development in case of occurrence.

Research objects and methods. In order to reduce accidents, ensure comprehensive protection and emergency resistance at explosive and fire hazardous industrial facilities, it is necessary to use automated systems for controlling technological processes. Automation of production processes is the highest form of development of gas production and transportation technology, providing for the use of advanced technology, high-performance and reliable equipment.

The fundamental problem of automatic control theory is the problem of safe observation, which is solved on the basis of the theory of asymptotic state observers. In many cases, only after solving the observation problem can one begin to solve the control problem, namely, to the synthesis of feedback [1,2].

To form a safe feedback in automatic control systems, information about the state vector of the control object is required. In the case when all the state variables are available for measurement, a feedback can be selected for the controlled system that provides the desired dynamic properties of the closed-loop system [3-4]. In practice, usually measured (output) variables of an object are only individual components of the state vector or linear combinations of these components (either because the number of measuring devices is limited, or because some of the state variables, in principle, cannot be measured). Ensuring safety requires the installation of additional sensors, however, on the one hand, this leads to an increase in the cost of the system, and on the other hand, measuring devices introduce unnecessary dynamics into the control system, which complicates the synthesis of the control system. Thus, there is a need to solve the observation problem, namely the problem of obtaining current information about the state vector of dynamic systems by the measured variables [5-6].

Consider the problem of safe recovery of the current values of the components of the state vector of the system from the measured variables in relation to linear multi-connected stationary systems of the following form:

, (1)

where is the state vector; - control vector; - vector of output (measured) variables; A, B, D - matrices with constant coefficients of the corresponding dimensions. Without loss of generality, we will assume that.

The idea of constructing safe asymptotic observers is to construct a dynamic model of the control object (1) and then “fit” the initial conditions using corrective actions of the observer [8, 9]:, (2)

where is the state vector of the observer; - matrix of coefficients before corrective actions to be determined.

The problem of estimating (observing) the state vector is reduced to the problem of stabilizing the system of equations written taking into account (1) and (2) with respect to the residuals:... (3)

Assuming that the pair is observable, the choice of the coefficients of the matrix L can provide the desired distribution of the roots of the characteristic polynomial and, therefore, provide asymptotic convergence of residual (1) with a given rate or the convergence of the observer's state vector to the state vector of the control object.

Above, the problem of recovering the vector x of system (1) was solved with the help of an observer (2) -th order. The possibility of decreasing the order of the state observer is associated with the fact that the vector of output variables is available for measurement and from the point of view of the observation problem it is not required to re-obtain its estimates [9].

The results of the analysis for the stability preservation property of a parametrically indefinite system often turn out to be insufficient even in the case of invariance of the stability properties, since the convergence rates, estimated by the worst case, may be unsatisfactory. In this case, the problem arises of specifying the parameters when forming the model of the control object, or, if the former is difficult or impossible, it is required to obtain direct or indirect estimates of the parameters in real time by using adaptive control algorithms or the method of expanding the state space.

The structural diagram of the safety of a closed system (1) with an observer (2) is shown in the figure 1.

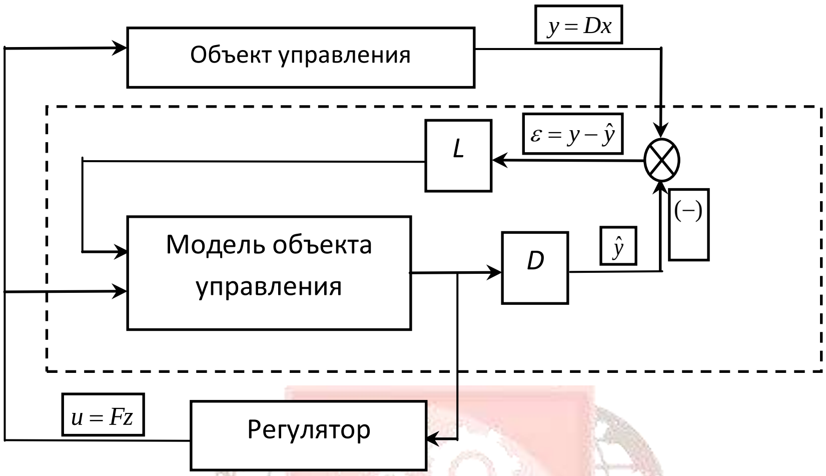

Figure: 1. Safe closed system with state observer

This computational scheme is widely used in the synthesis of the safety of dynamic systems in the presence of disturbances based on the rms optimality criterion.

Conclusion: Thus, in order to prevent emergency situations at hazardous production facilities, a safe closed system with a state observer has been developed. This system has been tested at the Mubarek Gas Processing Plant of the Republic of Uzbekistan. The proposed control system has been implemented at the Mubarek Gas Processing Plant of the Republic of Uzbekistan. This system allows you to stabilize the technological modes of the process and increase the efficiency of its operation. Economic efficiency obtained by ensuring energy and resource conservation amounted to 126 million soums. in year.

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