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Optimization of the structure of the control system using the fuzzy controller

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Abstract

The article is devoted to synthesis of the fuzzy controller for controlling of levels in a three-phase separator «Hiter-Triter» type. Presented are some methods of optimization to ensure an automated control system best quality. Some examples showing efficiency of the methods offered have been provided

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Keywords: fuzzy logic; fuzzy controller; optimization; mathematical model; reference points; level; control parameter; terms.

1. Introduction

Development and introduction of automated process control systems is mostly trendy in the development of up-to-date industrial production. In this regard, optimization of industrial processes is becoming more widely used. Of great importance in the optimization is a properly developed and most realistic mathematical model of the process control system. The mathematical model allows simulating the processes occurring within the system. By studying the simulation model, it is possible to obtain the data and information that can be used to control a real object.

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Fuzzy sets are a tool enabling to develop models for controlling complex objects which do not always make it possible to develop precise mathematical models using integro-differential equations.

In this article, we will describe mathematical model of a three-phase separator "Hiter-Triter" type, we will consider methods for optimization of the control system structure using the fuzzy controller.

2. Brief characteristics of the three-phase separator of "Hiter-Triter" type

The three-phase separator "Hiter-Triter" type is used for receiving commercial oil from oil wells, for separation of well product for preliminary dehydration. It is capable to replace the installation consisting of several parts. The installation can be operated in severe climatic conditions, at a temperature of down to -60 °C.

The separator "Hiter-Triter" type is the horizontal cylindrical installation with the elliptic bottoms mounted on two saddle supports. On a cylindrical part of the body and the bottoms of the installation there are process connections, the connections provided for mounting instrumentation and control equipment and hatches. On the bottom (product inlet side) a flange connection of the heater pipes to the body is provided.

For controlling of the oil level and the of phase separation, the installation is equipped with mechanical control valves on the oil and water outlet pipelines. The oil control valve and the valves of the water outlet operate mechanically, using level controllable floats inside the vessel which has the valve attached to it.

In practice, there are cases that some water starts arriving in the oil outlet pipeline due to the fact that the mechanical control valves are unable to perform well their mission so that the operator has no time to adjust the valves in the manual mode because of what the phase separation level is not under control any more. Following which the process of separation (dehydration) is to be implemented again. For the problem to be solved, we will set the task to synthesize the controller for the level control.

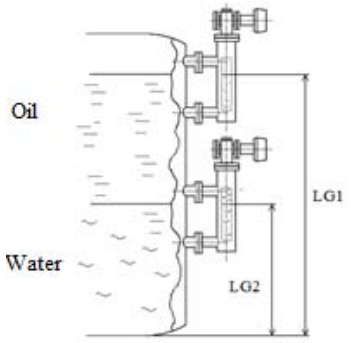

Fig. 1.Level measurement of in the three-phase separator «Hiter-Triter» type

3. The level control system modeling in a three-phase separator «Hiter-Triter» type

3.1. Production control quality criteria

Quality of an automated control system is defined by set a of properties providing effective functioning of both the control object, and the controlling device, i.e. of all the control system on the whole.

The properties which make up this set and which have quantitative values are called the control system quality criteria.

The automated system quality may be estimated by criteria such as system synthesis working hours and the computing power (processor time and memory) required for it.

Working hours of the system synthesis in our case involves the time consumption for fuzzy controller development.

In order to reduce working hours, it is suggested using the following methods of optimizing the control system structure using the fuzzy controller:

A Transition from one fuzzy controller to consecutively connected fuzzy controllers;