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Intelligent Control System of the Lifecycle of Technological Complexes of Rectification Processes

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Abstract:

An online diagnostic system that can be used in the lifecycle management of technological complexes of the process of rectification of multicomponent mixtures and a structural scheme of an intelligent control system serving to extend the life cycle of complexes is proposed. The proposed online diagnostic system allows to analyze the current condition of the complex devices and predict the parameters of the operating mode, and the intelligent control system allows to extend the life cycle of the complex.

Keywords: multi-component mixture, rectification complex, online diagnostics, digital model, lifecycle management, intelligent management.

The main goal of managing the life cycle of technological complexes of rectification of multi-component mixtures is to organize long-term efficient use of complexes of rectification devices and to achieve energy and resource savings along with the production of quality products. In recent years, special attention has been paid to the modernization of industrial enterprises, especially oil and gas processing plants. All this ensures obtaining high-quality products, satisfying consumer needs, introducing energy and resource-efficient technologies, and saving resources spent on technical and technological needs. Therefore, it is desirable to introduce innovative solutions aimed at solving the problems presented for chemical, petrochemical and food industry enterprises.

Among the technological priorities focused on the rectification of multicomponent mixtures are issues such as increasing the efficiency of technological complexes of rectification, extending their service life by managing their life cycle and saving resources spent on them, managing the efficient operation of technological complexes of rectification processes, increasing the reliability of the complexes [1,2,3].

The role of the automated system of data accounting in the development of the management system of the life cycle of the technological complex is incomparable. This system includes the creation of a system for storing and processing the operating parameters of rectification devices for collecting statistical data and managing the complex based on current measured and calculated indicators. The automated system of data accounting is manifested as an infrastructure that provides information in the creation of a life cycle management system of a technological complex for the rectification of multicomponent mixtures and provides for the processing and storage of the following data [4]:

– information on the design of each separation device;
– information on the technology of assembly and maintenance / repair of each device;

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– information on the operating parameters of the complex devices obtained from the complex's automated control/checking systems;

– information about the time of operation of the complex;

– documents related to the operation of the complex, related to all stages of the life cycle of the complex.

Operators participating in the operation of each device in it should be able to access all their information in order to analyze and assess the state of technological complexes for the rectification of multi-component mixtures, make the right management decisions and plan the complex's long-term operation.

Algorithms for rapid processing and analysis of information inherent in the automated control system of potential risks can be used to calculate the life cycle cost of multicomponent rectification complexes [5], forecast [6] and create an online diagnostic system for the condition of the complex [7] (figure 1).

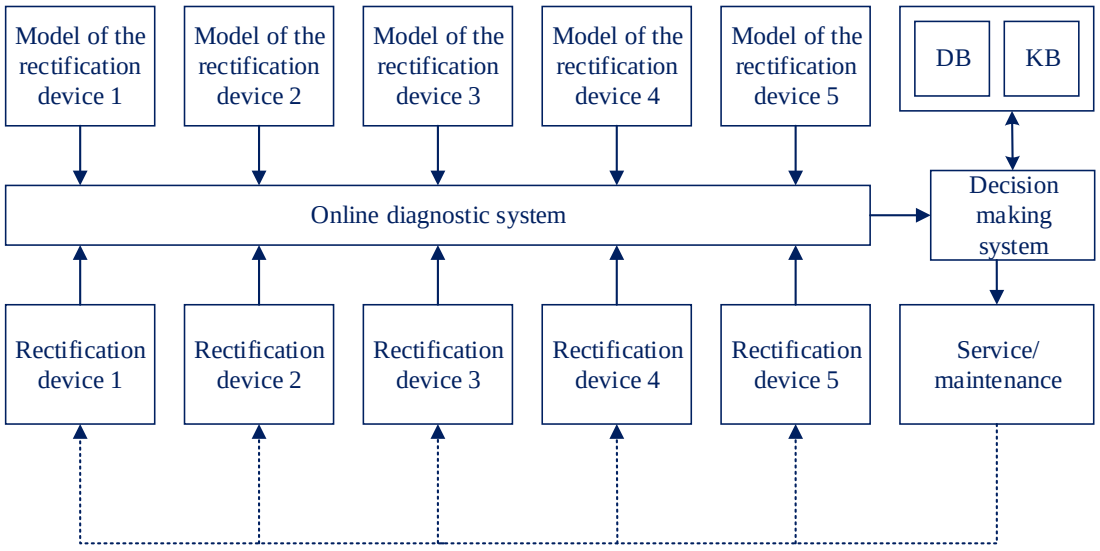

Figure 1. Use of online diagnostic system in life cycle management of separation complexes

A diagnostic algorithm that can be used in the management of the life cycle of rectification process technological complexes is built on the basis of a generally accepted approach in cybernetics with the help of state monitors. The model of the online diagnostic system in the management of the life cycle of the complex allows not only to analyze the current state of the complex devices, but also to predict the operating parameters of the complex based on statistical data and modeling of the rectification processes taking place in the devices.

After the completion of the online diagnostic system and algorithm, it is possible to develop an intelligent system of life cycle management based on real-time digital models, which allows to extend the life cycle of technological complexes of rectification of multicomponent mixtures. The structural scheme of the life cycle intelligent management system, which serves to extend the life cycle of rectification complexes, is presented in Fig. 2.

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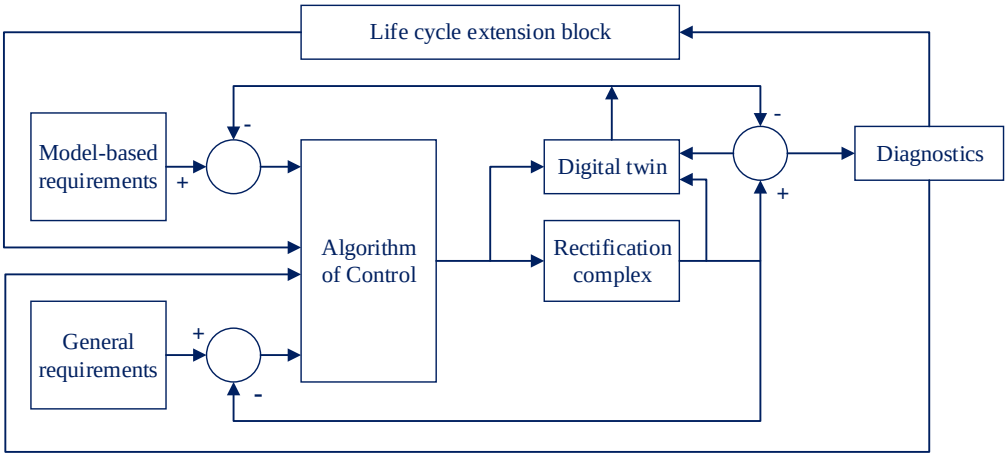

Figure 2. The structure of an intelligent control system that prolongs the life cycle of rectification complexes with the help of a diagnostic algorithm

The developed management system allows to predict the operation of the rectification complex, manage its reliability, as well as extend the life cycle of the complex according to the operational efficiency of the complex and risks in the management of rectification devices.

For the reliable operation of devices of multi-component rectification complexes, implements formal documentation of practices related to the implementation of their life cycle management system, control of life cycle management indicators, identification of various risks in the management process and elimination of problems at all stages of life cycle management of devices.

The system for managing interactions with suppliers of various spare parts, equipment and service providers for rectification complexes, customer requirements for suppliers, mechanisms and tools for checking suppliers, requirements for production systems of suppliers, project management requirements, quality of value chains for continuous monitoring, prices and manages the development of transparency and the management of the life cycle stages of the operation of rectification devices for which third-party organizations are responsible.

The above-described intelligent module for managing the life cycle of technological complexes of rectification processes serves to perform the following main tasks:

- monitoring, collection and storage of data on operation modes and parameters of the separation complex;
- to analyze information and implement quick and long-term corrective technical measures in order to increase the efficiency of the rectification complex;
- optimization of interaction of participants in the use of rectification complexes;
- creation of a single transparent information exchange environment for participants in the process of using rectification devices in order to optimize the planning processes of maintenance and repair of rectification complexes;
- implementation of predictive online diagnostics of the state of rectification complexes in order to create a single database of solutions for the efficient use of operating modes of rectification devices;

• creation of a system of reasonable repair and maintenance of devices to extend the life cycle of the rectification device and increase its efficiency, taking into account the requirements of the regulations in the field of industrial safety.

The proposed online diagnostic system allows to analyze the current condition of the complex devices and predict the operating mode parameters, and the intelligent control system allows to extend the life cycle of the complex.

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