

Designing an Operational Control System for the Continuous Cycle of Industrial Technological Processes Using Fuzzy Logic

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Abstract : Fuzzy logic is a modeling method for complex or ill-defined systems and is a relatively new mathematical approach. Its basis is to consider overlapping cases of parameter values and define operations to manipulate these cases. Fuzzy logic can successfully create operative automatic management or appropriate advisory systems. Fuzzy logic techniques in various operational control technologies have grown rapidly in the last few years. Fuzzy logic is used in many areas of human technological activity. In recent years, fuzzy logic has proven its great potential, especially in the automation of industrial process control, where it allows to form of a control design based on the experience of experts and the results of experiments. The engineering of chemical technological processes uses fuzzy logic in optimal management, and it is also used in process control, including the operational control of continuous cycle chemical industrial, technological processes, where special features appear due to the continuous cycle and correct management acquires special importance. This paper discusses how intelligent systems can be developed, in particular, how fuzzy logic can be used to build knowledge-based expert systems in chemical process engineering. The implemented projects reveal that the use of fuzzy logic in technological process control has already given us better solutions than standard control techniques. Fuzzy logic makes it possible to develop an advisory system for decision-making based on the historical experience of the managing operator and experienced experts. The present paper deals with operational control and management systems of continuous cycle chemical technological processes, including advisory systems. Because of the continuous cycle, many features are introduced in them compared to the operational control of other chemical technological processes. Among them, there is a greater risk of transitioning to emergency mode; the return from emergency mode to normal mode must be done very quickly due to the impossibility of stopping the technological process due to the release of defective products during this period (i.e., receiving a loss), accordingly, due to the need for high qualification of the operator managing the process, etc. For these reasons, operational control systems of continuous cycle chemical technological processes have been specifically discussed, as they are different systems. Special features of such systems in control and management were brought out, which determine the characteristics of the construction of control and management systems. To verify the findings, the development of an advisory decision-making information system for operational control of a lime kiln using fuzzy logic, based on the creation of a relevant expert-targeted knowledge base, was discussed. The control system has been implemented in a real lime production plant with a lime burn kiln, which has shown that suitable and intelligent automation improves operational management, reduces the risks of releasing defective products, and, therefore, reduces costs. The special advisory system was successfully used in the said plant both for the improvement of operational management and, if necessary, for the training of new operators due to the lack of an appropriate training institution.

Keywords : chemical process control systems, continuous cycle industrial technological processes, fuzzy logic, lime kiln

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