CONTRIBUTIONS REGARDING THE DEVELOPMENT OF A HIERARCHIZED DISTRIBUTED CONTROL SYSTEM FOR FRACTIONATION PROCESSES

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ABSTRACT

The fractionation processes complexity given by their dimensions, and by the multiple objectives which they have to satisfy, implies a high effort in finding the appropriate control solutions. The evolution of the fractionation processes, of the operational targets to be achieved, and also the development of the control equipment lead towards one of the realization methods of advanced systems for chemical processes control, namely the hierarchical and distributed control.

In this context, the PhD thesis aims to bring some contributions regarding the complex problem of hierarchical and distributed control for a gas fractionation system.

The fractionation system is represented in this study by three columns of the GASCON separation plant, from a catalytic cracking complex of a refinery.

The main general objectives targeted in this thesis refer to the following aspects:

- finding the place and purpose in a refinery flow of the studied fractionation system;
- identify the control systems associated with the fractionation columns;
- investigation of the main problems regarding the current state of the development of hierarchical and distributed control systems;
- analysis of the representative distributed control systems;
- selecting the control structures for each fractionation column within the GASCON plant;
- modeling and simulation of the studied fractionation column;
- development of hierarchical control structures for the three columns of the GASCON plant;
- testing through simulation of the proposed solutions for each fractionation column.

The thesis is organized in six chapters, briefly described below.

In the first chapter, *Introduction*, are presented the main objectives of the PhD thesis and also the defining elements of each chapter.

The second chapter entitled *The current state of fractionation processes control systems*, describes the fractionation processes from control point of view, and the control objectives of a fractionation column are outlined. Also, are described the concepts associated with the hierarchical and distributed systems, and are reviewed some accomplishments in the field of advanced control of fractionation processes.

The third chapter, *Distributed control equipment*, presents some elements regarding the evolution of distributed control systems, and a few trends in this field. Also, the main distributed control architectures are characterized, together with the representative control systems.

In chapter four, *Contributions to modeling and simulation of fractionation processes*, are presented the principles of mathematical modeling for fractionation processes and are characterized the types of models associated with the control strategy design for a fractionation process, namely the simulation models and control models. Also, in this chapter is realized the selection of the control structures for each fractionation column, and the modeling and simulation of the fractionation system from GASCON plant, the author's contributions being emphasized.

The fifth chapter, *Contributions regarding the development of a hierarchized distributed control system for fractionation processes*, is dedicated to the main contributions of the PhD thesis and deals with the elaboration of the hierarchical and distributed control system with the presentation of the control solutions proposed for each column from GASCON plant. Thus, for the $C_3 - C_3^{'}$ separation column at level 2 is proposed a feedforward control system and at level 3 an optimal control system. For the $C_4 - C_4^{'}$ separation column at level 2 is proposed a decoupler to reduce the crossed channels effects, the control structure having as central elements two monovariable internal model controllers for composition control, and at level 3 there is an optimal control system. The control structure for the $C_3 - C_4$ separation column implements at the optimal control hierarchical level an objective function proposed by the author. In all three cases, the first hierarchical level is associated with the conventional control systems.

The sixth chapter, *Final conclusions, summary of contributions and future research*, highlights the main conclusions and contributions of the thesis, and presents possible future developments of the research theme.