

Section 5

Applications

The previous sections of this book have shown how process systems engineering has developed methods and tools to address the increasing complexity of the process industries; it seeks to foster the development of new products and processes, to achieve optimal operation of complex equipment, and to help in the complex management of the global enterprises. Section 5 illustrates some applications of CAPE techniques, and aims to demonstrate what their benefits are, their current limits, and their short and long-term perspectives.

The first chapter illustrates the issue of education and training: how to teach the students to efficiently use very powerful tools, in order to better understand the concepts, to appreciate how the theory can be put into practice, while avoiding the dangers of misusing the software by merely pushing buttons to generate results. The applications covered deal mainly with process and product design, and illustrate also the concept of tool integration, since results must be carried out from one calculation step to the next.

The second chapter concentrates on model-based process operation. It illustrates various industrial applications of data validation, and shows how the use of more detailed models can improve the accuracy of estimating plant parameters. Use of thermodynamic constraints besides component and overall mass balances is illustrated. Examples are taken from a range of industries: oil refineries, chemicals, fertilizers, nuclear power plants. The main benefits are more reliable plant monitoring, capability to operate closer to limits with a better efficiency, early detection of faults, and reduction of analytical and instrumentation cost.

The last chapter illustrates CAPE techniques applied to solving production-planning problems for a multiproduct plant. The goal is to optimize revenue by reacting swiftly to changes in product demand, market prices and feed stocks availability. The uncertainty aspect is modeled by means of a stochastic approach. Multiple objectives are considered: either maximizing the expected value of the final profit over the planning period, or maximisation of the first quartile of the profit (robust solution). All steps in the application of the method are illustrated by means of a case study taken from a food additives plant.

Thus, Section 5 illustrates the diversity of CAPE tools and methods, and shows examples of current practice in areas ranging from process design to plant operation and production planning under uncertainty.