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Paper

Maria Graça Rasteiro
Coimbra University

with:
Pedro Saraiva and Fernando Bernardo,
Chemical Eng. Dep./Coimbra University.

contact:
mgr@eq.uc.pt

Using an Interactive Computational Platform to Teach Unit Processes in Chemical Engineering: A Case Study

Unit processes are usually considered as the core of chemical engineering. In fact, they are present in any industrial chemical process, either on the feed and product lines or on the effluents' cleaning stages. Thus, unit processes are always considered as compulsory subjects in any chemical engineering curricula. Moreover, the design of unit processes has made extensive use of computational techniques ever since the first steps of computational science.

The question we will address here is how to integrate computational tools, namely the more modern and interactive ones, in the teaching, itself, of unit processes. There are mainly two possible approaches. One of them is to start by teaching the physical/chemical phenomena involved in the different unit processes and to use later, in the design stage, process simulators like Aspen Plus, PRO/II or SuperPro Designer, which have been built mainly as large module-based software packages to meet industrial needs. The other approach is to introduce the students to a process simulator like ASCEND or gPROMS, where the user is asked to provide the necessary process model equations, or a general computational platform, like Mathematica or Matlab, and lead them to use those tools as a way to describe the physical/chemical phenomena behind the unit processes and thus design the equipment that performs the desired task (mixing, transport, separation, etc.).
The second approach was the one selected in the case study to be presented here. Mathematica, a well-known interactive computational platform, was used as a complementary tool to teach distillation to the chemical engineering students at the University of Coimbra (distillation is covered in about 2/3 of a one-semester course). The students had not gone through any formal previous classes introducing them to such a computational tool, though they had already had introductory courses on Fortran programming and numerical methods. The main objective was to use Mathematica to achieve a better understanding of the physical phenomena involved in distillation processes and, simultaneously, to show how this tool could be easily used to design distillation equipment. Some of the lectures were supported by the Mathematica interface, which allowed visualisation of the impact of several parameters in the design and operation of distillation equipment, always keeping in mind the underlying process model equations. Additionally, it is believed that after this course, and without the need to go through formal classes over Mathematica, students are now capable of using this computational platform to design other unit processes, besides distillation. In order to evaluate the new teaching strategy, a class survey was conducted aimed at judging both the benefits and difficulties experienced by students.
In short, we believe that the introduction of this strategy in the teaching of unit processes results in mutual benefits, leading students to a better and wider understanding of those processes and, simultaneously, providing a more perceptive way of learning how to use this type of computational platforms to solve engineering problems.