Capstone Chemical Product and Process Design Courses: Industry-Faculty Interactions

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Abstract

The key role of *industrial consultants* in the capstone chemical product and process design courses at Penn *is* described. Emphasis is placed on the timely design-problem statements they prepare and the advice they provide during the spring design-projects course. Also, the role of adjunct professors is reviewed. Several important industrial impacts are described over the past 65 years. Next, the interactions between many faculty advisors, who are not normally design-oriented, and our industrial consultants are examined. In several cases, these lead to product design-oriented projects, closely related to the research and teaching of our young faculty. Finally, the practices in other engineering disciplines at Penn and elsewhere are considered, with emphasis on the pedagogical constraints and practical limitations that prevent their adoption in our design courses.

Introduction

Two required courses are taught at the senior level:

Fall Lecture Course – introduces product and process design
Spring Design Projects Course – timely projects by *industrial consultants* who visit Penn on Tuesday afternoons in the Spring. Individual projects for 12 groups of 3-4 students.

Design Preparation Prior to the Senior Year

Throughout our curriculum, opportunities are sought to introduce design approaches and techniques that expose our students to the solution of open-ended design problems, and especially, to introduce them to widely-used design software packages, such as ASPEN PLUS and SUPERPRO DESIGNER

Industrial Consultants

Over the past 65 years, we have been fortunate to involve many chemical engineers from the chemical industry, our so-called *industrial consultants*. Just since 1980, 34 persons were employees of Air Products and Chemicals, ARCO Chemical, Arkema, Bio-en-gene-er Associates, CDI Engineering Group, Dow Chemical, DuPont, Environex, Exxon/Mobil, General Electric, Glaxo-Smith-Kline, Lyondell Chemical, Mobil Technology, and Pennwalt Corp. Each consultant vists Penn on five Tuesday afternoons in the Spring. All provide there services at no cost. Occasionally, student groups visit companies for lab tours and interaction with experts. No funds are provided by companies to cover the costs of prototype development.

Adjunct Faculty

An adjunct faculty member, Leonard Fabiano, who spent most of his career in industry (over 30 years) presents a few (~5) lectures in the fall and devotes two days weekly during the spring projects course. For this, he receives a small remuneration – unlike our other industrial consultants who receive no fees.

Over 30 years, Len was among the industry leaders promoting the development of process simulators. He became very proficient in their use and has provided our students with the assistance and guidance they have needed to apply them effectively.

Industrial Impacts

The impacts of our industrial consultants over the past 30 years are exemplified by the contributions of several persons; e.g.,

Bruce Vrana of DuPont. For the past 20 years, Bruce has provided 3-4 challenging design projects annually. In recent years, his focus has been on chemicals from renewable resources.
William B. Retallick. Over 30 years, Bill's problems involved an array of timely subjects, including: combustion in gas turbines, recovery of waste energy, and natural gas and coal processing.
John Wismer of Arkema. In recent years, especially, John has provided projects involving cutting-edge technologies – micro-channel reactors for the conversion of natural gas to liquids, the growth and conversion of algae to alkanes, and conversion of shale gas to liquids.
David Kolesar of Dow Chemicql. Dave has great expertise in the application of the Aspen Engineering Suite. He provides the last line of defense when simulation problems remain unresolved.
Tiffany Rau of Pall Corporation. Tiffany is our first consultant from the pharmaceutical industry. She has formulated challenging problems involving batch scheduling in the design of pharmaceutical processes.

Faculty Advisors

At Penn, over the past 65 years, most faculty members have served as advisors for one of our senior design groups each year.

In recent years, young faculty have had little experience in process design – rather the emphasis of their research has been biased towards small length and time-scales, often involving nano-structures, biotechnology, and materials technology.

Over the past decade, with our encouragement, several young faculty have authored problem statements that are product-design oriented – more closely aligned to their research interests.