

# Offensive Environmental Chemical Engineering Education\*

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The popular and image-saving excuse, used by members of the CPI when confronted with the legacy of the environmental problem, is: "We didn't think it was a problem or having an effect." Hindsight is perfect and it is now clear that we did not think. We did not do very much thinking about our chemical wastes nor our potentially harmful chemical products and their interaction with the natural environment. Although we do not like to admit we are non-thinkers in this regard, it is not the only root cause. I wish to explore in this editorial what I think are a few of the causes of the problem fostered by the education process chemical engineers undergo.

Chemistry is a very broad subject area. Chemical Engineering on the other hand is defined very narrowly. We have traditionally been associated with those aspects of chemistry that have to do with the bulk manufacturing and refinement of large quantities of chemical substances. Although the basic educational requirements for chemical engineers are broad, the focus of applied activities and values are very narrow. The traditional attitude has been to focus exclusively on the product and the process as though the chemical plant was disconnected from the natural environment. "As soon as a traditionally educated chemical engineer climbs over the factory

fence or passes beyond the end of the effluent pipe, he finds himself in a world which is far removed from the ideal, deterministic world he is familiar with" [1].

Our waste problem, and to a degree even pollution control, has been viewed as someone else's prime activity but not ours. (def. *pollution control*: Chemical engineering unit operations designed and controlled to remove chemical residues from air, water and solids before being placed back into the natural environment.) Our application of science has been two-tongued. We have been extremely clever and knowledgeable in manipulating physical and chemical principles to fashion useful substances in reactors and separation devices. Was it our conservatism and inward looking view of chemical engineering that caused us to not think about whether these same processes would occur in the natural environment? Specifically refer to the processes of fate and transport. (def. *fate and transport in the natural environment*: coupled processes that transform and mobilize chemicals in the air water and soil subsets of the ecosystem.) As a profession we have moved fairly easily into the area of pollution control since it was a natural extension of things we were comfortable in doing. Pollution control is essentially chemical separation processes aimed at removing residues. We are coming to grips with the fate and transport aspects of chemical engineering more cautiously. One reason for our reluctance is that we did not design, nor can we effectively control, this chemical processing system.

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The aspect of education and training of undergraduate and graduate students needs to be addressed. Undergraduate curricula changes in chemical engineering departments at U.S. universities have a time constant of at least 50 years. It is a conservative institution that reflects the narrow needs of the chemical process industries and is severely constrained by the professional organization (AIChE) and the accrediting agency (ABET). Students are still being produced with the old attitudes about what the profession entails and oftentimes without pollution control experiences, much less knowledge of fate and transport concepts concerning chemicals in the natural environment. "It is important to influence the way in which chemical engineers consider the environment, and it is often too late to do so after a conventional degree has hardened specific attitudes" [1].

The general lack of a good scientific/engineering data base and experienced professionals working in the area was a major contributor to our defensive stance. The CPI was not prepared to effectively counter many of the "sky is falling" predications about chemicals in the environment. An important contribution to this is the lack of data and knowledge. "In the absence of sufficient scientific data, decisions affecting environmental laws are based on socially perceived problems, rather than on the scientifically documented evidence" [4]. Apparently little progress has been made in this area since 1970. Jefcoat (1985) [3] has recently completed a survey of industry and university research in the environmental area. He finds that over the past decade there has been a dramatic decrease in environmental research activity involving chemical engineering principles as measured by the number of active projects reported.

Finally some attention must be devoted to placing limits on the nature of the involvement of the chemical engineer with chemicals in the natural environment. Knowing all things concerned with chemicals in the natural environment is beyond the capabilities of even the chemical engineer. The nature of this involvement should be in line with the existing and unique capabilities of the profession. Chemical engineers are unique in applying physicochemical principles to the transport and transformation of chemical species. These talents, when focused on the mechanisms of chemical fate and transport in the natural environment, will fill a void that presently exists. No other profession can bring such a high-level scientific and engineering know-

how to this important area. No other profession has a vested interest to the degree we have in this area.

Daniels (1982) [2] notes that, with increasing concern for trace chemicals and their potential impact on human health and the environment, the chemical engineer must be acquainted with toxicology, industrial hygiene, and environmental science. Other important disciplines are: agronomy, geohydrology, hydrogeology, analytical chemistry, pesticide chemistry, civil (environmental) engineering, oceanography and biology.

Although Daniels and I are not necessarily suggesting additional formal coursework at the university level, some mechanism of indoctrination is needed to bring about an acquaintance with other disciplines that will raise the level of environmental consciousness of chemical engineers. I envy the good attitude nearly all civil engineering graduates have concerning the natural environment. As chemical engineers, we do work in a highly artificial niche and apparently a consciousness of and concern for the natural environment have been bred out. We need to stop doing something in the education process or start doing something else to correct this bad attitude. I obviously don't have a good answer on how to realistically correct this blind spot.

#### LITERATURE CITED

1. Boyle, J. D., "Environmental Chemical Engineering," *Environmental Education and Information*, **2**, No. 1, 29-31 (1982).
2. Daniels, S., "Environmentally Sensitive Engineering," Paper presented before ASCE, Chemical Engineering Division, 1982 Summer School for Chemical Engineering Faculty, U. California at Santa Barbara, Aug 2, 1982.
3. Jefcoat, I. A., "1984 Survey of Research on Environmental Pollution — Its Sources, Fate, Effects and Control," *Environmental Progress* **4**, 217 (1985).
4. McKetta, J. J., "Is the Sky Really Falling," *Chemical Engineering Progress*, **79**, No. 9, p. 11-22 (1983).

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