ChE classroom

POLLUTION CONTROL TECHNOLOGY

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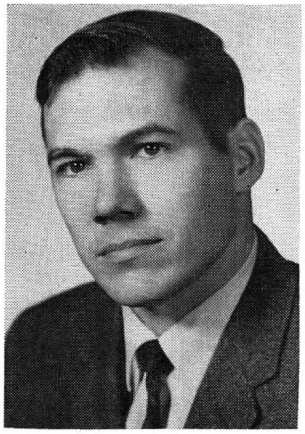

Gary Poehlein received the BS, MS, and PhD ('66) degrees in chemical engineering from Purdue University. His industrial experience was gained with The Procter and Gamble Co. and with The Humble Oil Co. His interests include polymer chemistry, applied rheology, heat transfer, and environmental sciences.

All of us are aware that environmental pollution has become a major social - political problem in many parts of the world. Governmental regulations and public pressure have had and will continue to have a significant economic impact on the chemical industry. These facts have resulted in larger allocations of capital for pollution research by industry and governmental agencies. This, in turn, has resulted in formal instruction in pollution control technology within some chemical engineering departments.

A course in pollution control technology can be a constructive part of nearly any engineering curriculum. This great flexibility results because of the large number of potential lecture topics and because of many possible organization schemes. Our course is not monolithic but depends strongly upon the teacher. We have tried instruction based on (a) in-depth studies of a few problems or processes and (b) brief introductory study of many processes and related topics. Both approaches have been readily accepted by our students; however, I believe that course organization is more important than the selection of study topics. The course is organized to teach the fundamentals of processes for pollution control while, at the same time, preserving the tremendous motivation generated among students by their concern for the problems of our society.

The major objectives of our elective course offered at Lehigh University for advanced undergraduates and graduate students are:

- To illustrate the magnitude of the pollution problems facing this country.
- To teach the fundamentals of the processes of importance in the design of facilities for air and water pollution control.
- To provide an opportunity for the study of real pollution problems in local industry.

These objectives were achieved through several types of study. Formal lectures were given on a number of topics listed in Table 1. Several of the lectures were presented by outside speakers who were experts in areas such as; water ecology, air pollution control regulations, thermal pollution, etc. Field trips to a local municipal treatment plant and the research laboratories of a large company were a very successful part of the course. More field trips will probably be included in the future.

TABLE 1. LECTURE TOPICS

1. Sources and Characteristics of Industrial Wastewaters
2. Air Pollution Detection and Measurement Problems
3. Sedimentation
4. Ecology
5. Flocculation and Flotation
6. Aeration and Gas Transfer
7. Biological Treatment Processes
   a. BOD and COD; Significance and Measurement
   b. Natural and Aerated Lagoons
   c. Trickling Filters
   d. Activated Sludge Processes
   e. Sludge Disposal Processes
8. Adsorption in Air and Water Treatment
9. Oil Refinery Problems
10. Liquid Scrubbing of Gas Streams
11. Thermal Pollution and Cooling Tower Design
12. Mathematical Modelling of Rivers
13. Ion Exchange
14. Water Chemistry Topics
15. Pollution Problems in the Steel Industry
16. Foam separation

The course presents the fundamentals of processes for pollution control while preserving the tremendous motivation generated among students by their concern for the problems of our society. . . . It can be a constructive part of nearly any engineering curriculum.

In addition to formal lectures and homework assignments, all students were required to submit a term report covering an in-depth study of a pollution topic of their choice. Graduate students were expected to suggest potential areas for future research. This activity was especially important when lectures were restricted to brief treatments of important topics. The term paper provided a mechanism for more complete study of a significant problem and it helped to illustrate the importance of current literature in a rapidly developing field.

The third major course objective was achieved with the assistance of local industry. During the summer prior to our last course offering I decided to ask a number of local corporations to assist me in teaching pollution control technology by allowing a group of 3 or 4 students to study a specific problem within their plant. At first I had doubts that such a program could be arranged because of the sensitive nature of the subject. Much to my surprise nearly all companies responded favorably to initial correspondence. Suitable projects were outlined for the complete undergraduate enrollment of 21 seniors.

These industrial problems were, without question, the most satisfying and successful part of the course. They served as an ideal laboratory experience and, equally as important, generated motivation among the students for learning the lecture material.

The industrial problems were chosen because I felt the students would be able to contribute to their solution. Brief descriptions of some of the more successful experiences are outlined below.

• **Meat Packing Plant.** A total plant water survey was conducted on a medium size (3,000 hogs/day) meat packing plant. The plant technical staff was minimal and concerned primarily with day-to-day operation.

The student group measured solids (mostly fat particles valued at 4¢/lb) content and BOD of effluent streams. They determined the value of lost fat at about $130,000/yr. They then obtained bids for screening equipment to recover this fat from vendors who had worked on similar problems in other packing plants. The total installed cost of the solids recovery system was estimated to be $40,000; not a bad investment (certainly better than continuing to dump this material into surface waters).

• **Small Inorganic Chemical Plant.** A plant wastewater survey was conducted. The plant technical staff were well trained but pollution control activity was minimal.

Sample analysis indicated that the major problem involved two highly acidic streams which were currently discharged into an earthen hole about 75 yards from a river. A plant process-water well, located between the hole and the river, was no longer in operation due to acid pollution.

The student group suggested the installation of a limestone acid neutralization pit. Detailed construction drawings for this pit were provided.

• **Organic-Inorganic Plant.** This plant was of medium size with full-time staff assigned to pollution control activities. The student group worked on an alkaline wastewater problem under the supervision of plant professionals. Plant laboratory facilities were available to the students for sample analysis.

This type of arrangement is attractive because in-plant personnel are well acquainted with economic restrictions. In this case an acid neutralization proved to be the best solution. The plant discussed above was too far away for the ideal solution of stream combination, but the students did think of this possibility.

SUMMARY

Formal instruction in pollution control technology will undoubtably increase markedly over the next several years. Such instruction may take the form of a course such as I have outlined in this paper or it may involve the use of pollution control problems as examples in other courses. Either approach will be well received by students. Our course has demonstrated one meaningful way to involve industry in the academic process. No one can doubt that a few experiences such as those cited above will help to "turn on" our students. Similar programs, especially if they could occur earlier, may help to attract more students to the study of engineering.