TEACHING PROFESSIONAL ETHICS*

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We expect all of our graduates to "behave as professionals." One characteristic is that professionals are ethical. This simple statement has four interesting components

- **Personal ethics**: individuals have their own internal ideas of right and wrong that they may or may not be aware of.
- **Professional ethics**: our engineering profession (as national organizations and as state or provincial associations) have published codes of ethics which they expect all professionals to use as their value system.
- **Microethics**: some value decisions involve us as individuals being ethical in our professional context.
- **Macroethics**: some value decisions involve ensuring that our company or institution behaves ethically.

What types of learning experiences can be used in the classroom to sensitize our students to this important professional attitude, and what resources are available?

BACKGROUND EXPERIENCES

If students have difficulty identifying their own ethics, then some techniques on values classification could be used. Some resources include Barrs et al [1] and Larson et al [2]. In these experiences, students learn to express their personal values. So far in our program, we have not used this as an introduction.

CODES OF ETHICS AND RESOURCES

A unified code [3], the AIChE code [4], and various state or provincial codes [5] are available. Some are more explicit than others and help guide the student into the practical application of the principles. Since our provincial licensing agency requires that young professionals pass a written examination in ethics, we use the Ontario Code. The codes are compared by Unger [6]. Fortunately, Larry Sentance of APEO headquarters helped me by providing worked examples of ethical situations and elaborations as to which sections of the code are pertinent [5]. Other sources of examples and interpretation are given by Alger et al [7]. My favorite examples are the Garrison Wyoming Rocky Mountain Fertilizer case [8] and Geza Kardo's case study of the Heron Road Bridge [9].

IN-CLASS USE

Our in-class exploration of ethics is a two-hour experience within a four-credit, 26-week long course on process analysis, professionalism, cost estimation, and process synthesis. Components of this course have been described elsewhere [10, 11, 12]. One of the required texts contains a nine-page description of micro- and macroethics, the code of ethics, and examples of interpretation [5].

For the ethics portion of the course, the code of ethics is described, and the meaning is illustrated by selected examples which are presented by the instructor. For homework, each student is to pose an ethical problem and submit it before class to one of four classmates who have been identified as facilitators. In the next class, each facilitator in turn presents to the class his/her choice of a challenging case situation. Examples are given in the Appendix to this paper. Each case is discussed in small groups of about five students, and then each group verbally reports

- **What sections of the code apply**
- **What the code says**
- **What the group considered to be alternative actions**
- **What actions they would take**

Thus, each group discussed four cases. As instructor, I have merely played the role of facilitator. If asked to judge the responses however, I would share my own views.

Often, problems on the final exam relate to

*Paper presented at the AIChE Annual Meeting in Los Angeles, CA, in November, 1982.

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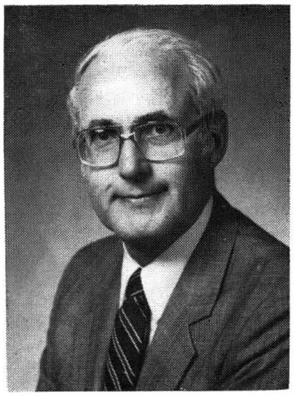

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ethics. A typical exam problem is

You are a professional engineer working for Company A. You submit a design for a new process. The plant manager, also an engineer, is quite old and has been in a management position for the last thirty-five years. Many of your colleagues feel his technical ability has virtually disappeared. The plant manager receives your proposal, but before implementing it he decides to make some small changes to increase its profitability. You realize that these changes, although profitable, could introduce a safety problem. But because of the nature of the case, you decide to keep quiet. Later, some of this process equipment blows up and a couple of workers are severely injured. Did you act unethically in this case? Discuss the case fully and make recommendations if possible.

STUDENT RESPONSE

Student response has been overwhelmingly favorable. They suggest that they learned a lot and enjoyed the approach taken. They do not, however, recommend that more time be spent on it.

OTHER IDEAS AND DISCUSSIONS

Many examples have been presented about responses to ethical situations. See, for example, the interesting series in *Chemical Engineering* [13, 14]. These have tended to report consensus viewpoints. What I enjoy about our approach has been the specific link between an established code of ethics and the situation. That is, the requirement to interpret one's actions in the context of the code.

Whistleblowing is a fascinating topic but one that should not be discussed idealistically out of context of the real possibility of being fined or blacklisted. Steps are being taken within various engineering professions [15] to help identify workable, whistleblowing procedures. Once these are in place, I can see the importance of professional engineers from the Practice and Ethics Committee describing cases of action taken in order to illustrate how best to proceed.

SUMMARY

A two-hour experience on professional ethics is part of a senior level course on process analysis and professional practice. The provincial code of ethics is explained by using examples. The students then pose ethical problems and discuss/report their solution to those problems in the context of the code.

ACKNOWLEDGEMENT

I am pleased to acknowledge the assistance of L. C. Sentance of the Association of Professional Engineers of Ontario for his generous help in the initial presentation of this programe and to Dr. J. W. Hodgins, whose insight helped me to develop the program. The pleasure comes from the students, and I am pleased to acknowledge their contributions, through examples and discussion, to this program. □

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APPENDIX: EXAMPLE PROBLEMS

Case 1

There is a major energy crisis in the country. All of the company's efforts are directed toward the design and development of new energy sources for such things as a steam generation plant.

Out of the old files, you dig up what is believed to be a brilliant design of a solar heater for the steam generation plant. The idea was proposed over fifty years ago and since, at that time, there was no energy crisis and fossil fuels were cheap, the design was economically unfeasible and therefore canned. However, in the light of the present situation it would be most economical and would save the company a lot of money, as well as conserving other depleted energy resources.

Only a handful of engineers had seen the original plan and in the ensuing fifty years they had all passed away. Nobody in the company today has ever seen the design.

Because of poor economic conditions, you have recently taken a cut in salary. You see yourself as a very hard worker and have contributed much to the company in the way of process optimization, but you have received very little credit or recognition for all your work. This design would give you that recognition along with a generous suggestion bonus. The savings to the company would far exceed what you would get as a bonus. So you make some minor adjustments to the design and submit it as an original idea. The bonus would have to be forfeited if it were known that the design was created over fifty years ago. This way, both the company and you come out ahead and no one is the loser. After all, you did the research, found the old plans, and modified them for present use. It would be unfair if you got nothing for your efforts.

Would this be ethical? (E. R.)

Case 2

In a waste treatment process, some of the activated sludge must be removed in order to keep the recycled sludge at a specified concentration. This spent sludge is used as landfill. Recently, you have found that this sludge has been concentrating a chemical which is known to be cancer producing. By allowing this sludge to be used as landfill, this chemical is returned to the watershed through leaching. You have notified the company of the problem, but they refuse to do anything about it.

Is this ethical? (R. A. B.)

Case 3

Within the last year, the parasite spruce budworm has infected approximately 25% of the forests in Nova Scotia. Most of the infestation is confined to northeastern Nova Scotia and Cape Breton Island, where the economy is heavily dependent on forest products. Failure to control the pest could result in the loss of this industry.

When the infestation first became apparent, the Nova Scotian government decided against spraying because the emulsifier in the spray was linked to an outbreak of a rare children's disease in New Brunswick, where spraying is carried out every summer. As an engineer with the ministry responsible for the environment, you estimate that about half the people in the province live in rural areas and that they obtain their water supplies from small, inland lakes and private wells. It is likely that the emulsifier will make its way into drinking water if spraying is carried out. Should you go along with the considerable pressure placed on you and the government by the forestry industry in the hope of saving the industry and the thousands of jobs involved? (V.)

Case 4

You are an engineer working at a steel mill. You come in on a night shift and discover that the smelter gas from the smelter is being shunted past the electrostatic precipitators in order to make the tonnage of steel that is required on the shift. There is a butterfly valve that can be turned so that all of the dirty gas just goes right out of the stack. Since it is at night, there are no complaints from people in the surrounding area or from the environment board. You are the engineer working on the control of the precipitators, not in the production department.

What should you do? (K. H.)

Case 5

I am a fourth year engineer seeking employment. In January, I am offered a job by company X and am given ten days to accept their offer. I accept their offer.

Two weeks later I receive a better offer, in pay and position. I take the second offer and tell the first company that I am unable to work for them.

1. Is this ethical?
2. Would the situation change if I was offered another job in May just before I was to report for company X?
3. Does a company expect this to happen?

ChE letters

SAFETY PROBLEM CHALLENGED

Dear Sir:

I read with interest Professor Jan Mewis' article, "How Much Safety Do We Need in ChE Education."

Unfortunately, the equation used by Professor Mewis to solve the tank overflow problem is not rigorous, and can give outrageously bad results. A rigorous derivation and the correct solution to the protective system problem can be found on p. 459 of *Reliability Engineering and Risk Assessment*, by E. J. Henley and H. Kumamoto, Prentice-Hall Inc., Englewood Cliffs, NJ, 1981.

I agree with Professor Mewis that all engineers should receive some training in reliability and safety analysis. Short courses, such as given by the AIChE are, in my opinion, adequate. In many European countries risk studies such as those mandated in the nuclear industry are required of all industry. I think this is very unfortunate. You really can't legislate safety; it is an individual and corporate responsibility.

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ChE book reviews

FUNDAMENTALS OF FLUIDIZED-BED CHEMICAL PROCESSES
by J. G. Yates
Butterworth Publishers, 10 Tower Office Park, Woburn, MA 01801, 1983; $49.95

Reviewed by L. T. Fan
Kansas State University

This lucidly written book contains five chapters. The first, which is the longest, deals with some fundamental aspects of fluidization. The modeling of fluidized-bed reactors is discussed in the second chapter; the majority of available models are compiled. The last three chapters cover the application of fluidization technology. More specifically, chapter three focuses on the well-known Fluidized Catalytic Cracking Process and chapter four on the combustion and gasification of coal. The last chapter outlines a number of miscellaneous processes, including production of several chemicals, sulphide ore roasting, and reduction of iron ores.

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