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Worldwide Training in Air Pollution Control

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A survey of academic training in air pollution control was recently conducted for the APCA Education Council. Questionnaires were sent to faculty at over 200 universities in the United States and 150 universities around the world. This paper lists the schools which completed the questionnaire and includes the number of both undergraduate and graduate courses available, the academic department, and the range of research projects presently underway. The findings indicate that air pollution is a subject being taught worldwide. Most schools predict that their current level of instruction will not change in the next five years. Additions and corrections are requested on a sample questionnaire.

Over the last 20 years there has been an increased awareness of air pollution by the people of many countries. Industrialized countries were concerned with changes in air quality and the desire to improve conditions of those exposed to an industrial environment and the community as a whole. Nonindustrialized countries became concerned with how they could avoid these problems in the first place and still have the growth they desired. In the United States 20 years ago, professionals who were forced to deal with the problems had no formal training in air pollution control. Often they were individuals with degrees in various engineering disciplines and/or with some background in public health.

Much progress was made and much was learned. Standards have been set that would protect the public health. Most of the easy problems have been solved and now complex problems remain. One can understand why the most qualified people are needed to work on these solutions for both industry and the regulatory agencies.

It is helpful to know where both training and research are carried out. This has been documented in the U.S. and Canada in several recent studies.^{1,2} Dr. Christopher Barthel and the staff of the National Clean Air Society (and the International Union of Air Pollution Prevention Associations) collected information on UK universities offering 3-year degree or postgraduate courses in environmental subjects.³ This formed the basis of the motivation for the present study.

Objective

It was desired not only to update information on what was currently being done in the U.S. but also expand Barthel's work. Questionnaires were sent to all the faculty the author knew might be involved in air pollution control teaching or research (Appendix A). In addition, directories and lists of

programs were consulted. It became clear that it was difficult to get a questionnaire that would substitute for a personal interview. The questionnaire was written in English.

In spite of the many limitations, good response was achieved on the initial attempt. This paper will summarize some of the results.

Results

In the U.S. 160 colleges and universities responded by completing questionnaires in 1982 and 1983. Academic programs with air pollution control training were identified in many other countries. A complete list of the results is given in Appendices B and C.

Appendix A. Questionnaire used in survey.

APCA EDUCATION COUNCIL SURVEY UPDATE

Please complete this questionnaire at your earliest convenience.

Number of different air pollution courses taught last year at university:

Undergraduate _____ Graduate _____

Number of air pollution related research projects:

None _____ 1 to 5 _____ 5 to 10 _____

Which of the following fits your program:

1. All students in major take one air pollution class.
2. Students in major can elect to take air pollution classes.
3. Students in major must take course covering air, water and other pollution control.
4. Students in which other majors will take one air pollution class:

CE
ME
ChE
CHEM
ENV
MET

How do you feel your program will change in the next few years?

1. It will remain the same.
2. It will be phased out.
3. It will be _____

Please make comments in space below. Include respondent's name and address.

Return to:

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Appendix B. U.S. universities with air pollution control training.

| State | University | Department | U ^a | G ^b | Res ^c |
|---------------|-----------------------------|---------------------|----------------|----------------|------------------|
| Alaska | U of Alaska-Anchorage | CE | 0 | 1 | 0 |
| Arizona | Arizona State U | CE | 0 | 1 | — |
| | U of Arizona | ME | 2 | 2 | 1 |
| California | Cal Poly Pomona | Aero Engr | 3 | 1 | 1 |
| | Cal Poly San Luis Obispo | CE, EnvE | 8 | 5 | 1 |
| | California Inst of Tech | EnvE Sci | 0 | 5 | — |
| | Humboldt State U | EnvR E | 2 | 0 | — |
| | Stanford U | ME | 1 | 1 | — |
| | U California-Los Angeles | CE | 3 | 1 | 1 |
| | U of California-Berkeley | CE, ME, ChE, Chem | 2 | 10 | — |
| | U of California-Davis | CE | 3 | 7 | — |
| | U of California-Irvine | ME | 3 | 3 | — |
| | U of California-Riverside | Env Sci | | | |
| Colorado | Colorado School of Mines | Env S Eng | 1 | 2 | 1 |
| | Colorado State U | AtmSci, ME | 0 | 3 | 1 |
| Connecticut | U of Hartford | ME | 1 | 0 | 0 |
| Delaware | U of Delaware | CE, ChE | 1 | 1 | — |
| Florida | Florida Inst of Tech | Env Sci, Engr | 3 | 3 | 1 |
| | Florida International U | CE, EnvE Tech | 1 | 4 | — |
| | U of Central Florida | CE, Env Sci | 1 | 1 | 1 |
| | U of Florida | EnvE Sci | 1 | 5 | 1 |
| Hawaii | U of Hawaii-Manda | Engr | 0 | 2 | 0 |
| Idaho | U of Idaho | ChE, Chem | 3 | 0 | 1 |
| Illinois | De Paul U | Chem | 1 | 0 | 1 |
| | Illinois Inst of Tech | EnvE | 1 | 7 | — |
| | Northwestern U | CE | 0 | 1 | — |
| | S Illinois U-Carbondale | ThE, EnvE | 3 | 1 | 2 |
| | S Illinois U-Edwardsville | Geo | 1 | 1 | 1 |
| | U of Illinois-Chicago | PH, Env & Occ H Sci | 1 | 5 | 2 |
| | U of Illinois-Urbana | CE, EnvSt | 1 | 9 | 2 |
| Indiana | Purdue U | CE, ME | 3 | 3 | 1 |
| Iowa | U of Iowa | CE, EnvE | 2 | 2 | — |
| Kansas | U of Kansas | CE | 1 | 3 | 1 |
| Kentucky | Eastern Kentucky U | EnvH Sci | 3 | 0 | 0 |
| | U of Kentucky | ChE | 1 | 1 | 1 |
| | U of Louisville | ChE, EnvE | 1 | 1 | — |
| Louisiana | McNeese State U | Bio, Env Sci | 2 | 1 | 1 |
| Maryland | The Johns Hopkins U | EnvH | 0 | 4 | 2 |
| | U of Maryland | Met | 3 | 1 | 1 |
| Massachusetts | Harvard | PH | 0 | 6 | — |
| Michigan | Ferris State College | EnvQ Con | 1 | 0 | 1 |
| | Michigan State U | CE Sanitary Engr | 0 | 3 | 2 |
| | Oakland U | Chem | 1 | 0 | 1 |
| | Wayne State U | ChE | | | |
| Minnesota | U of Minnesota | EnvH, ME | 0 | 5 | — |
| Missouri | U of Missouri-Rolla | CE | 0 | 2 | — |
| | Washington U | ME | 2 | 2 | — |
| N. Carolina | Duke U | CE, EnvE | 1 | 1 | — |
| | NC State U | ChE, Air Cons | 2 | 5 | 2 |
| | U of NC-Chapel Hill | EnvE Sci, Engr | 0 | 8 | 1 |
| New Jersey | NJ Inst of Tech | CE & EnvE | 10 | 9 | — |
| | Rutgers U | Env Sci, Met | 1 | 3 | 1 |
| New York | City Coll of NY | CE | 0 | 3 | — |
| | Cooper Union | Engr | 9 | 0 | — |
| | Cornell U | CE, ChE | 0 | 2 | — |
| | Manhattan College | ChE | 0 | 1 | 1 |
| | New York U-Medical Center | Inst Env Med | 0 | 4 | 2 |
| | Polytechnic Inst. New York | ChE | 0 | 0 | 1 |
| | Rensselaer Poly Inst | CE, EnvE | 1 | 3 | — |
| | SUNY-Oswego | Erth Sci | 1 | 0 | 1 |
| | Syracuse U | CE | 0 | 1 | — |
| Ohio | Hocking Tech College | EnvInd H | 1 | 0 | 0 |
| | Muskingum Area Tech College | Eng Sci Div | 3 | 0 | 0 |
| | Ohio U | ChE | 1 | 1 | 1 |
| | U of Cincinnati | CE, EnvE, ChE | 1 | 14 | 3 |
| | U of Toledo | CE | 4 | 9 | 1 |
| Oklahoma | East Central U | Env Sci | | | |
| | Oklahoma State U | ChE | 0 | 1 | 1 |
| | U of Oklahoma | CE, EnvE | | | |
| Oregon | Oregon Graduate Center | Env Sci | 0 | 6 | 2 |
| | Oregon State U | ME | 1 | 2 | 1 |
| | Portland State U | ME | 2 | 1 | 1 |

Appendix B continued

| State | University | Department | U ^a | G ^b | Res ^c |
|---------------|----------------------------|--------------------|----------------|----------------|------------------|
| Pennsylvania | Carnegie-Mellon U | ME, CE | 2 | 2 | 2 |
| | Drexel U | Env St Inst | 0 | 8 | — |
| | Lafayette Coll | Chem, ME, CE, MetE | 5 | 0 | 0 |
| | Penn State U | ME, ChE, CE, Met | 24 | 7 | 2 |
| | U of Pittsburgh-GSPH | EnvH: Sci | 0 | 7 | 2 |
| S. Carolina | Villanova U | ChE | 0 | 2 | — |
| | Clemson U | Env S Engr | 1 | 3 | 2 |
| S. Dakota | SD School of Mines & Tech | Inst AtmSci | 0 | 1 | 1 |
| | East Tennessee State U | EnvH | 1 | 2 | — |
| Tennessee | Tennessee Tech U | ChE | 1 | 1 | — |
| | U of Tennessee-Chattanooga | ChE, Env Sci | 1 | 1 | — |
| Texas | U of Tennessee-Knoxville | CE | 1 | 5 | 2 |
| | Vanderbilt U | CE, EnvE | 2 | 3 | — |
| | Lamar U | Env Sci | 2 | 0 | — |
| | Texas A&M U | Pl Path, Micro | 0 | 1 | 1 |
| | Texas Tech | ChE | — | — | — |
| | U of Houston | Env Mg, ChE | 1 | 2 | 1 |
| | U of Texas-Arlington | CE | 1 | 3 | — |
| | U of Texas-Austin | CE | — | — | — |
| | U of Texas-Dallas | Env Sci | 0 | 5 | 2 |
| | U of Texas-El Paso | CE | 5 | 4 | — |
| Utah | Brigham Young U | ChE, Therm Inst | 1 | 0 | 1 |
| | U of Utah | ChE | 3 | 0 | 1 |
| Vermont | Utah State U | CE, EnvE | 1 | 2 | 1 |
| | Norwich U | Engr, Env Tech | 4 | 0 | 1 |
| Virginia | Virginia Polytechnic Inst | CE | 2 | 3 | 1 |
| Washington | Washington State U | CE, EnvE | 2 | 7 | 2 |
| | U of Washington | CE | 3 | 4 | 2 |
| West Virginia | WV College of Grad St | — | — | — | |
| Wisconsin | Marquette U | CE | 2 | 0 | — |
| | U of Wisconsin-Madison | ME | 1 | 1 | 1 |

^a Number of undergraduate courses.

^b Number of graduate courses.

^c Number of research projects: 0 = none; 1 = 1 to 5; 2 = 6 to 10; — = not reported.

Abbreviations Used

| | |
|---------------|---|
| Aero Engr | Aeronautical Engineering |
| Air Cons | Air Conservation |
| AtmSci | Atmospheric Science |
| Bio | Biology |
| CE | Civil Engineering |
| ChE | Chemical Engineering |
| Chem | Chemistry |
| Engr | Engineering |
| Eng Sci Div | Engineering Science Division |
| EnvE | Environmental Engineering |
| EnvInd H | Environmental & Industrial Health |
| EnvE Sci | Environmental Engineering & Science |
| EnvH | Environmental Health |
| EnvH Sci | Environmental Health Science |
| Env Mg | Environmental Management |
| Env S Engr | Environmental Systems Engineering |
| EnvE Tech | Environmental Engineering Technology |
| Env&Occ H Sci | Environmental & Occupational Health Science |
| EnvQ Con | Environmental Quality Control |
| EnvR E | Environmental Resources Engineering |
| Env S | Environmental Service |
| Env Sci | Environmental Science |
| EnvSt | Environmental Studies |
| Env St Inst | Environmental Studies Institute |
| Env Tech | Environmental Technology |
| Erth Sci | Earth Science |
| Inst Atm Sci | Institute of Atmospheric Science |
| Inst Env Med | Institute of Environmental Medicine |
| Geo | Geography |
| ME | Mechanical Engineering |
| Met | Meteorology |
| MetE | Metallurgical Engineering |
| Micro | Microbiology |
| PH | Public Health |
| Pl Path | Plant Pathology |
| San Engr | Sanitary Engineering |
| ThE | Thermal Engineering |
| Therm Inst | Thermochemistry Institute |

Appendix C. World air pollution control training.

| Country | University | Number of courses | | Level of research ^a | Department |
|-------------|--------------------------------|-------------------|------|--------------------------------|---------------------------------|
| | | U | G | | |
| Australia | U of Melbourne | 0 | 2 | C | Faculty of Engineering |
| | U of New South Wales | 1 | 1 | B | Chemistry |
| Brazil | U Federal de Minas Gerais | 0 | 0 | A | Engenharia Sanitaria |
| Canada | Mour. Royal College | 4 | 0 | B | Chemical and Biological Science |
| | U du Quebec C Montreal | 0 | 1 | B | Dept de Physique |
| | U of British Columbia | 0 | 1 | B | Chemical Engineering |
| | U of Toronto | 1 | 5 | C | Chemical Engineering |
| | | 2 | 8 | B | Environmental Engineering |
| | U of Windsor | 1 | 2 | B | Chemical Engineering |
| | U de Sherbrooke | 1 | 1 | B | Chemical Engineering |
| England | Leeds U | 1 | 0 | C | Fuel and Energy |
| | The City U | 1 | 0 | B | Civil Engineering |
| | Trent Polytechnic | 1 | 1 | A | Building & Env Health |
| | U of Newcastle Upon Tyne | 3 | 1 | B | Civil Engineering |
| | U of East Anglia | 1 | 0 | B | Environmental Science |
| | U of Exeter | 1 | 0 | A | Chemical Engineering |
| | U of Lancaster | 2 | 0 | B | Environmental Science |
| | U of Salford | 1 | 0 | B | Chemical Engineering |
| | U of Southampton | 0 | 0 | A | Civil Engineering |
| | U of York | 1 | 0 | A | Biology |
| Finland | Lappeenranta U of Technology | 0 | 0 | B | — |
| | U of Helsinki | 0 | 1 | B | Physics |
| | U of Oulu | 2 | 2 | C | Botany |
| Germany | Tech U Berlin | 1 | 9 | B | Fachgebiet Luftreinhaltung |
| | U Stuttgart | 0 | 1 | B | Abteilung Biologie |
| Holland | Eindhoven U of Technology | 1 | 1 | B | — |
| India | Andhra U | 0 | 5 | B | Meteorology |
| Japan | Res Inst for Pollution Control | 0 | 1 | B | — |
| | Shizuoka U | 1 | 1 | C | Chemical Engineering |
| Mexico | U Autonoma-Azcapotzalco | — | — | — | — |
| Netherlands | Agricultural U | 3 | 1 | C | — |
| | Eindhoven U of Tech | — | — | — | — |
| | U of Utrecht | 1 | 2 | B | Psychology Lab |
| | U of Toernodiveld | 1+ | 1+ | C | Botanisch Laboratorium |
| New Zealand | U of Canterbury | 0 | 1 | B | Joint Center for Studies |
| Poland | Agricultural U | 1 | 2 | B | Katedra Ochrony Shodowiska |
| | Technical U | 6 | 8 | C | — |
| Scotland | U of Strathclyde | 1 | 0 | B | Civil Engineering |
| Singapore | Singapore Polytechnic U | 1 | 0 | A | Math & Science |
| Sweden | Swedish U of Ag Sci | 0 | 0 | B | Plant and Forest Protection |
| Taiwan | Academic Sinica | 0 | 2 | B | Institute of Physics |
| | Tungai University | 2 | 0 | B | — |
| Thailand | Asian Inst of Technology | 0 | Some | B | Environmental Engineering |
| Turkey | Ankara U | 0 | 4 | B | Pharmacy F. Toxicology |
| Yugoslavia | U of Ljubljana | 3 | 1 | B | — |

^a Level of research: A = 0 projects; B = 1 to 5 projects; C = 6 to 10 projects.

In the U.S., many universities offer one or two courses in air pollution control. The number with more extensive programs is limited. The academic programs are centered in many different departments, as shown in Figure 1. Details on curriculum are covered elsewhere.^{1,4,5,6} Typically, many schools indicated they have from one to five research projects related to air pollution. Those with more extensive programs can be identified either by the number of courses offered or the number of research projects.

The training in countries outside of the U.S. is centered in schools of Engineering, Environmental Science, Geography, Medicine and Agriculture.⁷ Detailed information on the programs in other countries was not obtained because it was desired to keep the questionnaire as short and uncomplicated as possible.

Conclusions

It is clear that air pollution control is a subject being studied and taught at universities worldwide. It would be useful for the faculties to know what type of work is going on in other

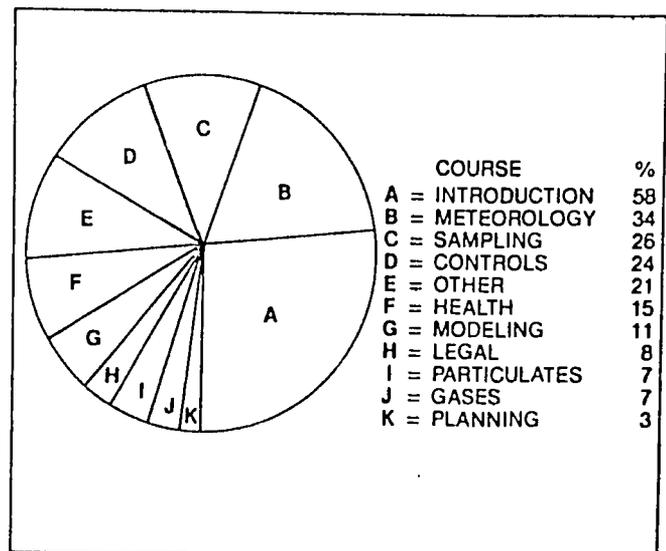


Figure 1. Air pollution courses at 65 U.S. universities.

countries and by whom. In addition, this information would be useful to prospective students and employers such as control agencies and industry.

It is difficult for any one individual or association to collect and interpret all the information. It must be recognized that this study is not complete. It is hoped that by publishing the results the present effort can be expanded. It would be helpful if the reader would let the author know of any errors or omissions in Appendix B or C. In addition, it would be helpful if graduates of universities not included in the Appendices would inform the author. This can be done by either completing the questionnaire in Appendix A or sending the name and complete address of the faculty involved the program.

References

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