ENVIRONMENTAL ENGINEERING TECHNOLOGY GETTING DOWN TO BUSINESS AT MURRAY STATE UNIVERSITY

Mike Kemp, Steve Schneiderman
Murray State University, Kentucky

Introduction

Traditionally, engineering technology programs stressed hands-on, applied engineering fundamentals used in manufacturing, production, electronics, electrical power, and construction. Environmental engineering technology historically concentrated on two-year programs for water and wastewater treatment plant operations. Environmental issues and solutions have become increasingly diverse, complex, and multidisciplinary over the past 15 years. The separation of several environmental engineering programs from civil engineering has also led to the development of four-year environmental engineering technology programs leading to a Bachelor of Science degree. In Who's Who in Environmental Engineering (AAEE, 1997), 16 schools were listed as having ABET accredited environmental engineering or related programs, and 5 schools were listed as having accredited environmental engineering options within the civil engineering programs. Only three environmental engineering technology programs were listed as being accredited, and since publication, two of the three technology programs have converted to engineering programs. Murray State University (MSU) offers the remaining accredited environmental engineering technology program.

Unfortunately, some potential employers, some state registration boards, and other schools often share the views editorialized by Dr. William Rezak (Rezak, 1997); graduates of four-year engineering technology programs must compete with engineering graduates for the same jobs and job titles but have insufficient education. The bachelor's degree in engineering technology is not widely recognized or appreciated, and continual justification of the adequacy of the program is necessary. Although the Commonwealth of Kentucky does not allow engineering technology graduates to become registered as professional engineers, several MSU graduates have passed the Fundamentals of Engineering examination in other states and some have gone on to become registered engineers. Regionally, MSU environmental engineering technology graduates are highly sought by manufacturing companies, chemical plants, municipalities, and environmental management consultants.

The graduate employment survey and academic program comparisons described in this paper were conducted to address the following questions:

1. In what positions do environmental engineering technology graduates work?
2. What salary levels are typical?
3. What is the level of job satisfaction from both the employer and employee viewpoints?
4. How does the course content compare between environmental engineering, civil engineering,

and environmental engineering technology programs?
5. How broad is the environmental course content in environmental engineering, civil engineering, and environmental engineering technology programs?

Graduate Employment Survey

Thirty, randomly selected, MSU environmental engineering technology graduates from the past five years were surveyed to determine current job titles and salary levels. The job titles, presented in Table 1, show a wide variety of technical and administrative positions held by the graduates. Many of the positions involved environmental and/or safety management and reflected the chemical production and manufacturing industry regulatory compliance needs in the region. Some of the graduates held environmental engineering positions, and at least two recent graduates crossed over into other types of engineering. Other technical positions included chemical process operations, research, and environmental education. At least four recent graduates held upper level management positions. One graduate is the manager of a community water district. The others hold executive positions in private companies.

The wide variety of positions held by recent graduates is a strong indication that the environmental technology curriculum at MSU provides students with a broad academic and experiential background. Municipalities, government agencies, and private industry seek persons having this broad background because of the complexity of environmental issues. The movement of graduates into executive positions within a relatively short time is an indication that employers and employees are highly satisfied with the nature and quality of work.

Another measure of program success is the salary level. Figure 1 shows the current annual salaries of the surveyed graduates. Starting salaries ranged from about $21,000 to $38,000, and within 5 years, four graduates had salaries exceeding $50,000. The median salary over the 5-year period was approximately $35,000, and a slight upward trend over time was noted. State government starting salary levels for people having a master's degree in civil or environmental engineering are between $20,000 and $25,000. Some environmental management consultants in Kentucky also offer relatively low starting salaries regardless of whether the degree is in engineering or engineering technology. Generally, salaries for MSU graduates within the first five years of employment appeared to be at about the same level expected for graduates having a bachelor's degree in civil or environmental engineering. Hence, employers in Kentucky seemed to expect the same level of competency and performance from environmental engineering technology graduates as from engineering graduates.

Program Evaluation and Comparisons

To evaluate our own views that the MSU Environmental Engineering Technology program provides a comprehensive environmental education rivaling that obtained in an environmental engineering program and exceeding the environmental education obtained in civil engineering undergraduate programs, we conducted a comparative study. MSU course work in environmental engineering and related sciences was compared to the course work in three

accredited environmental engineering programs and two civil engineering programs offering an environmental engineering emphasis. The three environmental engineering programs were Pennsylvania State University - Harrisburg (PSU), Utah State University (USU), and Humboldt State University (HSU). The two civil engineering programs were Tennessee Technological University (TTU) and the University of Kentucky (UK). The PSU environmental engineering program was selected because it was recently converted from an engineering technology program. The USU and HSU environmental engineering programs were chosen because of outstanding national reputations. TTU and UK were selected as representative civil engineering programs because of proximity to MSU. The comparisons included examination of the specific environmental engineering and related science courses required, the total semester hours of required and elective environmental engineering course work, the semester hours in water related classes, and the semester hours in other environmental engineering areas.

Course Work

Environmental engineering requires a broad educational background in science, math, fluid mechanics, treatment process design and operations, economics, and communication. Because most environmental issues involve ecology, science education should extend beyond chemistry and physics. Since many environmental issues involve multimedia contamination, and solutions often include cross-media transfers of these contaminants, environmental education should extend beyond traditional water and wastewater treatment system design. A firm grounding in environmental regulation is necessary.

Most of the evaluated programs, including MSU, incorporated traditional basic engineering courses such as technical drawing (CAD), statics, dynamics, electrical systems, thermodynamics, soil mechanics, and hydrology/hydraulics. All programs required economics and/or engineering economy. In an engineering technology program such as at MSU, the statics and dynamics courses typically are not calculus based. Applied hydraulics, however, is usually taught at the same level as in an engineering program.

Major program differences are summarized in Table 2. Both civil engineering programs, USU, and MSU required surveying. Both civil engineering programs, but, surprisingly, only one of the environmental engineering programs (HSU), included geology. Each program included introductory and organic chemistry, but only the environmental engineering and MSU programs included introductory biology and microbiology. All of the programs except for MSU required physics and math through differential equations. Two semesters of calculus are required in the MSU program, but physics was eliminated to allow students more opportunity to take other sciences and environmental electives. Only the MSU program required a co-operative education assignment, although the civil engineering programs offered co-op electives.

An introductory water/wastewater treatment system design class was included in each program. Only the environmental engineering and MSU programs required a course in environmental health or safety. The civil engineering programs did not allow for course work in air quality or land restoration. Environmental Regulatory Affairs was required at MSU and USU.

Environmental regulation was offered as an elective at UK. A course in water resources was offered as an elective in all programs except at MSU and PSU.

Overall, the environmental course work in the environmental engineering programs and at MSU appeared to be broader than at the civil engineering schools. MSU was the only school evaluated which required students to obtain professional work experience prior to graduation.

Semester Hours

The total semester hours (or equivalent in the case of HSU, which is on quarters) of environmental engineering or related classes for each program is shown in Figure 2. The bars show a comparison of required water/wastewater related hours, required non-water hours, and elective hours. The required water hours include fluid mechanics, hydrology, and hydraulics courses.

Total environmental hours for the environmental engineering programs averaged 40, double those of the civil engineering programs (19 hours average). The MSU program requirement of 34 hours was similar to the environmental engineering programs. The environmental engineering programs required more than twice as many hours in water and/or wastewater than MSU, which had requirements similar to the civil engineering programs.

MSU required an average of 10 semester hours more of non-water environmental classes than the environmental engineering programs and 15 hours more than the civil engineering programs. The environmental engineering programs did offer more elective hours, which included water and non-water courses, than the civil engineering programs and MSU.

Based on the number of required water hours and non-water hours, MSU appeared to offer a broader environmental program than the environmental engineering and civil engineering programs. Only HSU had total semester hours of non-water and elective classes similar to MSU. Having a broad program meets the needs of employers in the region. These employers look for professional staff that can manage and achieve compliance for a variety of environmental affairs related to pollution prevention, water, wastewater, air, and hazardous substances.

Conclusions

1. Based on initial and current position titles, employers in Kentucky appear to expect the same level of performance and competency from environmental engineering technology graduates as from engineering graduates. The broad academic and experiential background provided at MSU provides students with the tools needed to succeed in a wide variety of technical, administrative, and management positions.

2. Salaries earned by MSU environmental engineering technology graduates are competitive with those earned by civil and environmental engineering graduates. This further supports the conclusion that employer expectations are high and that graduate performance is exemplary.

3. MSU environmental engineering technology program requirements relative to required and elective environmental courses are similar to the requirements in nationally renowned environmental engineering programs. The MSU requirements exceed those of civil engineering programs in the region offering an environmental engineering emphasis.

4. Based on the total semester hours of non-water related environmental courses required, MSU offers a broader program than the environmental engineering schools and a considerably broader program than the civil engineering schools.

Views of employers, registration boards, and other schools that environmental engineering technology students are inadequately prepared for employment, registration, and graduate education are antiquated and inaccurate. This survey and program comparison demonstrated that environmental engineering technology graduates are productive in a variety of well paying positions, employer satisfaction is high, and the education obtained rivals that provided by outstanding environmental engineering institutions.

References

AAEE, 1997. Who's Who in Environmental Engineering. American Academy of Environmental Engineers.

Rezak, W.D., 1997. *Should the Bachelor of Engineering Technology Become an Applied Engineering Program?* Journal of Engineering Technology, Spring.

Biographical

MIKE KEMP, PE, Ph D, Assistant Professor
Member, Water Environment Federation
Member, American Society of Civil Engineers
Member, American Society for Engineering Education

STEVE SCHNEIDERMAN, PE, Ph D, Associate Professor
Diplomate, American Academy of Environmental Engineers
Fellow, American Institute of Chemists
Member, American Society for Engineering Education

Figure 1

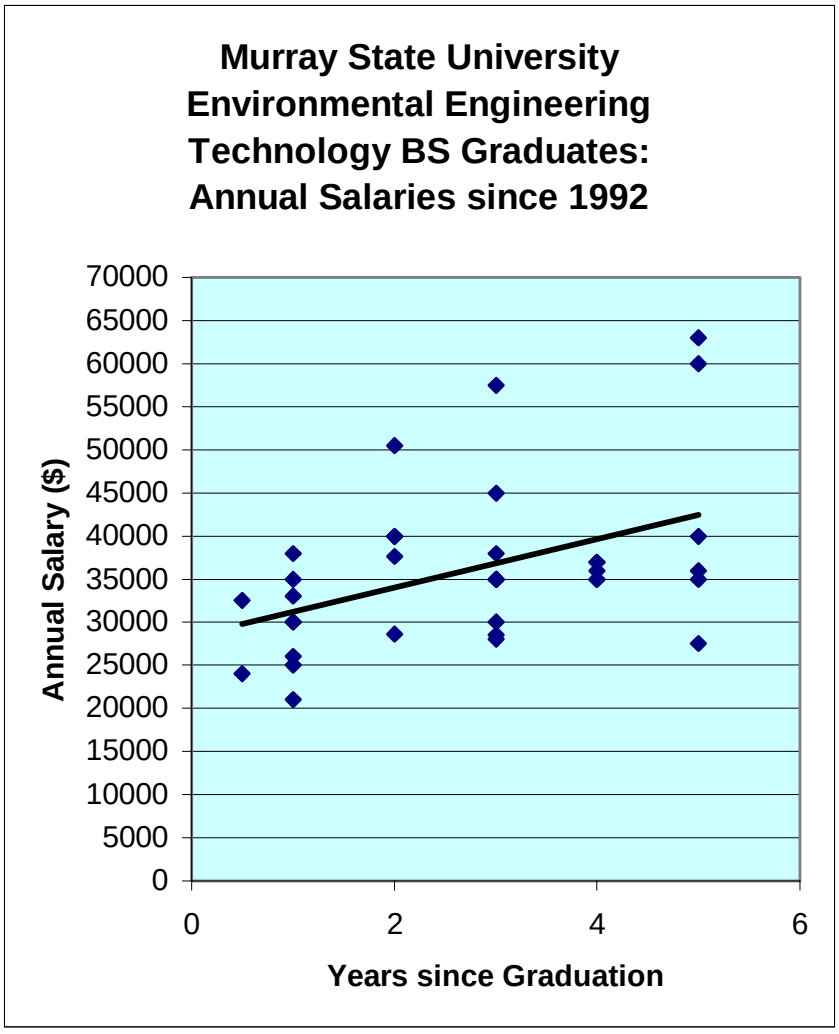
Murray State University
Environmental Engineering
Technology BS Graduates:
Annual Salaries since 1992
Annual Salary ($)
70000
65000
60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
0
2
4
6
Years since Graduation

Figure 2: Comparative Semester Hours in University
Environmental Engineering/Technology Programs

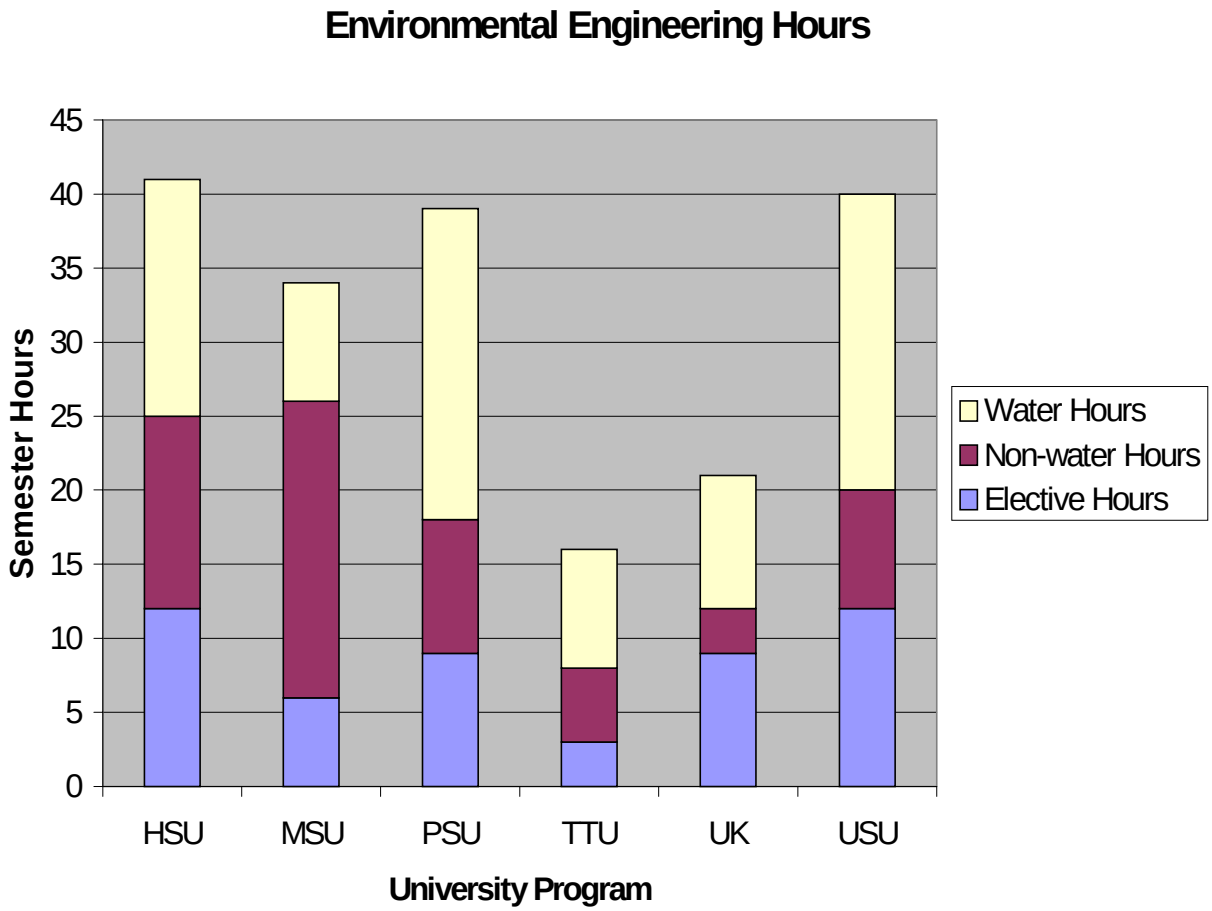

Table 1: MSU Environmental Engineering Technology (BS) Graduate Employment Summary

Graduation Year	Job Title (ca. 1 Jan. 98)
1996	**Safety/Environmental Manager**
	Safety & Environmental Coordinator
	Environmental/Safety Chemist
	Vice President
	Environmental Engineer
	Civil Engineering Technician
	Environmental Specialist
	Carburetor Engineer
	Engineering Technician
	Environmental & Safety Director
	Research/Testing Engineer
1995	**Environmental Engineering Manager**
	Environmental Coordinator
	Environmental Specialist
	Environmental QC Engineer
	Assistant Project Manager
1994	**Chemical Systems Operator**
	Air Pollution Engineer I
	Environmental Engineer
	R & D Technician
	Water District General Manager
	Risk Assessor
	Project Analyst
	Environmental & Safety Manager
	Environmental Coordinator
1993	**Chemical System Operator**
	Air Pollution Engineer II
	Customer Service Representative
	Fleet Service manager
	Environmental Technician III
	Environmental Technician
1992	**Environmental Education Coordinator**
	Environmental Coordinator
	Safety & Environmental Manager
	Chemical System Operator
	Materials Control Assistant
	Project Manger
	Executive Vice President

Table 2. Environmental Engineering/Technology Program Differences

	TTU	UK	PSU	USU	HSU	MSU
Introductory Biology	N	N	N	R	R	R
Microbiology	N	N	R	R	E	R
Geology	R	R	N	N	E	N
Physics	R	R	R	R	R	N
Differential Equations	R	R	R	R	R	N
Co-op Education	E	E	N	N	N	R
Surveying	R	R	N	R	N	R
Health/Safety	N	N	R	R	R	R
Air Quality	N	N	R	N	E	R
Land Restoration	N	N	N	E	N	R
Envr. Regulation	N	E	N	R	N	R
Water Resources	E	E	N	E	E	N
Legend	REQD	ELECT	NONE			