

What Chemical Engineers Do¹

Last May, chemical engineering seniors at UMD took their last final examinations, attended graduation ceremonies, threw their mortarboards in the air, enjoyed their farewell parties, said goodbye to one another, then headed off in an impressive variety of geographical and career directions.



? Are you thinking about following in the footsteps of those graduates — spending the next few years learning to be a chemical engineer and applying what you learn in a career? If so, it is a fairly safe bet that, like most people in your position, you have only a limited idea of what chemical engineering is or what chemical engineers do. A logical way for us to begin answering these questions might therefore be with a definition of chemical engineering.

Unfortunately, no universally accepted definition of chemical engineering exists, and almost every type of skilled work you can think of is done somewhere by people educated as chemical engineers. We will therefore abandon the idea of formulating a simple definition and instead take a closer look at what those recent graduates did, either immediately after graduation (or following a well-earned vacation). Consider these examples and see if any of them sound like the sort of career you can see yourself pursuing and enjoying.



- About 45% of the class went to work for large chemical, petrochemical, pulp and paper, plastics and other materials, or textile manufacturing firms.

- Another 35 % went to work for government agencies and design and consulting firms (many specializing in environmental regulation and pollution



control) and for companies in emerging fields such as microelectronics and biotechnology.

- About 10% of the class went directly into graduate school in chemical engineering. The masters degree candidates will get advanced education in traditional chemical engineering areas (thermodynamics, chemical reactor analysis and design, fluid dynamics, mass and heat transfer, and chemical process design and control), and get jobs doing process or control systems design or product development. The doctoral degree candidates will work on major research projects, and either go into industrial research and development or join a university faculty.

- The remaining 10% of the class went into graduate school in an area other than chemical engineering, such as medicine, law, and business — building on their chemical engineering problem solving skills.

- Several graduates went to work for companies manufacturing specialty chemicals — pharmaceuticals, paints and dyes, and cosmetics, among many other products. All of these companies hire chemical engineers to design and run their production processes. To remain competitive they have to pay attention to such things as mixing efficiency, heat transfer, automatic temperature and liquid level control, statistical quality control, and control of pollutant emissions.



- Some went to work for companies that manufacture integrated semiconductor circuits. A critical step in the production of computer chips involves coating small silicon wafers with extremely thin and uniform layers of silicon-containing, semi-conducting materials. The technique used for this process is chemical vapor deposition, in which the coating material is formed in a gas-phase reaction and then deposited on the surface of

¹ From Felder, R. and Rousseau, R, *Elementary Principle of Chemical Processes*, 3rd ed., Wiley, New York, NY, pp. 3-6, 1999.

the wafer. The graduates working in this area may be called on to identify reactions that can be used to produce the desired films, determine the best conditions at which to run the reactions, design the reactors, and continue to improve their operation.

- Some took elective courses in biochemistry and microbiology and got jobs with biotechnology firms. One graduate works on the design of pharmaceutical production processes that involve immobilized enzymes, biological chemicals that can make specific reactions go orders of magnitude faster than they would in the absence of the enzymes. Several others work on processes that involve genetic engineering, in which recombinant DNA is synthesized and used to produce valuable proteins and other medicinal and agricultural chemicals that would be hard to obtain by any other means.



- Some joined companies that manufacture polymers (plastics). One is working on the development of membranes for desalination of seawater (fresh water passes through, salt is kept out) and for gas separations (hydrogen passes through and hydrocarbons are kept out, or vice versa); another is developing membranes to be used in hollow-tube artificial kidneys (blood flows from the patient's body through thin-walled tubes; metabolic wastes in the blood pass through the tube walls but proteins and other important body chemicals remain in the blood, and the purified blood is returned to the body).



- A few of the graduates went to medical school. (Chemical engineering graduates who take electives in the biological sciences have a strong record of success in gaining medical school admission.) One went to law school. Others enrolled in MBA programs and will probably move into management tracks in chemical-related industries.

- One graduate joined the Peace Corps for a two-year stint in East Africa helping local

communities develop sanitary waste disposal systems and also teaching science and English in a rural school. When she returns, she will complete a Ph.D. program, after ten years run for the United States Senate, win two terms, become head of a highly successful, private foundation dedicated to improving education in economically deprived communities. She will attribute her career successes to the problem-solving skills she acquired in her undergraduate training in chemical engineering.



- At various points in their careers, some of the graduates will work in chemical or biochemical or biomedical or material science laboratories doing research and development or quality engineering, at computer terminals designing processes and products and control systems, at field locations managing the construction and startup of manufacturing plants, on production floors supervising and troubleshooting and improving operations, on the road doing technical sales and service, in executive offices performing administrative functions, in government agencies responsible for environmental and occupational health and safety, in hospitals and clinics practicing medicine or biomedical engineering, in law offices specializing in chemical process-related patent work, and in classrooms teaching the next generation of chemical engineering students.

The different careers described here are clearly too diverse to fall into a single category. They involve disciplines including physics, chemistry, biology, environmental science, medicine, applied mathematics, statistics, computer science, economics, management and information science, research, design, construction, sales and service, production supervision, and business administration.

The single feature they have in common is that chemical engineers can be found doing them.



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