

will be best for those with apprenticeship training or vocational school courses covering systems operation using computerized controls and instrumentation.

Employment of stationary engineers and boiler operators is expected to decline through the year 2010. Continuing commercial and industrial development will increase the amount of equipment to be operated and maintained. However, automated systems and computerized controls are making newly installed equipment more efficient, thus reducing the number of jobs needed for its operation. Some job openings will arise from the need to replace experienced workers who transfer to other occupations or leave the labor force. However, turnover in this occupation is low, partly due to its high wages. Consequently, relatively few replacement openings are expected.

Earnings

Median annual earnings of stationary engineers and boiler operators were \$40,420 in 2000. The middle 50 percent earned between \$31,490 and \$51,090 a year. The lowest 10 percent earned less than \$24,470, and the highest 10 percent earned more than \$61,530 a year. Median annual earnings of stationary engineers and boiler operators in 2000 were \$46,600 in local government and \$37,680 in hospitals.

Related Occupations

Other workers who monitor and operate stationary machinery include chemical plant and system operators; gas plant operators; petroleum pump system operators, refinery operators, and gaugers; power plant operators, distributors, and dispatchers; and water and wastewater treatment plant and system operators. Other workers who maintain the equipment and machinery in a building or plant are industrial machinery repairers and millwrights.

Sources of Additional Information

Information about apprenticeships, vocational training, and work opportunities is available from State employment service offices, locals of the International Union of Operating Engineers, vocational schools, and State and local licensing agencies.

Specific questions about this occupation should be addressed to:

- ▶ International Union of Operating Engineers, 1125 17th St. NW., Washington, DC 20036. Internet: <http://www.iuoe.org>
- ▶ National Association of Power Engineers, Inc., 1 Springfield St., Chicopee, MA 01013. Internet: <http://www.powerengineers.com>
- ▶ Building Owners and Managers Institute International, 1521 Ritchie Hwy., Arnold, MD 21012. Internet: <http://www.bomi-edu.org>

Water and Liquid Waste Treatment Plant and System Operators

(O*NET 51-8031.00)

Significant Points

- Employment is concentrated in local government and private water supply and sanitary services companies.
- Postsecondary training is increasingly an asset as the number of regulated contaminants grows and treatment plants become more complex.
- Operators must pass exams certifying that they are capable of overseeing various treatment processes.

Nature of the Work

Clean water is essential for everyday life. *Water treatment plant and system operators* treat water so that it is safe to drink. *Liquid waste treatment plant and system operators*, also known as wastewater treatment plant and system operators, remove harmful pollutants from domestic and industrial liquid waste so that it is safe to return to the environment.

Water is pumped from wells, rivers, and streams to water treatment plants, where it is treated and distributed to customers. Liquid waste travels through customers' sewer pipes to liquid waste treatment plants, where it is treated and returned to streams, rivers, and oceans, or reused for irrigation and landscaping. Operators in both types of plants control processes and equipment to remove or destroy harmful materials, chemical compounds, and microorganisms from the water. They also control pumps, valves, and other processing equipment to move the water or liquid waste through the various treatment processes, and dispose of the removed waste materials.

Operators read, interpret, and adjust meters and gauges to make sure plant equipment and processes are working properly. They operate chemical-feeding devices, take samples of the water or liquid waste, perform chemical and biological laboratory analyses, and adjust the amount of chemicals, such as chlorine, in the water. They use a variety of instruments to sample and measure water quality, and common hand and power tools to make repairs. Operators also make minor repairs to valves, pumps, and other equipment.

Water and liquid waste treatment plant and system operators increasingly rely on computers to help monitor equipment, store sampling results, make process-control decisions, schedule and record maintenance activities, and produce reports. When problems occur, operators may use their computers to determine the cause of the malfunction and its solution.

Occasionally operators must work under emergency conditions. A heavy rainstorm, for example, may cause large amounts of liquid waste to flow into sewers, exceeding a plant's treatment capacity. Emergencies also can be caused by conditions inside a plant, such as chlorine gas leaks or oxygen deficiencies. To handle these conditions, operators are trained to make an emergency management response and use special safety equipment and procedures to protect public health and the facility. During these periods, operators may work under extreme pressure to correct problems as quickly as possible. These periods may create dangerous working conditions, and operators must be extremely cautious.

The specific duties of plant operators depend on the type and size of plant. In smaller plants, one operator may control all machinery, perform tests, keep records, handle complaints, and do repairs and maintenance. A few operators may handle both a water treatment and a liquid waste treatment plant. In larger plants with many employees, operators may be more specialized and only monitor one process. The staff also may include chemists, engineers, laboratory technicians, mechanics, helpers, supervisors, and a superintendent.

Water pollution standards have become increasingly stringent since adoption of two major Federal environmental statutes: the Clean Water Act of 1972, which implemented a national system of regulation on the discharge of pollutants; and the Safe Drinking Water Act of 1974, which established standards for drinking water. Industrial facilities sending their wastes to municipal treatment plants must meet certain minimum standards to ensure that the wastes have been adequately pretreated and will not damage municipal treatment facilities. Municipal water treatment plants also must meet stringent drinking water standards. The list of contaminants regulated by these statutes has grown over time. For example, the 1996 Safe Drinking Water Act Amendments include standards for the monitoring of cryptosporidium and giardia, two biological organisms that cause health problems. Operators must be familiar with



Operators take samples of water or liquid waste, perform laboratory analyses, and adjust the amount of chemicals, such as chlorine, in the water.

the guidelines established by Federal regulations and how they affect their plant. In addition to Federal regulations, operators also must be aware of any guidelines imposed by the State or locality in which the plant operates.

Working Conditions

Water and liquid waste treatment plant and system operators work both indoors and outdoors, and may be exposed to noise from machinery and unpleasant odors. Operators' work is physically demanding and often is performed in unclean locations. They must pay close attention to safety procedures for they may be confronted with hazardous conditions, such as slippery walkways, dangerous gases, and malfunctioning equipment. Plants operate 24 hours a day, 7 days a week; therefore, operators work one of three 8-hour shifts, including weekends and holidays, on a rotational basis. Operators may be required to work overtime.

Employment

Water and liquid waste treatment plant and system operators held about 88,000 jobs in 2000. Most worked for local governments. Some worked for private water supply and sanitary services companies, which increasingly provide operation and management services to local governments on a contract basis.

Water and liquid waste treatment plant and system operators are employed throughout the country, but most jobs are in larger towns and cities. Although nearly all work full time, those who work in small towns may only work part time at the treatment plant—the remainder of their time may be spent handling other municipal duties.

Training, Other Qualifications, and Advancement

A high school diploma usually is required to become a water or liquid waste treatment plant operator. Operators need mechanical aptitude and should be competent in basic mathematics, chemistry, and biology. They must have the ability to apply data to formulas of treatment requirements, flow levels, and concentration levels. Some basic familiarity with computers also is necessary because of the trend toward computer-controlled equipment and more sophisticated instrumentation. Certain positions—particularly in larger cities and towns—are covered by civil service regulations. Applicants for these positions may be required to pass a written examination testing mathematics skills, mechanical aptitude, and general intelligence.

Completion of an associate degree or 1-year certificate program in water quality and liquid waste treatment technology increases an applicant's chances for employment and promotion because plants are becoming more complex. Offered throughout the country, these programs provide a good general knowledge of water and liquid waste treatment processes, as well as basic preparation for becoming an operator.

Trainees usually start as attendants or operators-in-training and learn their skills on the job under the direction of an experienced operator. They learn by observing and doing routine tasks such as recording meter readings; taking samples of liquid waste and sludge; and performing simple maintenance and repair work on pumps, electric motors, valves, and other plant equipment. Larger treatment plants generally combine this on-the-job training with formal classroom or self-paced study programs.

The Safe Drinking Water Act Amendments of 1996, enforced by the U.S. Environmental Protection Agency, specify national minimum standards for certification and recertification of operators of community and nontransient, noncommunity water systems. As a result, operators must pass an examination to certify that they are capable of overseeing liquid waste treatment plant operations. There are different levels of certification depending on the operator's experience and training. Higher certification levels qualify the operator for a wider variety of treatment processes. Certification requirements vary by State and by size of treatment plants. Although relocation may mean having to become certified in a new location, many States accept other States' certifications.

Most State drinking water and water pollution control agencies offer training courses to improve operators' skills and knowledge. These courses cover principles of treatment processes and process control, laboratory procedures, maintenance, management skills, collection systems, safety, chlorination, sedimentation, biological treatment, sludge treatment and disposal, and flow measurements. Some operators take correspondence courses on subjects related to water and liquid waste treatment, and some employers pay part of the tuition for related college courses in science or engineering.

As operators are promoted, they become responsible for more complex treatment processes. Some operators are promoted to plant supervisor or superintendent; others advance by transferring to a larger facility. Postsecondary training in water and liquid waste treatment, coupled with increasingly responsible experience as an operator, may be sufficient to qualify for superintendent of a small plant, where a superintendent also serves as an operator. However,

educational requirements are rising as larger, more complex treatment plants are built to meet new drinking water and water pollution control standards. With each promotion, the operator must have greater knowledge of Federal, State, and local regulations. Superintendents of large plants generally need an engineering or science degree.

A few operators get jobs with State drinking water or water pollution control agencies as technicians, who monitor and provide technical assistance to plants throughout the State. Vocational-technical school or community college training generally is preferred for technician jobs. Experienced operators may transfer to related jobs with industrial liquid waste treatment plants, water or liquid waste treatment equipment and chemical companies, engineering consulting firms, or vocational-technical schools.

Job Outlook

Employment of water and liquid waste treatment plant and system operators is expected to grow as fast as the average for all occupations through the year 2010. Because the number of applicants in this field is normally low, job prospects will be good for qualified applicants.

The increasing population and growth of the economy are expected to boost demand for essential water and liquid waste treatment services. As new plants are constructed to meet this demand, employment of water and liquid waste treatment plant and system operators will increase. In addition, many job openings will occur as experienced operators transfer to other occupations or leave the labor force.

Local governments are the largest employers of water and liquid waste treatment plant and system operators. However, Federal certification requirements have increased reliance on private firms specializing in the operation and management of water and liquid waste treatment facilities. As a result, employment in privately owned facilities will grow faster than the average. Increased pretreatment activity by manufacturing firms also will create new job opportunities.

Earnings

Median annual earnings of water and liquid waste treatment plant and system operators were \$31,380 in 2000. The middle 50 percent earned between \$24,390 and \$39,530. The lowest 10 percent earned less than \$19,120, and the highest 10 percent earned more than \$47,370. Median annual earnings of water and liquid waste treatment plant and systems operators in 2000 were \$31,120 in local government and \$29,810 in water supply.

In addition to their annual salaries, water and liquid waste treatment plant and system operators usually receive benefits that may include health and life insurance, a retirement plan, and educational reimbursement for job-related courses.

Related Occupations

Other workers whose main activity consists of operating a system of machinery to process or produce materials include chemical plant and system operators; gas plant operators; petroleum pump system operators, refinery operators, and gaugers; power plant operators, distributors, and dispatchers; and stationary engineers and boiler operators.

Sources of Additional Information

For information on employment opportunities, contact State or local water pollution control agencies, State water and liquid waste operator associations, State environmental training centers, or local offices of the State employment service.

For information on certification, contact:

► Association of Boards of Certification, 208 Fifth St., Ames, IA 50010-6259. Internet: <http://www.abccert.org>

For educational information related to a career as a water or liquid waste treatment plant and system operator, contact:

► American Water Works Association, 6666 West Quincy Ave., Denver, CO 80235.

► Water Environment Federation, 601 Wythe St., Alexandria, VA 22314-1994. Internet: <http://www.wef.org>

Printing Occupations

Bookbinders and Bindery Workers

(O*NET 51-5011.01, 51-5011.02, 51-5012.00)

Significant Points

- Most workers train on the job.
- Employment is expected to grow more slowly than average, reflecting increasingly productive bindery operations.
- Opportunities for hand bookbinders are limited because of the small number of establishments that do this highly specialized work.

Nature of the Work

The process of combining printed sheets into finished products such as books, magazines, catalogs, folders, directories, or product packaging is known as "binding." Binding involves cutting,

folding, gathering, gluing, stapling, stitching, trimming, sewing, wrapping, and other finishing operations. Bindery workers operate and maintain the machines that perform these various tasks.

Job duties depend on the kind of material being bound. In firms that do *edition binding*, for example, workers bind books produced in large numbers, or "runs." *Job binding* workers bind books produced in smaller quantities. In firms specializing in *library binding*, workers repair books and provide other specialized binding services to libraries. *Pamphlet binding* workers produce leaflets and folders, and *manifold binding* workers bind business forms such as ledgers and books of sales receipts. *Blankbook binding* workers bind blank pages to produce notebooks, checkbooks, address books, diaries, calendars, and note pads.

Some types of binding and finishing consist of only one step. Preparing leaflets or newspaper inserts, for example, require only folding. Binding of books and magazines, on the other hand, requires a number of steps.

Bookbinders and bindery workers assemble books and magazines from large, flat, printed sheets of paper. Skilled workers