

## Wastewater Glossary

**activated-sludge process** Biological wastewater treatment process that converts nonsettleable (suspended, dissolved, and colloidal solids) organic materials to a settleable product using aerobic and facultative microorganisms.

**advanced wastewater treatment** Any physical, chemical, or biological treatment process used to accomplish a degree of treatment greater than that achieved by secondary treatment.

**aerator** A device that brings air and a liquid into intimate contact.

**ammonia (NH<sub>3</sub>), ammonium (NH<sub>4</sub><sup>+</sup>)** Dissolved degradation products of urea and proteins in raw wastewater. Typically, raw wastewater contains 30 to 50 mg/L of NH<sub>3</sub>. Reactions between chlorine and ammonia are important in disinfection.

**anaerobic** (1) A condition in which free and dissolved oxygen is unavailable. (2) Requiring or not destroyed by the absence of air or free oxygen.

**anaerobic bacteria (anaerobes)** Microorganisms that grow only in the absence of free and dissolved oxygen.

**anoxic** Condition in which oxygen is available in the combined form only; there is no free oxygen. Anoxic sections in an activated sludge plant may be used for denitrification.

**average daily flow** The total flow past a point over a period of time divided by the number of days in that period.

**biochemical oxygen demand (BOD)** A measure of the quantity of oxygen used in the biochemical oxidation of organic matter in a specified time, at a specific temperature, and under specified conditions.

**biochemical oxygen demand load** The biochemical oxygen demand content, typically expressed in kilograms or pounds per unit of time, of wastewater passing into a treatment system or water body.

**biological denitrification** The transformation of nitrate nitrogen to inert nitrogen gas by microorganisms in an anoxic environment in the presence of an electron donor.

**biological nutrient removal (BNR)** An adaptation of the conventional activated-sludge process where anaerobic and anoxic zones are added to biological reactors to create the correct conditions under which bacteria and other microorganisms are able to remove nitrogen and phosphorous from wastewater.

**biosolids** The solid organic matter recovered from wastewater treatment processes and used, especially as fertilizer.

**capacity** (1) The quantity that can be contained exactly, or the rate of flow that can be carried out exactly. (2) The load for which a machine, apparatus, station, or system is rated.

**capital cost** The amount of cash or credit needed initially to complete a project such as the construction of a wastewater treatment plant.

**certification** A program to substantiate the capabilities of personnel by documentation of experience and learning in a defined area of endeavor.

**chemical oxygen demand (COD)** A quantitative measure of the amount of oxygen required for the chemical oxidation of carbonaceous (organic) material in wastewater.

**chlorination** The application of chlorine or chlorine compounds to water or wastewater, typically for the purpose of disinfection, but frequently for chemical oxidation and odor control.

**clarification** Any process or combination of processes whose primary purpose is to reduce the concentration of suspended matter in a liquid; formerly used as a synonym for settling or sedimentation. In recent years, the latter terms are preferred to describe settling processes.

**clarifier** Any large circular or rectangular sedimentation tank used to remove settleable solids in water or wastewater. A special type of clarifier, called an upflow clarifier, uses flotation rather than sedimentation to remove solids.

**clean-out hole** Hole or port that is provided for inspection and maintenance purposes.

**collection system** In wastewater, a system of conduits, typically underground pipes, that receive and convey sanitary wastewater or storm water. In a water supply, a system of conduits or canals used to capture a water supply and convey it to a common point.

**combined sewer** A sewer intended to receive both wastewater and stormwater.

**contact tank** A tank used in water or wastewater treatment to promote contact among treatment chemicals or other materials and the liquid treated.

**conventional treatment** Well-known or well-established water or wastewater treatment processes, excluding advanced or tertiary treatment. It typically consists of primary and secondary treatment.

**denitrification** (1) The anaerobic biological reduction of nitrate nitrogen to nitrogen gas. (2) Removal of total nitrogen from a system. See nitrification.

**design criteria** (1) Engineering guidelines specifying construction details and materials. (2) Objectives, results, or limits that must be met by a facility, structure, or process in performance of its intended functions.

**design flow** Engineering guidelines that typically specify the amount of influent flow that can be expected on a daily basis over the course of a year. Other design flows can be set for monthly or peak flows.

**design loadings** Flow rates and constituent concentrations that determine the design of a process unit or facility necessary for proper operation.

**detention time** The period of time that a water or wastewater flow is retained in a basin, tank, or reservoir for storage or completion of physical, chemical, or biological reaction. See contact time and retention time.

**dewater** (1) To extract a portion of the water present in a sludge or slurry. (2) To drain or remove water from an enclosure. A structure may be dewatered so that it can be inspected or repaired.

**digester** A tank or other vessel for the storage and anaerobic or aerobic decomposition of organic matter in sludge.

**digestion** (1) The biological decomposition of the organic matter in sludge, resulting in partial liquefaction, mineralization, and volume reduction. (2) The process carried out in a digester.

**disinfection** (1) The killing of waterborne fecal and pathogenic bacteria and viruses in potable water supplies or wastewater effluents with a disinfectant; an operational term that must be defined within limits, such as achieving an effluent with no more than 200 colonies fecal coliform/100 mL. (2) The killing of the larger portion of microorganisms, excluding bacterial spores, in or on a substance with the probability that all pathogenic forms are killed, inactivated, or otherwise rendered nonvirulent.

**dissolved oxygen (DO)** The oxygen dissolved in water, wastewater, or other liquid-typically expressed in milligrams per liter (mg/L) or percent saturation-available for use by aquatic organisms.

**domestic wastewater** Wastewater derived principally from nonindustrial sources (e.g., dwellings, business buildings, institutions, etc.).

**effluent** Wastewater or other liquid, partially or completely treated or in its natural state, flowing out of a reservoir, basin, treatment plant, or industrial treatment plant, or part thereof.

**effluent quality** The physical, biological, and chemical characteristics of a wastewater or other liquid flowing out of a basin, reservoir, pipe, or treatment plant.

**extended aeration process** A modification of the activated-sludge process.

**fecal coliform bacteria** Aerobic and facultative, Gram-negative, non-spore-forming, rod-shaped bacteria capable of growth at 44.5 degrees Celsius (112 degrees Fahrenheit) and associated with fecal matter of warm-blooded animals. Their presence in water or sludge is an indicator of pollution and possible contamination by pathogens.

**filamentous growth** Intertwined, threadlike biological growths characteristic of some species of bacteria, fungi, and algae. Such growths reduce sludge settleability and dewaterability.

**final effluent** The effluent from the final treatment unit of a wastewater treatment plant.

**flow** (1) The movement of a stream of water or other fluid from place to place. The movement of silt, water, sand, or other material. (2) The fluid that is in motion. (3) The quantity or rate of movement of a fluid discharge; the total quantity carried by a stream. (4) To issue forth or discharge. (5) The liquid or amount of liquid per unit time passing a given point.

**force main** A pressure pipe joining the pump discharge at a water or wastewater pumping station with a point of gravity flow.

**gallons per day (gpd)** A unit of measurement for the flow rate of water, wastewater, or other liquid.

**gallons per minutes (gpm)** A unit of measurement for the flow rate of water, wastewater, or other liquid.

**gate valve** A flow type of valve in which the closing element (the gate) is a disk that moves across the flow in a groove or slot to provide support against pressure.

**grinder pump** A mechanical device that shreds solids and raises sewage to a higher elevation through pressure sewers. These pumps are used to handle raw domestic or industrial wastewater and septage or to break up digester scum.

**grit** The heavy suspended mineral matter in water or wastewater, such as sand, gravel, or cinders. It is removed in a pretreatment unit called a grit chamber to avoid abrasion and wearing of subsequent treatment devices.

**headworks** The initial structures and devices of a water or wastewater treatment plant.

**high-rate activated-sludge process** A modification of the activated-sludge process whereby the mixed liquor suspended solids loadings are kept high, allowing high food-to-microorganisms ratios and shorter detention times.

**hydraulic retention time** The amount of time a small unit of the process flow stays within a tank (such as a reactor) as calculated by the volume of the tank and the flow rate.

**industrial wastewater** Wastewater derived from industrial sources or processes.

**influent** Water, wastewater, or other liquid flowing into a reservoir, basin, treatment plant, or treatment process. See effluent.

**inorganic matter** Mineral-type compounds that are typically nonvolatile, noncombustible, and nonbiodegradable. Most inorganic-type compounds or reactions are ionic in nature; therefore, rapid reactions are characteristic.

**lift station** A structure that contains pumps and appurtenant piping, valves, and other mechanical and electrical equipment for pumping water, wastewater, or other liquid. Also called a pumping station.

**milligrams per liter (mg/L)** A measure of concentration equal to and replacing ppm in the case of dilute concentrations.

**million gallons per day (mgd)** A measure of flow equal to 1.547 ft<sup>3</sup>/sec, 681 gallons per minutes, or 3.785 m<sup>3</sup>/d.

**mixed liquor** A mixture of raw or settled wastewater and activated sludge contained in an aeration tank in the activated-sludge process. See mixed liquor suspended solids.

**mixed liquor suspended solids (MLSS)** The concentration of suspended solids in activated sludge mixed liquor, expressed in milligrams per liter (mg/L). Commonly used in connection with activated sludge aeration units.

**moving average** Trend analysis tool for determining patterns or changes in treatment process. For example: a 7-day moving average would be the sum of the datum points for 7 days divided by 7.

**municipal wastewater treatment** Typically includes the treatment of domestic, commercial, and industrial wastes.

**nitrification** The oxidation of ammonia nitrogen to nitrate nitrogen in wastewater by biological or chemical reactions. See denitrification.

**nitrifying bacteria** Bacteria capable of oxidizing nitrogenous material.

**nitrite (NO<sub>2</sub>)** An intermediate oxygenated form of nitrogen.

**nitrogen (N)** An essential nutrient that is often present in wastewater as ammonia, nitrate, nitrite, and organic nitrogen. The concentrations of each form and the sum (total nitrogen) are expressed as milligrams per liter (mg/L) elemental nitrogen. Also present in some groundwater as nitrate and in some polluted groundwater in other forms. See nutrient.

**nitrogen cycle** A graphical presentation of the conservation of matter in nature showing the chemical transformation of nitrogen through various stages of decomposition and assimilation. The various chemical forms of nitrogen as it moves among living and nonliving matter are used to illustrate general biological principles that are applicable to wastewater and sludge treatment.

**nitrogen removal** The removal of nitrogen from wastewater through physical, chemical, or biological processes, or by some combination of these.

**Nutrient** Any substance that is assimilated by organisms and promotes growth. Typically applied to nitrogen and phosphorus, but also to other essential and trace elements in surface water, groundwater, and wastewater

**nutrient deficiency** In wastewater treatment, a condition in which the influent is lacking in an essential nutrient, typically nitrogen, phosphorus, or iron, which limits the growth of the biomass. Chemicals must be added to correct the deficiency before proper treatment can occur.

**organic loading** The amount of organic material, typically measured as BOD, applied to a given treatment process. Expressed as weight per unit time per unit surface area or per unit weight.

**organic nitrogen** Nitrogen chemically bound in organic molecules such as proteins, amines, and amino acids.

**orthophosphate** (1) A salt that contains phosphorus as  $(PO_4)^{3-}$ . (2) A product of hydrolysis of condensed (polymeric) phosphates. (3) A nutrient required for plant and animal growth. See phosphorus removal.

**Outfall** (1) The point, location, or structure where wastewater or drainage discharges from a sewer, drain, or other conduit. (2) The conduit leading to the ultimate disposal area.

**overflow rate** One of the criteria in the design of settling tanks for treatment plants; expressed as the settling velocity of particles that are removed in an ideal basin if they enter at the surface. It is expressed as a volume of flow per unit water surface area.

**oxidation ditch** A secondary wastewater treatment facility that uses an oval channel with a rotor placed across it to provide aeration and circulation. See secondary treatment.

**parts per million (ppm)** The number of weight or volume units of a minor constituent present with each 1 million units of a solution or mixture. The more specific term milligrams per liter (mg/L), is preferred.

**peak load** (1) The maximum demand for water placed on a pumping station, treatment plant, or distribution system; expressed as a rate. (2) The maximum rate of flow of wastewater to a pumping station or treatment plant. Also called peak demand.

**phosphorus removal** The precipitation of soluble phosphorus by coagulation and subsequent flocculation and sedimentation.

**pipe** A closed conduit that diverts or conducts water or wastewater from one location to another.

**pipe diameter** The nominal or commercially designated inside diameter of a pipe, unless otherwise stated.

**plant hydraulic capacity** The level of flow into a plant above which the system is hydraulically overloaded.

**polymers** Synthetic organic compounds with high molecular weights and composed of repeating chemical units (monomers). Polymers may be polyelectrolytes (such as water-soluble flocculants or water-insoluble ion-exchange resins) or insoluble uncharged materials, such as those used for plastic or plastic-lined pipe and plastic trickling filter media. Liquid polymers are used as flocculation aids.

**preliminary treatment** Unit operations, such as screening, comminution, and grit removal, that prepare the wastewater for subsequent major treatment.

**pretreatment** Treatment of industrial wastewater at its source before discharge to municipal collection systems.

**Programmable Logic Controller (PLCs)** Devices that take signals from sensors on process inputs and outputs and, using a logic-based program, produce a change in one or more manipulated variables by means of some type of actuator. Although PLCs are designed and programmed in mathematical terms, they implement a control strategy through mechanical or electronic means.

**publicly-owned treatment works (POTW)** Municipal wastewater treatment plant.

**pump** A mechanical device for causing flow, raising or lifting water or other fluid, or applying pressure to fluids.

**pumping station** (1) A facility housing relatively large pumps and their appurtenances. Pump house is the typical term for shelters for small water pumps. (2) A facility containing lift pumps to facilitate wastewater collection or reclaimed water distribution.

**reactor** The container, vessel, or tank in which a chemical or biological reaction occurs.

**receiving water** A river, lake, ocean, or other watercourse into which wastewater or treated effluent is discharged.

**removal efficiency** A measure of the effectiveness of a process in removing a constituent. Often expressed as a percentage.

**return activated sludge (RAS)** Settled activated sludge returned to mix with incoming raw or primary settled wastewater. Also called returned sludge.

**screen** A device with openings, typically of uniform size, used to retain or remove suspended or floating solids from a flow stream, preventing them from passing a given point in a conduit. The screening element may consist of parallel bars, rods, wires, grating, wire mesh, or perforated plate.

**screening** A preliminary treatment process that removes large suspended or floating solids from raw wastewater to prevent subsequent plugging of pipes or damage to pumps.

**scum** (1) Extraneous or foreign matter that rises to the surface of a liquid and forms a layer or film there. (2) A residue deposited on a container or channel at the water surface. (3) A mass of solid matter that floats on the surface.

**secondary clarifier** A settling tank following secondary treatment designed to remove part of the suspended matter by gravity. Also called a secondary sedimentation tank.

**secondary effluent** (1) The liquid portion of wastewater leaving secondary treatment. (2) An effluent that, with some exceptions, contains not more than 30 mg/L each (on a 30-day average basis) BOD and suspended solids.

**secondary treatment** (1) Typically, a level of treatment that produces secondary effluent. (2) Sometimes used interchangeably with the concept of biological wastewater treatment, particularly the activated-sludge process. Commonly applied to treatment that consists chiefly of clarification followed by a biological process with separate sludge collection and handling.

**Skimming** (1) The process of diverting water from the surface of a stream or conduit by means of a shallow overflow. (2) The process of removing grease or scum from the surface of wastewater in a tank.

**sludge** (1) Accumulated solids separated from liquids during the treatment process that have not undergone a stabilization process. (2) Removed material resulting from chemical treatment, coagulation, flocculation, sedimentation, flotation, or biological oxidation of water or wastewater. (3) Any solid material containing large amounts of entrained water collected during water or wastewater treatment.

**sodium hypochlorite (NaOCl)** A water solution of sodium hydroxide and chlorine in which sodium hypochlorite is the essential ingredient.

**solids loading** Amount of solids applied to a treatment process per unit time per unit volume.

**submersible pump** A motor and pump combination designed to be placed entirely below the liquid surface. Submersible pumps are typically constructed as pumps vertically closed-coupled to a submersible motor. They are used for domestic and industrial treatment applications and for pumping groundwater from wells.

**tertiary treatment** The treatment of wastewater beyond the secondary or biological stage; term typically implies the removal of nutrients, such as phosphorus and nitrogen, and a high percentage of suspended solids. Term now being replaced by advanced wastewater treatment.

**total Kjeldahl nitrogen** The combined amount of organic and ammonia nitrogen.

**total suspended solids (TSS)** The amount of insoluble solids floating and in suspension in wastewater. Also referred to as total nonfilterable residue.

**turbidity** (1) A condition in water or wastewater caused by the presence of suspended matter and resulting in the scattering and absorption of light. (2) Any suspended solids imparting a visible haze or cloudiness to water that can be removed by filtration. (3) An analytical quantity typically reported in turbidity units determined by measurements of light scattering.

**valve** A device installed in a pipeline to control the magnitude and direction of flow. It consists of a shell and a disk or plug fitted to the shell.

**variable-frequency drive (VFD)** An electronic controller that adjusts the speed of an electric motor by modulating the power being delivered. These drives provide continuous control, matching motor speed to the specific demands of the work being performed.

**waste activated sludge (WAS)** Solids removed from the activated-sludge process to prevent an excessive buildup in the system.

**wastewater** Spent or used water of a community or industry containing dissolved and suspended matter.

**weir** A device that has a crest and some side containment of known geometric shape, such as a V, trapezoid, or rectangle, and is used to measure flow of liquid. The liquid surface is exposed to the atmosphere. Flow is related to the upstream height of water above the crest, position of crest with respect to downstream water surface, and geometry of the weir opening.

**wet wells** A component of a pumping station that creates a reservoir of the fluid from which the pumps draw their suction.