Water distribution component

Pipelines

The pipeline system of a municipal water distribution network consists of arterial water mains or primary feeders, which convey water from the treatment plant to areas of major water use in the community, and smaller-diameter pipelines called secondary feeders, which tie in to the mains. Usually not less than 150 mm (6 inches) in diameter, these pipelines are placed within the public right-of-way so that service connections can be made for all potential water users. The pipelines are usually arranged in a gridiron pattern that allows water to circulate in interconnected loops; this permits any broken sections of pipe to be isolated for repair without disrupting service to large areas of the community. “Dead-end” patterns may also be used, but they do not permit circulation, and the water they provide is more susceptible to taste and odor problems because of stagnation.

A water distribution pipeline must be able to resist internal and external forces, as well as corrosion. Pipes are placed under stress by internal water pressure, by the weight of the overlying soil, and by vehicles passing above. They may have to withstand water-hammer forces; these occur when valves are closed too rapidly, causing pressure waves to surge through the system. In addition, metal pipes may rust internally if the water supply is corrosive or externally because of corrosive soil conditions.

Fittings

In order to function properly, a water distribution system requires several types of fittings, including hydrants, shutoff valves, and other appurtenances. The main purpose of hydrants is to provide water for firefighting. They also are used for flushing water mains, pressure testing, water sampling, and washing debris off public streets.

Many types of valves are used to control the quantity and direction of water flow. Gate valves are usually installed throughout the pipe network. They allow sections to be shut off and isolated during the repair of broken mains, pumps, or hydrants. A type of valve commonly used for throttling and controlling the rate of flow is the butterfly valve. Other valves used in water distribution systems include pressure-reducing valves, check valves, and air-release valves.

Materials

Distribution pipes are made of asbestos cement, cast iron, ductile iron, plastic, reinforced concrete, or steel. Although not as strong as iron, asbestos cement, because of its corrosion resistance and ease of installation, is a desirable material for secondary feeders up to 41 cm (16 inches) in diameter. Pipe sections are easily joined with a coupling sleeve and rubber-ring gasket. Cast iron has an excellent record of service, with many installations still functioning after 100 years. Ductile iron, a stronger and more elastic type of cast iron, is used in newer installations. Iron pipes are provided in diameters up to 122 cm (48 inches) and are usually coated to prevent corrosion. Underground sections are connected with bell-and-spigot joints, the spigot end of one pipe section being pushed into the bell end of an adjacent section. A rubber-ring gasket in the bell end is compressed when the two sections are joined, creating a watertight, flexible connection. Flanged and bolted joints are used for above ground installations.

Plastic pipes are available in diameters up to 61 cm (24 inches). They are lightweight, easily installed, and corrosion-resistant, and their smoothness provides good hydraulic characteristics. Plastic pipes are connected either by a bell-and-spigot compression-type joint or by threaded screw couplings.

Precast reinforced concrete pipe sections up to 366 cm (12 feet) in diameter are used for arterial mains. Reinforced concrete pipes are strong and durable. They are joined using a bell-and-spigot-type connection that is sealed with cement mortar. Steel pipe is sometimes used for arterial mains in above ground installations. It is very strong and lighter than concrete pipe, but it must be protected against corrosion with lining of the interior and with painting and wrapping of the exterior. Sections of steel pipe are joined by welding or with mechanical coupling devices.

Pumps

Many kinds of pumps are used in distribution systems. Pumps that lift surface water and move it to a nearby treatment plant are called low-lift pumps. These move large volumes of water at relatively low discharge pressures. Pumps that discharge treated water into arterial mains are called high-lift pumps. These operate under higher pressures. Pumps that increase the pressure within the distribution system or raise water into an elevated storage tank are called booster pumps. Well pumps lift water from underground and discharge it directly into a distribution system.

Most water distribution pumps are of the centrifugal type, in which a rapidly rotating impeller adds energy to the water and raises the pressure inside the pump casing. The flow rate through a centrifugal pump depends on the pressure against which it operates. The higher the pressure, the lower the flow or discharge. Another kind of pump is the positive-displacement type. This pump delivers a fixed quantity of water with each cycle of a piston or rotor. The water is literally pushed or displaced from the pump casing. The flow capacity of a positive-displacement pump is unaffected by the pressure of the system in which it operates.