THE VALUE OF A CONTINUOUS SETTLING BASIN.*

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The City of Muskogee, Oklahoma, has under construction a number of improvements to its water supply and sewerage systems. The water improvements consist of an intake tower in the Grand River some 2,000 ft. above its junction with the Arkansas River, a 54-in. concrete-lined intake 2,500 ft. long constructed in rock tunnel under the Arkansas basin, the installation of additional pumping units, a water purification plant, the reinforcement of the water distribution system, and a 6,000,000-gal. equalizing reservoir, consisting of a 50-sided polygon whose walls are built entirely above the ground. That portion of the water purification plant now under construction is sedimentation assisted by coagulation with ferrous sulphate and lime. Provision is made so that ultimately mechanical filters can be introduced if they should be found necessary. In this article the settling basin only will be discussed.

The new settling basin is a reinforced concrete structure, 212 ft. square on the inside. When filled to a depth of 18 ft. this basin holds over 6,000,000 gal. A curtain-wall of reinforced concrete divides the basin into two compartments. The first or smaller of these compartments, 212 ft. long and 52½ ft wide, has its bottom perforated and underdrained. A distributing trough, supported upon the counterforts, extends the entire width of the first compartment. The water enters the first compartment from the distributing trough through a series of 8-in. openings spaced two in each panel formed by the counterforts; the counterforts are on 13 ft. 4 in. centres. A 4-in. concrete baffle or stilling-wall in front of the distributing trough extends the extire length of the basin. The water passes through the first compartment over the curtain-wall into the larger compartment. Balanced valves in the bottom of the curtain-wall equalize the pressure on the wall during filling. A collecting channel of the same size as the distributing channel is located at the far end of the basin. The water enters this collecting channel through a series of 2-ft. weirs located one in each panel. The basin is designed to operate continuously.

Advantages of Continuous Settling.—A settling basin operating continuously possesses a number of advantages over a basin which is operated intermittently. There is first a considerable saving in the size of the settling basin. This saving may amount to as much as 50 per cent. over an intermittent installation in which two basins are used, decreasing, of course, somewhat with the number of basins. When a settling basin is operated continuously, the capacity of the basin, except for the sludge displacement, is always available, which is not the case with the intermittent type. There is no reason why in a properly designed basin the settling efficiency should be impaired by the disturbance at the inlets and outlets.

Removal of Sludge.—At the Muskogee settling basin the sludge from the first or smaller compartment is removed without interfering with the efficient continuous operation of the plant by a system of underdrains in the small compartments. These underdrains consist of 3-in vitrified pipe drains, each perforated with a hole 9/16 in. in diameter. The underdrains are laid with Pioneer asphalt joints, and are arranged in five zones. The collecting channel for each zone is 8 in. deep and 14 in. wide. Each channel is covered with a 24-in. square reinforced concrete slab, perforated with a 9/16-in. hole in the centre.

The sludge valves are 12-in. hydraulically-operated valves of the Rensselaer make. Each valve controls a zone approximately 212 ft. long and 10½ ft. wide. In each zone are 405 perforations, each 9/16 in. in diameter, spaced 2 ft. on centres in rows 27½ in. apart. As the amount of sludge deposit depends principally upon the distance from the distributing trough, the arrangement of the zones is such that the sludge will be fairly uniformly deposited over the area of any one zone.

Operation.—The intervals between openings of the valves and the length of time they remain open at the outlet end of the sludge drains will vary with the condition of the raw water. The precipitated solids should not be allowed to accumulate long enough to pack over the openings. The sludge valve should be closed at once when the discharge, which is visible at all times, begins to show up clear. After the sludge is drawn off there is formed a cone-shaped depression in the deposit at each perforation. Between the perforations some of the sludge is left standing in the form of wedges and pyramids. Assuming a side slope of 45 deg. for the sludge, which is considerably steeper than most sludges stand in water, the amount of sludge that is out of reach of the underdrains in this particular case would cover the bottom, if considered uniformly distributed, to a depth of 6 in. This means a decrease in the capacity of the first compartment of approximately 2.8 per cent.

Great care should be exercised in the design of a system of underdrains such as has been outlined to insure its successful operation. The underdrains and perforations must be designed so as to give the same amount of suction for all of the perforations or holes in any one zone. Otherwise, clean water will be drawn in at those points where the suction is greatest, while sludge is still covering a large part of the opening. Such a condition not only leads to a great waste of water, but results sooner or later in the partial clogging of the perforations, and ultimately in the permanent breakdown of the underdrain system. To be efficient, the water must enter the perforations at as high a velocity as it is practicable to obtain. This means that, especially in a shallow tank, the frictional losses in the underdrains and effluent pipes and the velocity head at the discharge end must be kept down as much as possible. In the average plant the area of each valve should approximate the total area of the perforations tributary to the valves, preferably less, although this proportioning is claimed to be protected by patents. Quick-opening valves should also be used for economy. Ample provision should be made to prevent excessive pressures developing in the effluent pipe from water hammer. Valves 8 in. or smaller can be readily operated by hand; larger valves should be either hydraulically or electrically operated.

This system of sludge removal was installed by the author at McKeesport, Pa., and Georgetown, Ky.

The larger compartment of the settling basin comprises three-quarters of the total capacity of the basin. It has a sloping bottom draining to a sump. A 12-in. cast-iron sludge pipe is carried from this sump to a 24-in. vitrified pipe drain located outside of the basin. It is expected that fully 85 per cent. of the suspended solids will settle out in the first compartment. For this reason it was considered unnecessary to underdrain the larger compartment. Whenever the sludge reaches a depth of several feet or more in the larger compartment the operation of the basin will have to be suspended and the basin cleaned. The turbidity of the river water, however, is normally low, and it is not expected that this will happen more than once in several years.

The cost of constructing the underdrain system for the removal of sludge is not great when compared with the economy resulting in the cost of operation. By removing the sludge daily the capacity of the basin is not impaired as

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