MECHANICAL FILTER BOTTOMS AND STRAINER SYSTEMS*

By Robert Spurr Weston

IT is unnecessary to recall to your minds that the strainer system of the mechanical filter, unlike that of a sand filter, serves two purposes; namely, it must collect filtered water from the sand and must serve as a distributing medium for the wash water used for washing. Unfortunately, the velocity during washing may be more than five times the velocity during filtration, and this, of course, introduces great difficulties in design; for it is essential that the rate of filtration be uniform throughout the whole sand layer, and that the wash water be distributed as uniformly as practicable over the whole filter area so that it may rise as a plane or sheet for the purpose of separating the accumulated coagulant and fine suspended matter without at the same time causing any considerable loss of sand.

Four Strainer Systems Reviewed

The most generally satisfactory strainer systems are: (1) Manifolds, strainers and a 14-in. layer of gravel. (2) The Harrisburg system of perforated pipes with a 14-in. layer of gravel. (3) Troughs having strainers at their bottoms, with a 14-in. layer of gravel. (4) The Wheeler filter bottom with 8 ins. of gravel.

All of these systems should be designed to wash the sand layer without the use of air. Each system has its advantages and disadvantages, but the excessive cost of system No. 3 makes its use inadvisable. There are, therefore, three systems left. Of these, system No. 2, the Harrisburg system, is the simplest. It, however, consists largely of metal, all of which is exposed, and at the present prices is probably more expensive than the Wheeler filter bottom. System No. 1, like that installed by most of the filter companies, possesses the advantage over system No. 2, the Harrisburg system, of having the outsides of the pipes protected by concrete. The strainers, however, are exposed and must be constructed of bronze, which at present prices makes the installation costly, probably the highest of the three. The insides of the pipes are likewise exposed.

In either of the above systems there exist "dead" spaces on the floor of the filter between the openings where the wash water does not readily reach. This difficulty is overcome in systems Nos. 3 and 4, of which No. 4, the Wheeler filter bottom, is the cheaper. The advantages of the Wheeler filter bottom consist in the absence of metal (with the exception of the short brass tube at the apex of the pyramid); the nearly perfect distribution of the wash water secured by the "ball nozzle" effect of the balls; the lower cost, and the thinner gravel layer. The writer of these notes believes that the Wheeler filter bottom is best when placed above channels rather than built as a false bottom of the filter, although to construct the latter is perfectly feasible.

Why Sand Broke Through Gravel at Akron

Considerable difficulty has been experienced with the Wheeler filter bottom at Akron because of sand passing through the gravel around the walls of the filter, particularly at the corners. The writer has investigated this filter and found that there was a ledge 1 in. wide left around the walls of the filter and furthermore the gravel layer was only 6 ins. in depth. It was very difficult for the workmen to spread 1.5-in. layers of gravel evenly in the large units (2,000,000 gals. daily); consequently the sand had passed through the gravel in certain places until it rested on the ledge around the walls of the filter. This sand remained inactive. The difficulty was overcome by increasing the thickness of the gravel layer around the walls of the filter, particularly at the corners. Less than 0.5% of the area of the filter was involved. This is a very low percentage of sand surface out of action because of lumps, hard spots, etc., and the difficulty can be readily overcome. It would probably be best in a new filter with this bottom to make the gravel layer 8 ins. in thickness; namely, 4 ins. coarse gravel, 2 ins. medium gravel and 2 ins. fine gravel, rather than 3, 1½ and 1½ ins., respectively, first used. Where the filter area is small, the thickness of the gravel layer may be reduced to those last given.

In large filters there seems to be a tendency toward wave motion in the underdrains, which may accumulate pressure at certain points in the filter bed, particularly at the ends of the channels, and may possibly cause the rupture of the gravel layer if it be too thin. This statement, of course, applies equally well to the three systems under consideration. The Wheeler filter bottom is better designed to resist jet action from the strainers than are either of the others. The effect of a large ball immediately above the orifice is absolute and unchangeable.

False Bottom of Strainer Manifold Type?

The discussion regarding choice of filter bottoms at present centers around the relative merits of the false bottom and the strainer or manifold type. The false bottom was used in the Miraflores (C. Z.), Erie and other plants, but only a few plants have been so built. The fear in the minds of operators of filter plants is that they may not prove so efficient bacteriologically as a plant designed on the other plan. On the other hand, the false bottom approaches nearer the condition for successful washing—namely, that of a series of orifices discharging from a tank—but with underdrain channels of sufficient size, relative to the areas of the orifices discharging from them, good enough distribution may be secured for all practical purposes, and the dangers, both structural and in operation, which the false bottom presents, avoided. There should be no objection to the use of the false bottom in small filters.

Should Wash at High Velocity with Water Only

Thirty years' experience and the results of experiments by Ellms and others, indicate that the successful filter will be washed at a high velocity with water alone. This effect is best secured by a strainer system consisting of orifices, above each of which is placed a layer of graded material to prevent sand from passing out of the filter, either when filtering or washing.

The underdrain system should be designed to throttle the discharge of wash water from the orifices. The latter should be reasonably large to avoid unusual loss of head in the filter, and the underdrains should be proportioned to the orifices. The false bottom system, while cheaper, is not so reliable as the other systems, and there are more or less troublesome results from cast or wrought-iron headers and manifold-strainer systems, even when they are cheaper, which is rarely the case. The Wheeler bottom, with sufficient gravel, best fulfils the conditions of practice. It is, however, on account of its being a patented device, more expensive than the Harrisburg system. On the other hand, it is more durable.

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