# DESCRIPTION OF RAPID SAND FILTER PLANT OF STEEL CONSTRUCTION, BRISTOL, CONNECTICUT*

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BEFORE DESCRIBING the filter plant which you have visited this afternoon, it may be of interest to outline very briefly the origin and development of the Bristol Water Supply and the factors leading up to the construction of the purification works.

The supply is obtained from five upland reservoirs located on Poland River or its tributaries at points 1½ to 8 miles west of the center of the city. First developed by a private water company in 1885, the plant was purchased by the city on January 1, 1914, and has since been operated by a commission of three citizens. It is of interest to note that the present chairman, Mr. Charles L. Wooding, is one of the original members. The secretary, Mr. William E. Tracy has been a member of the Commission since 1920 and Mr. Townsend G. Treadway has served as a member for the past eight years. Mr. G. E. Laurie has been in continous charge of plant operations for seventeen years. Because of these long periods of service, the water department officials have been able to plan for the future requirements of the city and to make progressive improvements in the character of the water supply.

The Commission has continued a policy, started by the original water company, of purchasing properties adjoining the reservoirs and their tributary streams in order to eliminate, so far as practicable, direct contamination of the water. Twenty-seven houses and their accompanying barns and outbuildings have been purchased and removed. Areas near important highways have been protected by fences. The Water Department now owns 3525 acres of land or approximately 54% of the total drainage area of 10.2 square miles.

In addition to these methods of protection, the water has been subjected to chlorine treatment since April, 1923.

Although these measures have been effective in safeguarding the sanitary quality of the water, the supply, like many surface waters has been unsatisfactory at times because of objectionable tastes, odors, and discoloration. Copper sulphate treatment has been used with fairly satisfactory results in the control of tastes and odors, but consumer objections to discoloration have persisted.

*Presented at the Bristol Meeting of the Connecticut Society of Civil Engineers, Inc., November 18, 1937.

During the early months of 1936, while investigating methods for satisfying objections to the physical appearance of the water, the attention of

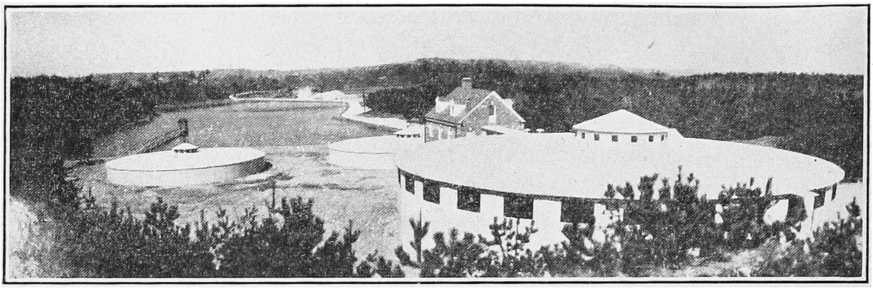

FIG. 1. GENERAL VIEW OF THE FILTER PLANT

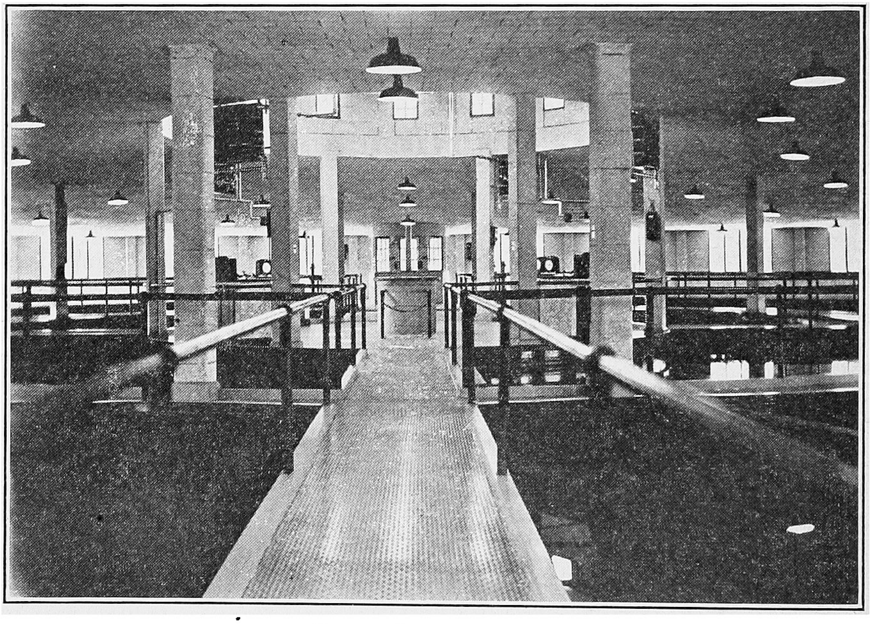

FIG. 2. INTERIOR VIEWS

the Commission was directed to the possible use of rapid sand filters, several of which were then under construction for other Connecticut cities. Consideration was given to both the standard type of concrete plant and the Morse type constructed of steel, the first of which was completed about four years ago for the Washington Suburban District at Burnt Mills, Maryland, by the late Mr. Robert B. Morse. The writer was asked to advise the Commission regarding the relative merits of the two types of construction and serve as consulting engineer on the plant to be designed for Bristol.

In our consideration of the problem it was recognized that, while the modern gravity type rapid sand filter has ordinarily been constructed of concrete, the use of iron and steel for rapid sand pressure filters has been common practice since the early eighties. At Greenwich, Connecticut, cast iron pressure filters were installed about 1884. Additional steel units were constructed in 1910 and although gravity type filters of concrete construction were added to the system in 1926 the iron and steel pressure filters are still in use, representing a life of fifty-three years for the iron and twenty-seven years for the steel tanks up to date. At Atlanta, Georgia, steel pressure filters with a capacity of three million gallons per day were constructed in 1887. Some time later steel pressure filters with a capacity of eighteen million gallons per day were added. In 1923 gravity type filters were constructed having a capacity of twenty-one million gallons per day. The Census of Municipal Water Purification Plants 1930-1931 lists both systems as being used. The life of the earliest filters of 1887 in this system is 50 years to date. At Davenport, Iowa, where the writer had his first experience with filter problems in 1903, steel pressure filters had been in use for 12 years and they are still in operation after a period of forty-six years.

Steel pressure filters are used extensively in the purification of water for industrial purposes, but the gravity type plant ordinarily constructed of concrete represents common practice today for municipal purification works.

It remained for the late Mr. Robert B. Morse to direct attention to the practicability of fabricating steel tanks for gravity type water filters when he built the first five million gallon plant at Burnt Mills, Maryland, completed about four years ago. A second plant of the same capacity has since been constructed. Mr. Laurie and the writer visited this plant during the summer of 1936 and were very favorably impressed with the condition of the metal surface and its protective coating after about three years operation of the filters.

After some further investigation including a second visit with the Water Department officials to the Burnt Mills plant and a visit to a new filter of the same capacity but of concrete construction, the Commission accepted our report advising the construction of a plant similar to that at Burnt Mills, but with a considerable number of changes in design, necessitated by differences in the local conditions. The Contract was let to the Chicago Bridge and Iron Company on December 30, 1936.

Following a survey and the development of a contour map by Mr. Carleton W. Buell of Bristol, grading for the site was begun on March 26, 1937, and the underground piping and reinforced concrete mats for the

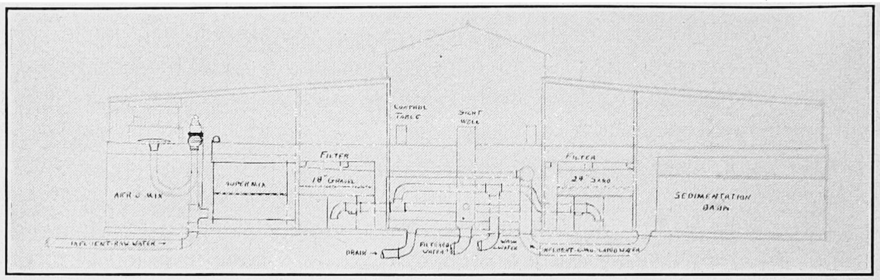


FIG. 3. SECTION

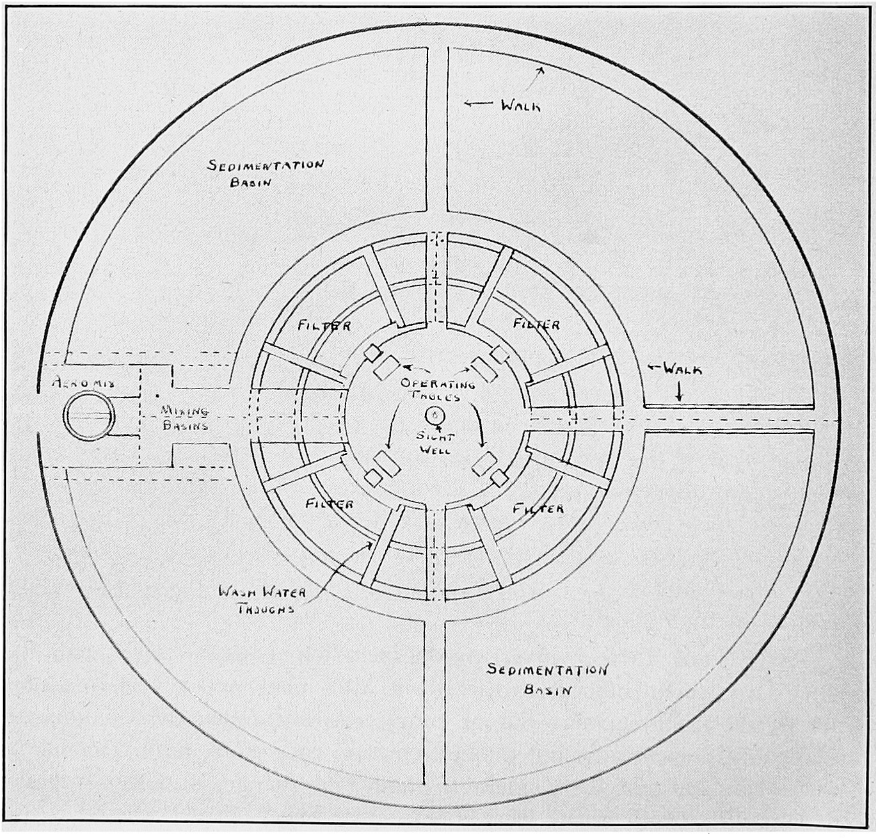


FIG. 4. PLAN

filter unit and the clear water tanks were completed on June 1st. Erection of the superstructures was started on May 18th, and we hope to have the plant in operation before the end of the year.

While the shape of the units in this type of plant differs from that of the usual rectangular tanks used in concrete construction, the purification steps are the same. The filters are equipped with rate controllers, loss of head and rate of flow gages, and all valves in daily use are operated hydraulically from tables on the operating floor. Wash water is supplied from two elevated tanks with a head of about 35 feet at the filter units. The wash water will have a vertical rise through the sand of 24″ per minute. The gravel and sand is supported on a steel grating having about 80% open area. The vertical rise of wash water through the grating will be at a rate of about 30″ per minute. This permits a more uniform rise of water through the sand than is possible with the average strainer system which acts as a series of nozzles.

In order to increase the head in the city by about ten feet, the raw water is elevated from the reservoir level to the filter unit by means of two one-and-a-quarter million gallon pumps and two two-and-a-half million gallon pumps, these to be operated as required to supply one or more of the four filter units each of which has a normal capacity of one and a quarter million gallons per day. Aluminum sulphate will be added to the raw water before it is discharged from the pump house to the aerators and mixing tanks with a mixing period of fifteen minutes at maximum rating. The water then discharges over weirs on each side of the mixing tanks to the two settling basins having a detention period of four hours. Passing over the outlet weirs at the ends of the semi-circular settling basins the water flows to the pipe gallery beneath the operating floor in the center of the plant and then to the filter units as required. The filter effluent discharges through a pipe line from each unit to a sight well in the center of the operating floor, then in a 20″ line through the head house basement where lime will be added to control corrosion before the water passes to the clear water tanks. Chlorine will also be applied to the filtered water if and when it is needed. Beyond the junction of the clear well outlets, the water passes through a venturi tube and then to the distribution mains. The venturi Indicator Recorder located in the pump room will enable the operator to regulate the rate of filtration in accordance with the city demand and the stored water available. The filtered water storage now available from the two tanks at the filter plant, a steel standpipe and high service reservoir in the city totals 1,572,000 gallons and this with the filtering capacity of the plant will meet the maximum requirements of the Fire Underwriters for fire service in Bristol.

All steel surfaces below the water level have been cleaned with mechanically operated wire brushes to remove rust and the surfaces have been painted with four coats of bakalite paint.

The interior surfaces of the filtration unit above the operating floor level have been covered with inch-and-a-half cork both for insulation and to control moisture condensation. The same covering is used in the pump house. The interior of the sight well in the filter unit and the interior of the aeration chamber will be lined with white tile.

Ordinarily it is difficult to obtain comparative cost data on water purification plants because the cost of labor and materials varies to some extent with the dates on which the contracts were let and the differences in pumping requirements, filtered water storage capacity, etc., effect the final cost per million gallons of water purified. It so happens, however, that several rapid sand filter plants have been erected in Connecticut during the past year and, as three of these are of concrete construction of the same capacity as the Bristol plant, approximately relative costs for concrete and steel construction are available.

The cost range for the plants of concrete construction is from $35,880.00 to $43,500.00 per million gallons capacity with an average cost for the three filter plants of about $38,600.00 per million gallons. The cost of the plant of steel construction at Bristol will be approximately $32,000.00 per million gallons.

It should be noted, however, that while the Bristol cost includes pumps and motors for increasing the city pressure, two of the other plants each have a single booster pump for use during low water storage in the reservoir and pumping is not required at the third. The filtered water storage capacity at Bristol is also higher than at any of the other plants.

It is not my purpose to leave the impression that the use of concrete is unwarranted in filter construction, but to indicate that in addition to its common use in pressure filters, steel also has a competitive place in the construction of gravity type plants.

I wish to acknowledge at this time my indebtedness to the representatives of the Chicago Bridge and Iron Company who are the contractors on this work. I am especially indebted to Mr. Harry B. Shaw whose experience during the construction of the Burnt Mills plant has been of inestimable value. Messrs. Humm, Kenney, Willis and Cochrane have all contributed to the final solution of problems which have arisen and I am sure that the water commissioners and Mr. Laurie will join me in this expression of appreciation.