THE HAMBURG FILTER PLANT.

The slow sand filtration plant at Hamburg is generally taken as a model in construction and efficiency. It was completed on May 27th, 1893.

For the five years before the plant was in operation the typhoid death-rate was 47.2 per 100,000 per annum.

For the five years after the plant was in operation the typhoid death-rate was 7.2 per 100,000 per annum.

The water is pumped direct from the river into settling basins. Each settling basin has an area of about 10 acres, and about 6.56 feet depth of water, holding 20,500,000 gallons.

The works will supply a maximum of 48,000,000 gallons of filtered water per day. In 1892 the average daily consumption was 35,000,000 gallons, or 59 gallons per head for a population of 600,000.

The settling basins are surrounded by earth embankments with slopes 1:3. The inner sides being paved with brick on a layer of clay.

The water flows by gravity from the basins to the filters, a distance of 1½ miles, through a conduit 8½ feet in diameter.

The filters are 18 in number, and each has an effective area of 1.89, or 34 acres in all. They will filter at a rate 1.60 million gallons per acre daily. The sides of the filters are embankments with 1:2 slopes. Both sides and bottoms have 20 inches of packed clay, above which are 4 inches of puddle, supporting a wide pavement laid in cement. The bricks are laid flat on the bottom, but edgewise on the sides when they come in contact with ice.

The filtering media consists of 2 feet of gravel, at the base with 3′ 4″ of sand on top. The water standing over the sand when the full filter depth is in operation is 43 inches. The depth of sand is decreased to 24 inches by scraping before it is renewed.

The average depth of sand is 32 inches. The effective size of sand grain .31 m.m. The maximum rate of filtration 1.60 million gallons per acre. The bacterial removal efficiency 99.93 per cent.

The cost of the plant including 34 acres effective filter surface, 40 acres of sedimentation basins, over 2 miles of 8½-foot conduit, pumping machinery, sand washing apparatus, laboratory, etc., was about $2,280,000, or $3.80 per head of population.

The bacterial removal efficiency in filters such as the Hamburg type depends not so much upon the sand composing the filter as upon a scum or blanket of silt which forms over the whole surface of the filter area. It is usual to let the first passage of water run to waste until the scum is sufficiently formed. As the scum thickens the rate of filtration is lowered, until the time comes when the surface must be scraped, the sand washed and replaced upon the surface.

Scraping and renewing the surface sand forms the chief cost in operating. The amount of scraping necessary depends on the turbidity of the particular water.

The average operating expense for the seven London companies operating slow sand filtration plants for 15 years amounted to $1.24 per million gallons. In Hamburg and in Europe generally the cost of operating is higher owing to the greater turbidity of the river waters.

In the United States, at Mt. Vernon, N.Y., with reservoir water, the operating cost has averaged about $2 per million gallons. At Poughkeepsie, N.Y., $3. At Laurence, Mass., the cost for operating for 1895 was $5.80 per million gallons.

Deaths in Hamburg from all causes, and from typhoid fever, before and after the introduction of filters.

Year.	Deaths from all causes per 100,000 living.	Deaths from typhoid fever per 100,000 living.	
1880	24.9	26	
1881	24.1	30	
1882	23.7	27	
1883	25.2	25	
1884	25.1	26	
1885	25.3	42	
1886	29.00	71	
1887	26.6	88	
1888	24.5	54	
1889	23.5	43	
1890	22.0	27	
1891	23.4	24	
1892	41.1	34	Cholera year.
1893	20.2	18	Filtered water from May 28th.
1894	17.9	7	
1895	19.0	11	
1896	17.3	6	
1897	17.0	7	
1898	17.5	5	
Average for 5 years excluding cholera year previous to filtration	24.0	47.2	
Average for five years after filtration	17.7	7.2	