SIGNIFICANCE OF BLACK SANDS IN FILTERS*

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REGULATIONS adopted by the Kansas State Board of Health under the Water and Sewage Law passed by the 1915 Legislature require weekly analysis to be made in the laboratory of the Board of waters from all surface sources and semi-annual inspections of the water works by the engineers of the division of water and sewage of the board. This relatively close contact with the filter plants has brought up many topics of filter plant operation for discussion and solution, not the least interesting of which is the darkening of the sands.

Filter plant operators noted a gradual darkening of the sands in many of the plants. At first no thought was given to the phenomenon other than the fact that the beds were not clean at the time of observation, but it was found impossible to wash the sand back to its original color. Samples were submitted to the laboratory and analyses made which showed that the dark color was due to manganese and iron. The darker the deposit, the higher the percentage of manganese.

At Osawatomie there was the most striking change in the color of the sand. In a few weeks the color changed from a natural light yellow to coal black. Careful study of the basin and influent lines showed a growth of bryozoa or pipe moss. When these organisms died, the deposit of their sheaths showed a very high percentage of manganese. An analogy was drawn between this phenomenon and the fact that the muck lands of Florida, Hawaii and other places carry an extremely high percentage of manganese and it seemed perfectly plausible that the same principles of decomposition and deposition would be maintained in a filter bed that was allowed to become foul.

Table 1.

Results of analyses of filter sands: grams in 10-gram samples

	Rate of Water *inches*	Mn_3O_4	Years in Bed	Fe_2O_3	Mn_3O_4 and Fe_2O_3	Oxides and Clay	Difference, Clay
Neosho River							
Burlington	12	0.0030	4	0.0035	0.0065	0.0771	0.0706
Chanute	15	0.0076	4	0.0142	0.0218	0.3908	0.3690
Humboldt	15	0.0129	2	0.0214	0.0343	0.4594	0.4251
Council Grove		0.0683	3½	0.0071	0.0754	0.3470	0.2716
Verdigris River							
Independence							
Original		0.0007	4	0.0093	0.0100	0.0583	0.0483
Used		0.0070		0.0214	0.0284	0.2915	0.2631
Coffeyville	15.0	0.0172	4½	0.0092	0.0404	0.3169	0.2765
Cherryvale	12.0	0.0312	6	0.0214	0.0526	0.9930	0.9404
Walnut River							
Douglas	12.0	0.0061	3½	0.0017	0.0078	0.1206	0.1128
Winfield	7.5	0.0634	8	0.0214	0.0848	0.6042	0.5194
Augusta	9.0	0.2037	6	0.0178	0.2215	0.9459	0.7244
Marais des Cygnes							
Osawatomie		0.0298	2½	0.0172	0.0470	0.2876	0.2406
Mill Creek							
Washington	12.0	0.0580	3½	0.0071	0.0651	0.2550	0.1899
Impounding Reservoir							
Garnett	18.0	0.0240	3	0.0214	0.0454	0.3507	0.3053
Olathe	14.7	0.0141	3½	0.0050	0.0191	0.1084	0.0893
Shreveport, La.		0.0095		0.0214	0.0309	0.2642	0.2333

In most communities plants are built to supply much more water than is actually needed. Consequently, they are intermittently operated. The filters will be run for a few hours and be allowed to stand six or eight or even twenty-four hours without filtering again and without washing. This procedure is continued until such a loss of head results that no more water can be put through the filter. The filter is then washed. In every filter plant mentioned in this paper, there have probably been many periods of stagnation varying from eight to twenty-four hours.

*From paper read before the American Water Works Association.

In Meade County, Kansas, and elsewhere there have been found small beds of almost pure quartz sand, coated with a deposit similar to those that develop in intermittently operated filter plants. No one can say just how and where these beds were laid down but it is fair to suppose that the conditions were somewhat similar to that existing in a foul filter bed.

In making analyses, the sodium bismuthate method was used to make the determination of manganese and the iron was determined colorimetrically. The clay reported in the table was accreted with the deposit of manganese and iron oxides. It is fortunate that the laboratory saved samples of the original sands that were introduced into the filter plants at the time of their construction. All of the sands returned negative results for manganese with the exception of the sample from Independence, which gave 10 milligrams of the combined oxides.

Table 1 gives the results of analyses and a short description of each plant is appended.

Burlington.—Installation test made May, 1914. New York Continental Jewell standard filter equipment; combined air and water wash. Wash water from distribution system at pressure of 50 pounds per square inch. Wash water valve opened to give rate of 12 inches vertical rise per minute. Considerable difficulty has been experienced with microscopic growth in basins and filters. General operation of plant good. Sand removed March, 1917, following trouble with filter bed. One manifold pipe found broken.

Chanute.—Installation test made May, 1914. Pittsburg Filter Company Standard equipment. Washed with water alone, furnished by centrifugal pump, giving a rate 15 inches vertical rise per minute. Plant operation fair.

Humboldt.—Installation test made May, 1916. Pittsburg Filter Company standard equipment. Filters washed with water alone. Wash water supplied from distribution system and valve opened to give wash water rate of 15 inches vertical rise per minute. Plant operation fair.

Council Grove.—Installation made September, 1914. New York Continental Jewell Filter Company standard wooden tub filter construction. Filters washed with mechanical agitation. Wash water supplied from distribution system pressure No reducing valve used on the wash water line and as a result excessive rates have been used, resulting in the displacement of the sand and gravel. In 1916 the filter beds were dug up and the gravel was found to be very much displaced and mixed with the sand, and many of the strainers clogged. February, 1918, the beds were again dug up and approximately 50 per cent. of the strainers were found to be clogged. Plant operation good.

Independence.—Installation test made May, 1914. Concrete filter construction, with ridged bottom under-drains using wire screen between gravel and sand. Wash water supplied from wash water tank, having a pressure of approximately 22 pounds per square inch at the inlet. Plant operation fair.

Coffeyville.—Installation test December, 1913. New York Continental Jewell Filtration Company standard equipment. Combined air and water wash. Wash water supplied by centrifugal pump, giving a wash velocity of approximately 15 inches vertical rise per minute. Plant operation good.

Cherryvale.—Installation test June, 1912. New York Continental Jewell Filtration Company standard equipment. Filter washed with combined air and water wash. Wash water supplied by centrifugal pump, giving a wash water velocity of approximately 12 inches vertical rise per minute. Plant operation good.

Douglas.—Installation test made September, 1914. New York Continental Jewell Filtration Company standard equipment. Filter washed with combined air and water wash. Water supplied from distribution system at a pressure of

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