connected by gearing with the water-wheel at the top of the tower. These valves can be set to open at fixed intervals, the rate of opening being dependent upon the rapidity with which the water is being passed through the plant. The sludge is discharged to sludge filters.

The total capacity of the four towers is 25,000 gallons, and the rate of upward flow in the second or largest tower, when 3,000 gallons per hour are passing, is about 2 inches per minute, while in the final towers it is about $1\frac{1}{4}$ inches per minute.

The sludge filters provided are six in number, each 9 feet by 8 feet. The sludge is discharged from the first tower at intervals of some $3\frac{1}{2}$ minutes, and from the final towers every 10 minutes. The quantity at each discharge is about one or two gallons.

The capital cost of the apparatus was about £750, and the weekly cost for wages, precipitants and steam about £1 6s. 6d. The cost of repairs and renewals in four years has amounted to £20.

MACKEY-AKEROYD APPARATUS FOR THE PURIFICATION OF DYEWATERS.

By H. MACLEAN WILSON, M.D., B.Sc., C.M.
(FELLOW.)

THE plant described is erected at the mills of Messrs. Brigg & Son, Dock Ing Mill, Batley.

The dyewaters dealt with are from the dyeing of pieces, the dyestuffs used being chiefly anilines, acid and neutral, with ground myrobalans and an iron salt for the cotton or burl dyeing. Bichromate of potash and sulphuric acid, and sometimes a patent bleaching agent, "Hyraldite," are also used to discharge colours from some of the goods. Town water is used in various processes, and the total discharge of refuse is estimated at 30,000 gallons a day on an average.

The dyewater is pumped to an averaging tank with a capacity of 10,500 gallons raised 20 feet high.

In a small wooden tank, fixed at the head of the averaging tank, lime is placed, and into this a proportion of the trade liquids is directed, and the contents are kept constantly agitated by paddles which are kept in motion by means of a small water-wheel driven by the bulk of the refuse. The quantity of lime required to precipitate the solids varies very considerably

Analyses of Samples taken at Dock Ing Mills, Batley (Messrs. Brigg & Sons.)
(Results expressed in parts per 100,000.)

Sample of	Date and Hour taken.	Total Solids.	Solids in Suspension (dried at 100° C.).			Solids in Solution (dried at 100° C.).			Nitrogen.			Oxygen absorbed in 4 hours at 80° F.	Alkalinity (as Ca O).	Acidity (as H ₂ SO ₄).	Hardness.		
			Total.	Ash.		Total.	Ash.		Ammo-niacal.	Alb (Wank-lyn).	Org (Kjeld-dahl).				Total.	Perm.	Temp.
Crude refuse	May 28th, 1907.	149.50	56.10	4.40	93.40	51.60	...	...	...	...	...	20.16	22.40	...	...	...	...
Final effluent	May 19th, 1908.	158.40	1.20	1.20	157.20	137.00	...	...	...	...	...	2.70	18.48	...	95.60	95.60	0.00
Crude refuse	May 26th, 1908.	120.60	10.80	0.56	109.80	93.60	...	...	...	...	...	6.14	...	6.86	17.70	17.70	0.00
Final effluent	10.30 a.m. to 12.30 p.m.	174.48	0.88	0.48	173.60	147.60	...	...	...	...	...	3.25	14.56	...	74.20	66.50	7.70
Crude refuse	June 16th, 1908.	223.60	14.80	1.65	208.80	155.60	0.30	0.54	1.41	0.80	0.80	14.30	...	24.50	75.70	65.70	10.00
Averaging tank effluent	10.20 a.m. to 4.25 p.m.	358.50	32.30	24.50	326.00	306.40	0.35	0.31	0.80	0.65	0.65	6.90	56.00	...	221.50	221.50	0.00
Boiler effluent	10.25 a.m. to 4.25 p.m.	285.30	1.30	1.00	284.00	256.00	0.30	0.26	0.65	0.26	0.65	5.00	23.50	...	185.70	167.70	18.00
Final effluent	10.25 a.m. to 4.25 p.m.	290.96	0.96	0.72	290.00	259.40	0.27	0.23	0.66	0.23	0.66	4.85	23.00	...	167.70	150.00	17.70
Crude refuse	Sept. 1st, 1908.	273.84	32.64	2.40	241.20	199.00	1.28	0.61	3.00	0.61	3.00	20.91	trace	...	55.20	40.70	14.50
Averaging tank effluent	10.10 a.m. to 2.10 p.m.	285.96	46.56	26.40	239.40	203.20	2.27	0.53	2.66	0.53	2.66	13.90	30.20	...	232.20	142.70	89.50
Boiler effluent	10.15 a.m. to 2.15 p.m.	238.96	4.16	3.72	234.80	207.20	0.65	0.27	0.72	0.27	0.72	5.46	25.20	...	235.50	106.00	129.50
Final effluent	10.15 a.m. to 2.15 p.m.	228.48	0.88	0.88	227.60	207.60	0.35	0.20	0.50	0.20	0.50	4.52	24.92	...	150.00	103.00	47.00
Sludge from boiler	Sept. 2nd, 1903	1353.30	1131.00	681.00	222.00	196.00	1.25	5.00	11.11	5.00	11.11	151.50	252.00	...	742.00	430.50	311.50
Sludge filter effluent	Do.	240.64	13.14	3.60	227.20	194.40	0.78	0.12	0.46	0.12	0.46	4.56	trace	...	81.40	59.00	22.40
Final effluent	Sept. 25th, 1903.	207.36	8.36	5.28	199.00	179.80	0.50	0.23	0.80	0.23	0.80	6.28	17.60	...	102.00	90.10	11.90
Sludge from filter	Sept. 28th, 1908.	223.00	17.40	10.68	205.60	193.20	1.11	0.26	1.04	0.26	1.04	6.74	32.50	...	118.00	102.00	16.00
Final effluent	Feb. 25th, 1909.	143.0	2.0	1.2	141.0	126.0	...	...	...	...	...	2.54	3.92	...	74.2	59.0	15.2
Final effluent	April 15th, 1909.	148.04	0.64	0.26	147.4	127.9	...	...	...	...	...	3.87	11.76	...	41.4	33.8	7.6
Final effluent	April 23th, 1900.	126.32	0.32	0.16	126.0	107.0	...	...	...	...	...	3.6	9.5	...	49.0	40.8	8.2

from day to day, for the refuse waters are sometimes strongly acid, and at other times neutral or even alkaline; but usually about 35 parts per 100,000 are necessary.

No attempt is made to retain the solids in suspension in this tank.

The effluent is next passed in an upward direction through an iron boiler which is set at an angle of 12° with the ground line and has a capacity of 7,700 gallons.

The outlet is at the highest point, which is somewhat lower than the bottom of the mixing tank, so that the boiler is kept full of the liquid. The liquid is continually passing through the boiler. The inlet pipe is directed upwards, and thus gives an eddying motion to the liquid, which probably aids in the deposition of solids.

The inventor claims that the deposited solids entangle the suspended solids in the liquid as it enters the tank, and that this ensures their rapid deposition.

The sludge is drawn off from the boiler once a week, and is air-dried on a sludge filter; the production of dried sludge is about three tons per month.

The effluent from the boiler is subsequently passed through a filter consisting of a vertical boiler flue, $6\frac{1}{2}$ feet in diameter and 12 feet in height, and filled for 9 feet of its length with pieces of coke of sizes ranging from $\frac{1}{2}$ inch to $1\frac{1}{2}$ inch cubes. The bottom $1\frac{1}{2}$ feet of the flue contains no coke, and into this the tank effluent is passed and rises through the coke to escape from its upper surface into a compartment $1\frac{1}{2}$ feet in depth, from which it is discharged as the final effluent. This is conveyed to the mill dam and used, mixed with stream water, for condensing.

Any sludge which accumulates in the compartment of the filter below the coke is drawn off through a sludge valve about once a day, and when this is open the reversal of the flow of liquid through the coke helps to wash out any solids which have become entangled among the particles.

The cost of lime is about $\frac{1}{2}$ d. per 1,000 gallons, and the attention required is about one hour per day of a man's time, exclusive of the cost of removal of sludge.