P A R T - I

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PRE-TREATMENT AND FILTRATION AT NIMETA WATER WORKS DURING 1962 to 1964.

C O N T E N T S

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INTRODUCTION

The urban population of India according to the 1961 census was roughly 78 millions distributed over 2551 towns. Of these 671 towns have a protected water supply system (Seminar on Water and Sewerage Works Financing and Management 1964). So, the need for water supply and sewerage facilities to the remaining towns is bound to grow in dimensions and urgency in the next few years. But, it cannot be said that the operation and maintenance of many of the completed projects conform to a high level of efficiency or performance. Many of the installations, particularly the medium and the small sized urban units suffer from lack of proper laboratory facilities and from lack of trained technicians to operate the plants for maximum economy and efficiency.

The Superintendent of Water Works in all the medium sized and smaller municipalities such as Ahmedabad, Bhavanagar, Baroda, Rajkot etc., are either civil, electrical or mechanical engineers who are interested only in seeing that raw water is pumped, a dose of alum is added to it, filters are run and washed and the final filtrate is chlorinated and sent to the town. No doubt the daily

operation data are carefully maintained in big leather-bound log books. No use is made of them. In short, the water works practice amounts to something like a ritual without a proper understanding of the hydrobiological, and hydrochemical aspects of water purification. At Baroda the Water Works is being run in the same manner as stated above. The data for this paper have been taken for the first time from the log-books of the Baroda Borough Municipality Water Works at Nimeta. An attempt has been made in this paper to describe the relation between the reservoir level, turbidity of raw and settled water, alum dose and the average number of hours per filter run per month during the last three years of 1962 to 1964. The utility and strategic importance of keeping an intelligent and faithful logging of the operation and performance of the different components of the Water Works system, day in and day out are indicated. How the log-sheet data can be made to reflect the degree of efficiency or performance of the plant and thereby how the plant performance can be maintained at a maximum efficiency are also shown.

II: Pretreatment Data

(a) Water level in the Ajwa reservoir (Table No.1)

Raw water for purification at the Nimeta Water Works is being drawn from the Ajwa reservoir by gravity

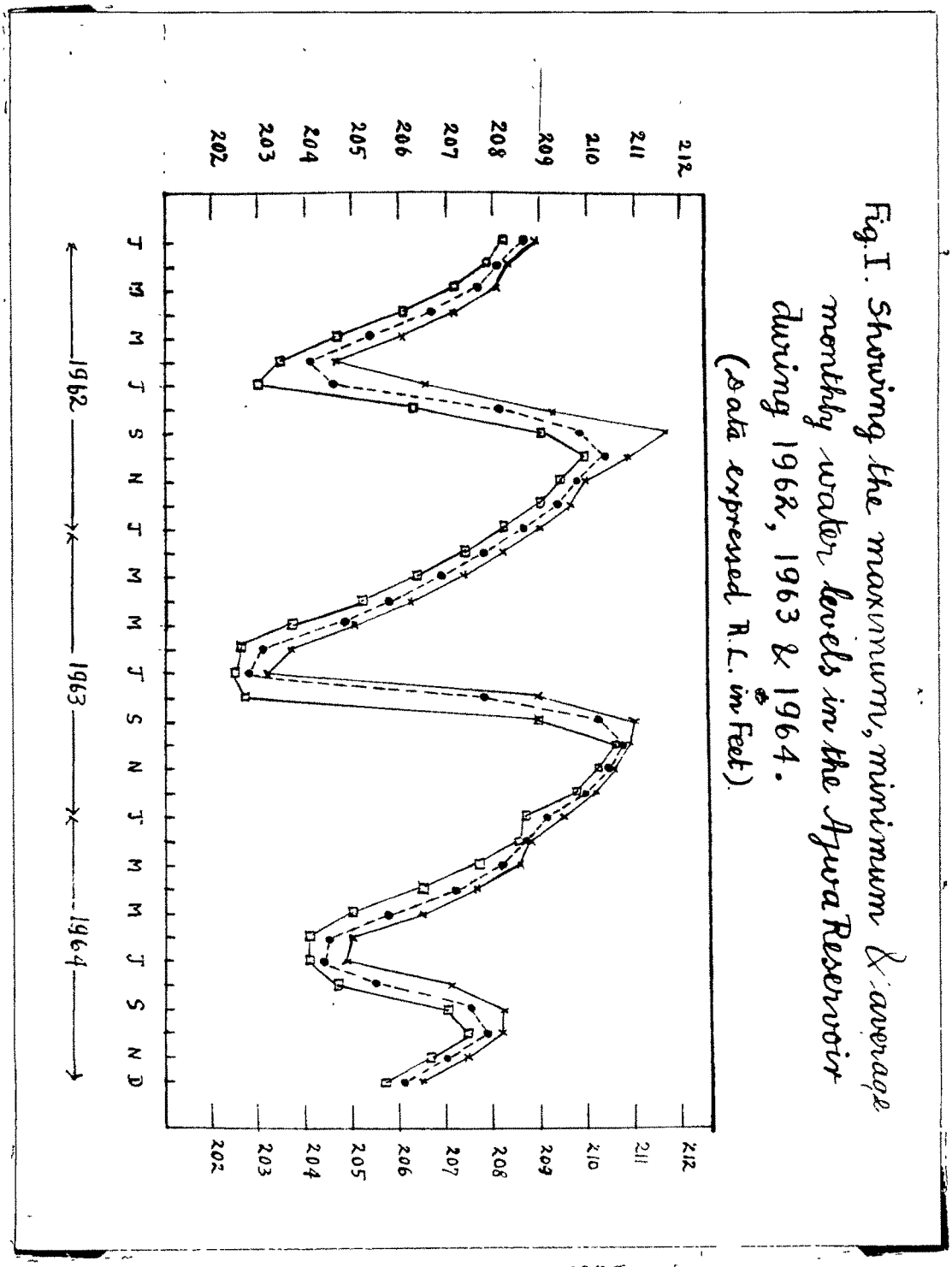

Fig. 24. Graph showing the maximum, minimum and average monthly water levels in the Ajwa reservoir.

through two cast iron pipes of 30" and 36" in diameter. The average monthly level of water in the reservoir is shown in Table No. 1 and in Fig No. I. From a study of the two, it will be seen that there is a decrease in water level as a result of evaporation and draw-off for the city water supply from January to July, when the lowest level is reached and thereafter there is a rise again due to southwest monsoon rains in July, August and September until the maximum level is reached usually in September. Then again, there is a gradual fall in level until the second lower minimum is reached in December. The quantity of water drawn per hour varied between 3,95,300 and 4,00,000 gallons.

The actual maximum and minimum depths reached in the reservoir are given below:

TABLE NO. 1

Year	Month	Maximum		Month	Minimum	
		R.L. in ft.	Actual ft.		R.L. in ft.	Actual ft.
1962	Sept.	211.75	28.75	July	203.04	20.04
1963	Sept.	211.05	28.05	July	202.52	19.52
1964	Sept. & October	208.20	25.20	June & July	204.10	21.10

(b) Turbidity of the Raw Water:
(Table No.II Appendix)

Values for turbidity are quite useful for recording the quality of water used for purification. In the case of the Ajwa reservoir water turbidity is not due to vegetable biological growths like algae; but it would appear that it is carrying finely divided silicious matter from the bottom of the reservoir, the state of division resembling that of colloidal matter. The suspended matter in the water is almost due to zoo-plankton organisms as has been shown in Part I (Sections A & B) of this thesis.

The values were found to fluctuate widely as will be seen from the tabular statement and Fig. II.

TABLE NO. 2

Year	Month	Maximum Value	Month	Minimum value
1962	August	300 ppm	Jan to April, Nov. to Dec.	10 ppm
1963	August	100 ppm	Nov. to Dec.	8 ppm
1964	August	45 ppm	November	6 ppm

Generally the values for turbidity were found to be 10 or less than 10 ppm in January, February, March, April, October, November and December and higher than 10 ppm in the remaining five months of the year.

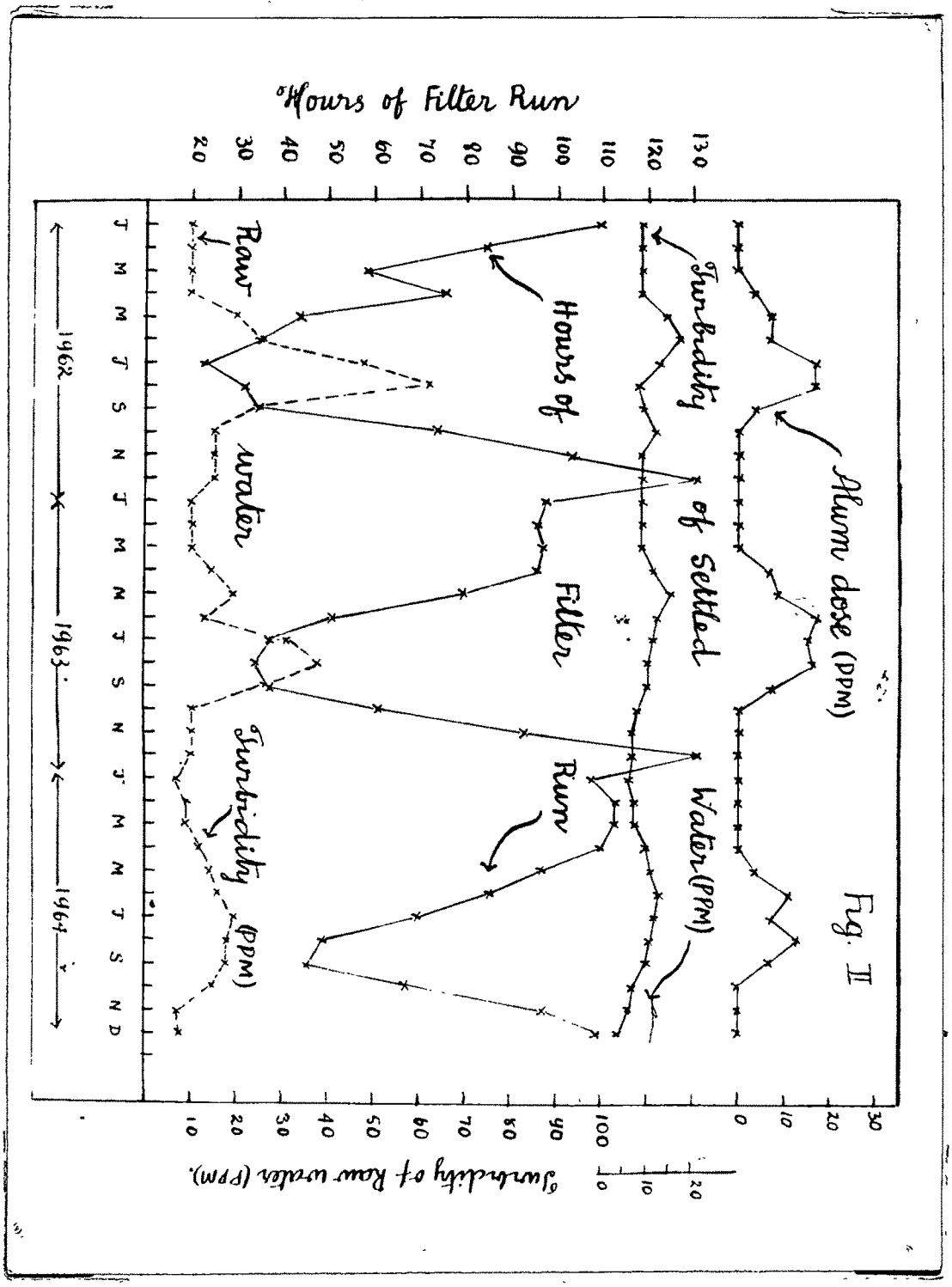

Fig. 25. Graph showing the relation between the dosages of alum for raw water, turbidity of raw and settled waters and the number of hours of filter run.

(c) Dosage of alum applied to raw water:
(Table No.III Appendix)

As the turbidity of raw water was 10 ppm for about 7 months in the year, and more than 10 ppm in the remaining months, alum was applied for 5-6 months only every year. The dosage applied is shown in Table III and Fig. II. The maximum and minimum dosages applied are shown below:

TABLE NO. 3

6

Year	Month	Maximum	Month	Minimum
1962	August	46.47ppm	May,June, Sept.& Oct.	3.57 ppm
1963	June,July & August	25.02 ppm	October	3.00 ppm
1964	June & August	14.30 ppm	May,June & July	3.57 ppm

(d) Turbidity of the settled water before filtration:
(Table No. IV Appendix)

The values for turbidity of the settled water were also found to fluctuate as will be evident from the tabular statement below and in Fig II.

TABLE NO. 4

Year	Month	Maximum	Month	Minimum
1962	June	30 ppm	July,Aug.,Sept.	7.0 ppm
1963	May	28 ppm	Oct. & November	6.0 ppm
1964	April	22 ppm	December	3.0 ppm

The turbidity figures for the settled water were found to vary between 30 and 3 ppm. Really they were excellent and would seem to be ideal; and so one should expect the filters to work for several days at a stretch. But that was not so. The filter runs were not very long.

III Filtration Statistics

Monthly average number of hours per filter run:
(Table No. V. Appendix)

The monthly average number of hours per filter run has been calculated for each month taking into account the number of hours worked by each filter every month. The fluctuations in the values shown in Fig. II reveal interesting reading:

TABLE NO. 5

Year	Month	Maximum Hours	Month	Minimum Hours	Average for the year(Hrs.)
1962	December	171	June	19	67.3
1963	December	160	September	17	76.0
1964	March	158	September	33	88.7

The yearly average per run varied between 67.3 and 88.7 hours.

IV DISCUSSION OF RESULTS:

A yearly may be roughly divided into two periods based on the monthly average turbidity values of the raw water. They are: (i) January, February, March, April, October, November and December, when the turbidity values of raw water are 10 ppm or less than 10 ppm. During these months alum is not applied to the raw water and the average filter runs are comparatively higher being between 74 and 110 in 1962, between 61 and 98 in 1963 and between 67 and 113 in 1964. During May, June, July, August and September when the monthly average turbidity values are greater than 10 ppm, the average filter runs varied between 23 and 44 hours in 1962, between 34 and 80 hours in 1963 and between 46 and 97 hours in 1964. It would appear in fact, that there is a gradual decrease from May to September. It is also during this period that alum is being added for clarification.

Taking the annual averages into consideration the average run of a filter is longest in 1964 being 88.7 hours and the least in 1962 being 67.3 hours. Therefore, the quantity of water filtered and used in 1964 must have been greater than that in 1962, and consequently, there must have been less quantity of wash water used for back-washing of filters.

V. SUMMARY

The economics of filtration statistics of Baroda Borough Water Supply for the three years 1962, 1963 and 1964 are discussed. Of the three years the average number of hours of run per filter was greatest in 1964 and least in 1962. So, the quantity of wash-water used for back-washing of the six rapid sand filters should have been much less in 1964 than in 1962.

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VI REFERENCES

1. Seminar on Water and Sewage Works Financing and Management- published by the Ministry of Health, Government of India, 1964.

TABLE NO. I

SHOWING THE MAXIMUM, MINIMUM AND AVERAGE MONTHLY WATER LEVELS IN THE AJWA RESERVOIR DURING 1962, 1963 & 1964(DATA EXPRESSED IN RL IN FEET)

Year	Maximum	Minimum 1962	Average	Maximum	Minimum 1963	Average	Maximum	Minimum 1964	Average
MONTHS									
January	208.95	208.17	208.60	209.01	208.21	208.61	209.50	208.76	209.15
February	208.30	207.95	208.15	208.20	207.44	207.85	208.85	208.63	208.71
March	208.10	207.19	207.67	207.42	206.38	206.92	208.61	207.72	208.20
April	207.18	206.11	206.69	206.33	205.18	205.79	207.69	206.54	207.16
May	206.09	204.74	205.42	205.15	203.75	204.96	206.50	205.08	205.84
June	204.72	203.49	204.06	203.72	202.62	203.14	205.03	204.10	204.49
July	206.65	203.04	204.60	203.25	202.52	202.85	204.95	204.10	204.45
August	209.35	206.34	208.10	208.96	202.75	207.77	207.15	204.72	205.55
September	211.75	209.01	209.83	211.05	208.98	210.22	208.20	207.05	207.47
October	210.91	209.98	210.44	210.97	210.63	210.83	208.20	207.49	207.91
November	209.97	209.47	209.80	210.66	210.27	210.50	207.47	206.66	207.05
December	209.74	209.02	209.38	210.23	209.80	209.91	206.54	205.70	206.14

SILL LEVEL = 183.0

TABLE NO. II

SHOWING THE MAXIMUM, MINIMUM, AND AVERAGE TURBIDITY OF AJWA RESERVOIR, BARODA.

(Results expressed in Parts per million)

Year	1962			1963			1964		
Months	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average
January	10	10	10	10	10	10	7	7	7.0
February	10	10	10	10	10	10	22	9	9.3
March	10	10	10	10	10	10	9	9	9.0
April	10	10	10	16	10	14	24	9	11.8
May	100	20	20	32	14	19	16	10	14.5
June	35	24	26	30	24	13	22	10	16.3
July	250	20	48	35	24	31	21	18	19.6
August	300	30	62	100	24	38	45	20	18.1
September	55	20	25	30	24	26	24	14	17.8
October	26	11	15	24	9	10	16	14	14.7
November	11	10	10	22	8	10	14	6	7.7
December	10	10	10	10	8	10	8	8	8.0

TABLE NO. III

SHOWING THE MAXIMUM, MINIMUM AND AVERAGE DOSAGE OF ALUM APPLIED TO RAW WATER AT THE NIMETA WATER WORKS, BARODA.

(Dosage of alum expressed in Parts per million)

Year	1962			1963			1964		
Months	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average
January	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
February	"	"	"	"	"	"	"	"	"
March	"	"	"	"	"	"	"	"	"
April	"	"	"	7.15	3.57	6.86	"	"	"
May	14.30	3.57	3.72	21.45	7.15	8.29	3.57	3.57	3.57
June	10.72	3.57	7.58	25.02	7.15	16.73	14.30	3.57	11.01
July	35.70	10.72	19.30	25.02	10.72	15.44	10.72	3.57	7.29
August	46.47	35.70	21.59	25.02	10.72	16.02	14.30	10.72	13.30
September	14.30	3.57	10.44	14.30	3.57	7.58	7.15	7.15	7.15
October	7.15	3.57	3.00	Nil	Nil	Nil	Nil	Nil	Nil
November	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
December	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

TABLE NO. IV

SHOWING THE MAXIMUM, MINIMUM AND AVERAGE TURBIDITY OF THE SETTLED WATER BEFORE RAPID FILTERATION AT THE NIMETA WATER WORKS, BARODA

(Results expressed in parts per million)

Year	1962			1963			1964		
Months	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average
January	9	9	9	9	9	9	6	6	6.0
February	9	9	9	9	9	9	10	7	7.3
March	9	9	9	9	9	9	7	7	7.0
April	9	9	9	12	9	11	22	7	9.8
May	22	10	14	28	10	15	12	6	10.8
June	30	14	17	24	8	12	18	8	13.0
July	28	7	13	14	7	11	16	7	12.0
August	12	7	8	15	8	10	18	9	10.6
September	16	7	9	12	8	10	12	8	10.1
October	16	9	12	9	6	8	10	8	7.1
November	9	9	9	11	6	7	10	6	6.6
December	9	9	9	8	8	7	5	3	4.0

TABLE NO. V

SHOWING THE MONTHLY AVERAGE, MAXIMUM AND MINIMUM NUMBER OF HOURS PER RUN PER FILTER OF THE SIX RAPID SAND FILTERS AT NIMETA WATER WORKS, BARODA

Year	1962			1963			1964		
Months	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average
January	128	96	110	123	82	98	150	43	108
February	114	68	85	118	76	96	141	85	113
March	101	47	59	130	73	97	158	80	113
April	109	62	76	125	71	96	154	70	110
May	90	26	44	104	55	80	140	65	97
June	64	19	35	80	30	51	116	52	86
July	42	27	23	63	23	37	117	40	70
August	54	23	32	49	24	34	67	34	49
September	56	21	35	56	17	37	59	33	46
October	99	49	74	96	38	61	101	43	67
November	123	78	104	125	68	93	121	83	97
December	171	91	131	160	97	131	127	91	109
Average	-	-	67.3	-	-	76.0	-	-	88.7