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Evaluation on the efficiency of rapid sand filtration

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INTEGRATED DEVELOPMENT FOR WATER SUPPLY AND SANITATION



Evaluation on the efficiency of rapid sand filtration

Bishaw Deboch and Kebede Faris, Ethiopia

JIMMA TOWN WHICH has a population of over 95,000 is supplied with many types of water sources including untreated spring water and deep well water. Recently three fourth of the population is supplied from a modern treatment plant that engage rapid sand filtration system (RSF). The population that are supplied with untreated water experience frequent water borne diseases such as typhoid. This study is therefore conducted to evaluate the efficiency of the Rapid Sand Filter treatment plant using physical, chemical and biological.

Samples were collected from both clarified and filtered water. Tests conducted were on fecal coliform, iron, manganese, sulfate, turbidity, color, pH, and temperature. The mean estimated fecal coliform bacteria in samples collected from clarified water was 230/ 100 ml. After the clarified water pass through the filter media coliform bacteria and color was removed by 100 per cent, and turbidity by 98.1 per cent. All parameters measured show positive agreement with world health organization's guideline values.

Methods

Based on the objectives, detection and estimation for the parameters was made using methods and procedures laid out by laboratory standard methods and as suggested by Monica (1,2,3).

A total of four samples for all parameters with an interval of one week for four consecutive weeks were collected from:

- Clarified water (after sedimentation basin).
- Filtered water (after RSF and before post chlorination) as suggested by Turner (2, 4).

Temperature and pH were measured in situ. Samples for laboratory tests were collected using sterilized bottles for bacteriological tests and in bottles washed and rinsed using di-ionized water for chemical tests. Samples were kept in an insulated cold box and transported to the laboratory. Test was conducted within six hours after arrival in the laboratory as suggested by standard methods, and HACH company (2).

Table 1. Arithmetic mean of number of positive tubes and MPN of fecal coliform bacteria in clarified water samples, Jimma water treatment plant, November 1997.

SAMPLE	Number of positive tubes in one / five of			MPN/100 mL
	50mL	10mL	1mL	
1	1	1	1	255
2	1	1	1	255
3	1	1	1	255
4	1	0	1	153
Mean	---	---	---	230

Table 2. Laboratory results of all the study parameters in water samples analyzed before and after rapid sand filtration, Jimma water treatment plant, November 1997.

Sample	PARAMETERS																
	Fecal coliform (MPN)		Iron (mg/L)		Manganese (mg/L)		Sulfate (mg/L)			Turbidity (NTU)		Colour (TCU)		pH		Temperature (°C)	
	WBRF	WARF	WBRF	WARF	WBRF	WARF	RW	WBRF	WARF	WBRF	WARF	WBRF	WARF	WBRF	WARF	WBRF	WARF
1	255	0	0.05	0.04	0.04	0.02	0	34	31	45.70	1.02	25	0	4.45	5.80	21.20	20.00
2	255	0	0.12	0.08	0.03	0.02	0	34	30	18.40	0.23	25	0	4.83	4.98	22.80	22.50
3	255	0	0.05	0.03	0.03	0.02	0	34	25	18.40	0.23	25	0	5.63	6.00	21.00	20.90
4	153	0	0.04	0.03	0.04	0.03	0	45	44	0.39	0.06	25	0	4.13	4.68	21.10	20.90
Mean	230	0	0.07	0.05	0.04	0.02	0		32.50	20.70	0.39	25	0	4.77	5.37	21.53	21.08

WBRF = Water before rapid sand filtration (Clarified water) **WARF** = Water after rapid sand filtration (Filtered water) **RW** = Raw water

Table 3. Mean, standard deviation (SD) and percentage decreased of the study parameters in filtered water samples, Jimma water treatment plant, November 1997.

PARAMETERS	FILTERED WATER		
	Mean	SD	% decrease
Fecal coliform (MPN/100mL)	0	0	100
Iron (Mg/L)	0.05	0.02	28.6
Manganese (mg/L)	0.02	0.005	50
Sulfate (mg/L)	32.50	8.10	11.6
Turbidity (NTU)	0.39	0.43	98.1
Colour (TUC)	0	0	100
Ph	5.37	0.64	12.6
Temperature (^{0}C)	21.08	1.04	2.1

Laboratory methods and procedures used for detection and estimation are:

- MPN technique as suggested by Monica for bacteriological tests.
- Iron test using phenanthroline.
- Manganese using Palin test procedures.
- Sulfate and color using HACH colorimeter procedure.
- pH and temperature using digital electrometric probes.
- Turbidity using turbidimeter method.

Result and discussion

The fecal coliform bacteria detected in the clarified water ranged from 153-255 MPN/ 100 ml. and mean of 230/100 ml. as shown in table 1.

After the clarified water passed through the RSF there was no fecal coliform detected in all four samples. Besides, iron was reduced by 28 per cent (0.07-0.05); manganese by 50 per cent, (0.04-0.02); turbidity by 98.1 per cent (20.7-0.4 NTU); and color by 100 per cent (25-0 TCU), table 2.

The efficiency of Jimma water supply system measured against parameters such as fecal bacteria, turbidity, manganese, sulfate and colour shows remarkably satisfactory results as shown in table 3.

The relationship between turbidity level and number of coliforms showed significant association ($p < 0.005$). all samples taken after filtration met the WHO guideline value for domestic water supply. (5). The fact that color was removed by 100 per cent favors chlorination and inhibit the formation of trihalomethanes and many other aquatic microorganisms which are responsible in the reduction of odor (5, 6, 7,8).

Due to the absence of pH adjustment process, the values detected through out the study were below pH 6 which may corrode pipe and fittings.

Conclusion

Although few samples, as has been done in this study can indicate only the conditions prevailing at the time of sampling, the results found indicate that the treatment plant is efficient in removing and / or reducing the fecal coliform bacteria, turbidity, iron. manganese, and color to a level recommended by WHO.

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