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Performance, Evolution of Water Treatment Plant

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Abstract – *Water treatment technologies have evolved over the past few centuries to protect public health from pathogens and chemicals. As more than a billion people on this earth have no access to potable water that is free of pathogens, technologies that are cost effective and suitable for developing countries must be considered. Sustainable operation of these treatment processes taking into consideration locally available materials and ease of maintenance need to be considered. In this chapter, we consider natural filtration for communities of various sizes. In natural filtration, slow-sand filtration and riverbank filtration are considered. Slow-sand filtration is suitable for small to medium size communities, whereas riverbank filtration can be suitable for small to very large communities depending on site and river conditions. Membrane filtration is another technology that can have application to individual households to moderately large communities. Both pressurized and gravity-fed systems are considered. For the developing regions of the world, small membrane systems have most applications. Solar distillation is a low-cost technology for sunny regions of the world. Particularly, it has the most application in tropical and semitropical desert regions. It can use low quality brackish water or groundwater for producing potable water. These systems can solely operate with solar energy. The scale of application is for individual households to very small communities. Solar pasteurization, like solar distillation depends on solar energy for purifying small quantities of water for individual or family use. It is most suitable for remote, sunny, high mountain regions such as the Andean mountains, central Africa or the Upper Himalayas where electricity is not available. Also, reliance on firewood is not feasible due to barren landscape in many of these regions. Also, case studies of natural (riverbank and lakebank) filtration, membrane filtration, solar distillation, and solar pasteurization are presented.*

Keywords- Natural filtration, Solar distillation, UV radiation

INTRODUCTION

Water is a precious commodity. Most of the earth water is sea water. About 2.5% of the water is fresh water that does not contain significant levels of dissolved minerals or salt and two third of that is frozen in ice caps and glaciers. In total only 0.01% of the total water of the planet is accessible for consumption. Clean drinking water is a basic human need. Unfortunately, more than one in six people still lack reliable access to this precious resource in developing world.

India accounts for 2.45% of land area and 4% of water resources of the world but represents 16% of the world population. With the present population growth-rate (1.9 per cent per year), the population is expected to cross the 1.5 billion mark by 2050. The Planning Commission, Government of India has estimated the water demand increase from 710 BCM (Billion Cubic Meters) in 2010 to almost 1180 BCM in 2050 with domestic and industrial water consumption expected to increase almost 2.5 times. The trend of urbanization in India is exerting stress on civic authorities to provide basic requirement such as safe drinking water, sanitation and infrastructure.

The rapid growth of population has exerted the portable water demand, which requires exploration of raw water sources, developing treatment and distribution systems. The raw water quality available in India varies significantly, resulting in modifications to the conventional water treatment scheme consisting of aeration, chemical coagulation, flocculation, sedimentation, filtration and disinfection. The backwash water and sludge generation from water treatment plants are of environment concern in terms of disposal. Therefore, optimization of chemical dosing and filter

runs carries importance to reduce the rejects from the water treatment plants. Also there is a need to study the water treatment plants for their operational status and to explore the best feasible mechanism to ensure proper drinking water production with least possible rejects and its management. With this backdrop, the Central Pollution Control Board (CPCB), studied water treatment plants located across the country, for prevailing raw water quality, water treatment technologies, operational practices, chemical consumption and rejects management.

1.1 Indian Scenario

India is signatory to resolution on international water supply and sanitation decade(1991-2000) is committed to the goal of providing safe and potable drinking water and adequate sanitation to all its citizens. The population in India on 1st March 2001 was 1,027,015,247 persons. And in the year 2010 the population in India is 1,150,000,000(1.15 billion) peoples, India is currently the world's second largest country.

With respect to Scenario in India Water supplies in India continue to inadequate, despite longstanding effort by the various level of government and communities at improving coverage. The level of investment in water has increased during the 2000s. In recent years the number of Indians with access to improved sources of water has increased significantly and it is estimated that 89% of Indians have access to these improved water sources. A number of innovative approaches to improve water supply have been tested in India, in particular in the early 2000.

The rural development committee reviews performance of Department of drinking water supply and say that sanitation coverage in India's village is less than 65% and overall progress in providing drinking water to rural areas is far from satisfactory.

The actual coverage of water supply has been 95% and 73% for urban and rural sectors respectively observed from report published by Department of water supply. The decade target for water supply has been scaled down to 96% for urban coverage and 85% for rural coverage as against 100% for both.

1.2 Status of Water Supply in Maharashtra State

As per the constitution of India, taking care of the water supply and sanitation needs of the citizens is a responsibility of State Governments and its lower tiers of governance such as the Zillaparishad, Urban Local Bodies and to some extent the Gram Panchayats also. In Maharashtra, the Ministry of Water Supply and Sanitation along with the department of Water Supply and Sanitation was created in 1996 to exclusively concentrate on the poor coverage and access to these essential services in both urban and rural areas. The Ministry is responsible for setting the policies for the State in this sector and coordinate with the Central Government and other key institutions.

The Ministry is headed by the Minister of Water Supply and Sanitation and is supported by the State Minister for Water Supply and Sanitation. The Secretary heads the Water Supply and Sanitation Department (WSSD).

It is planned to allocate funding of Rs. 438 Crore to be spend in next four years to achieve goals related to providing safe drinking water to the community. The rural water supply scheme in the state has been planned considering growth of about 2.5 % in state population. (Present population of Maharashtra in about 9.6 crore)

The Ministry of Urban Affairs of the Government of India, formed in 1985, was set up to review State development plans, and influences the policies and practices of the Urban Water Supply and Sewerage Sector. The Planning Commission also has a special cell that advises on the sector policy.

1.3 Objectives of Operation and Maintenance

The objective of an efficient operation and maintenance of a water supply system is to provide safe drinking water as per designed quality and quantity, with adequate pressure at convenient location and time at competitive cost on a sustainable basis "Operation refers to timely and daily operation of the components of a Water Supply system such as headwork's, treatment plant, machinery and equipment, conveying mains, service reservoirs and distribution system etc., effectively by various technical personnel, as a routine function."

"Maintenance is defined as the act of keeping the structures, plants, machinery and equipment and other facilities in an optimum working order. Maintenance includes preventive /routine maintenance and also breakdown maintenance. However, replacements, correction of defects etc. are considered as actions excluded from preventive maintenance.

Sector Organization Water supply and sanitation is treated as a State subject as per the Constitution of India and, therefore, the States are responsible for the planning, Implementation, operation and cost recovery of water supply and sanitation projects. At the local level, the responsibility is entrusted by legislation to the local bodies like Gram Panchayat / Village water & sanitation Committee (VWSC) in Rural Sector. The Public Health Engineering Department (PHED)/ Water Supply & Sanitation Boards (WSSBs) / Nigams are the

principal agency at the State level for planning and implementation of water supply program. The Ministry of Drinking Water and Sanitation, Government of India formulates policy guidelines in respect of Rural Water Supply & Sanitation Sector and provides technical assistance to the States & Rural Local Bodies (GPs/VWSC) wherever needed. The expenditure on rural water supply is met out by Ministry of Drinking Water and Sanitation under National Rural Drinking Water Programme NRDWP as well as State Government and also with loans from National/International financial institutions.

Operation& Maintenance Scenario It has been observed that lack of attention to the important aspect of Operation & Maintenance (O&M) of water supply schemes in several villages often leads to their dysfunction or deterioration of the useful life of the systems necessitating premature replacement of many components, incurring huge losses. As such even after creating such assets by investing millions of rupees, they failed to provide the proper services effectively to the community for which they have been constructed and became dysfunctional or remained underutilized most of the time.

Some of the key issues contributing to the poor Operation & Maintenance (O&M) have been identified as follows:

- Lack of finance, equipment, material, and inadequate data on Operation & Maintenance
- Inappropriate system design; and inadequate Workmanship
- Multiplicity of agencies, overlapping responsibilities.
- Inadequate operating staff
- Illegal tapping of water
- Inadequate training of personnel.
- Lesser attraction of maintenance jobs in carrier planning.
- Lack of performance evaluation and regular monitoring.
- Inadequate emphasis on preventive maintenance
- Lack of O & M manual.
- Lack of real time field information etc.

Therefore, there is a need for clear–cut sector policies and legal framework and a clear demarcation of responsibilities and mandates for O & M of water supply schemes.

II .LITERATURE REVIEW

2.1 General

The paper presents the importance and the necessity to increase the efficiency of cleaning process of the waters treatment plant. There are presented the methods of treatment of the water, in order to find the best condition and parameters treatment process.

M.A. EIDib , Mahmoud A. AzeemEIDayoumy (2003) This paper highlights finding of investigations of the treatment plant in Dakahlia (Meet Fares). The evaluation conducted in this research was carried out by reviewing the engineering design to assure matching of standards and codes. Also, biological, chemical and bacteriological analysis were conducted to investigate water quality. The conclusions drawn in this paper outlines the importance of accurate engineering design and need for continuous and analysis of each unit performance.

R. S. Dhaneshwar, V. P. Sharma, R. K. Gupta, P. S. Kelkar and R. Paramasivam (1991) The problem of supplying adequate quantity of potable water to the public does not end with the construction of water works alone. Their effective operation and maintenance is a sine qua non to ensure a commensurate return in the form of safe, wholesome water at minimum cost. This paper highlights salient plant features, in-depth performance evaluation, the status of operation and maintenance, plant personnel, laboratory facilities and overall management of Water works at Kanpur, Varanasi, Lucknow, Agra and Nainital in Uttar Pradesh.

S.J. Kardile, S.K. Gajendragadkar (1993) Adequate treatment has to be given tomost of the surface water resources irrespective of the size of the community for drinking water supplies. There is now a growing awareness in recent years to provide safe and clean drinking water to the rural masses which resides in the villages or small towns. Most of conventional technologies have techno-economics limitations when applied to small capacity plants in the rural areas. Therefore all over the world engineers are making continuous efforts to find appropriate indigenous solutions to solve this challenging problem. This paper highlights the evaluation of the performance of Water Treatment Plant in Trimbakeshwar, Nasik during the monsoon of the year 1991.

RESULT AND DISCUSSION

3.1 Source

The source of the water is collected from Dangurali on Vaingangariver which is left bank on river and this left bank is pernennial in nature. The water is collected at source i.e. Jackwell at Dangurali on Vainganga river and test the pH, DO, Total Solids , Suspended solid,E-Coli.

The Raw Water characteristics analysed in the given table.

Table No.3.1: Raw Water Characteristics at Source

pH	Total Solids (Mg/lit)	Suspended Solids(Mg/lit)
6.4	1800	1119
6.6	2000	1217
6.43	1600	995
6.3	1756	1015
6.56	1896	1035

E-Coli Test

Test	Date	10ml	1ml	0.1ml	MPN/100ml
1st	23.02.17	4+	2+	1+	26
2nd	02.03.17	5+	2+	0+	49

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3.2 Aeration

The Gravity type cascade aerator is provided. The aerated water is collected in channel and then transfer to flash mixer. Following table shows the typical performance of the aerator in Winter Season

TableNo.3.2: Performance of Aerator

PH		DO (Mg/lit)		Increase in DO (Mg/lit)
Inlet	Outlet	Inlet	Outlet	
6.4	6.8	7.25	8.5	0.68
6.6	7.2	7.52	8.2	1.8
6.43	7.0	6.5	8.3	1.3
6.3	6.9	7.2	8.4	2.16
6.56	6.95	6.24	8.2	1.55

3.4. Clariflocculator

The sample is collected in clariflocculator with coming of water filter house with leading channel.The following test is carried out in the clariflocculator i.e. pH, Total solids, Suspended solids, Alkanity.

Table No.3.3Performance Evaluation Clariflocculator

PH		Total Solid			Suspended Solid		
Inlet	Outlet	Inlet	Outlet	% Remove	Inlet	Outlet	% remove
6.8	6.85	1800	1656	8.00	1119	988	11.7
7.2	7.28	2000	1720	14.00	1217	1158	4.84
7.0	7.12	1600	1458	8.875	995	738	25.82
6.9	7.10	1756	1535	12.585	1015	885	12.8
6.95	7.5	1896	1690	11.099	1035	835	19.32

The following observation during the visit is summarized:

- Dose of coagulant are decided arbitrarily on the basis of turbidity. If the raw water has turbidity more than 40 - 50 NTU then only coagulant are used. Coagulants are not added regularly in raw water.
- Occasionally buoying up of floe in the day time was observed.
- The sludge from the clariflocculator is discharged into the stream in a nearby area.
- The scraping of sludge is not done due to which lot of sludge is accumulated at bottom.
- Sometime the water in clarifier is over discharged.
- Weir loading is not as per design, it is observed less than design.

3.5 Filter

The performance of filter was monitored with respect to pH, Total solids and Suspended solids water.

Table No.4.4 Performance of Filter

pH		Total solids (Mg/lit)			Suspended solid (Mg/lit)		
Inlet	Outlet	Inlet	Outlet	% remove	Inlet	Outlet	% remove
6.85	6.85	1656	750	54.71	988	600	39.27
7.28	7.28	1720	856	50.23	1158	895	22.71
7.12	7.12	1458	900	38.27	738	730	1.08
7.10	7.10	1535	1000	34.85	885	800	9.60
7.5	7.5	1690	995	41.12	835	756	9.46

3.6 Chlorination

Both, pre-chlorination and post chlorination are practiced at the treatment work. Pre-chlorination is done before flash mixer in channel for to prevent development of algae in the subsequent treatment unit. The chlorine gas is injected into the raw water in the channel at a dose of 0.5 to 3.0 mg/lit. The effectiveness of pre-chlorination was judge on the basis of measurement of residual chlorine at various stages of treatment.

The post chlorination is achieved by means of adding a dose of chlorine in the range of 1.0 to 3.0 mg/lit. at the common filtered water in the sump and observed adequate.

Table No. 3.5 Performance of Chlorination

After chlorination Ph value water sample	Ph
1	6.9
2	6.9
3	6.8
4	6.7
5	7

Table No. 4.6 E-coli test

Test	10ml	1ml	0.1ml	MPN/100ml
1st	0+	0+	0+	0
2nd	0+	0+	0+	0

CONCLUSION

After carrying out various tests on water for different unit's performance evolution on Gondia water treatment plant is done. The following conclusion is carried out,

1. The performance of Water Treatment Plant units are satisfactory.
2. Treated water is conforming to IS:10500 for drinking purpose and its is conclude that safe for drinking.
3. Continuous maintained and analysis will lead to precise evaluation of plant performance and definition of any required modification.
4. The head loss meter is working condition and its gives proper result.
5. All the filter apparatus should be checked of their functioning and deficiencies should be corrected.
6. The plant staff needs to be imparted with necessary training for effective operation maintenance of plant followed by refresher courses at regular interval.
7. The performance of water treatment plant at various stage of treatment units should be monitored by regularly collected water samples and analyzing for important parameter.
8. Proper housekeeping and routine maintenance of mechanical equipment should be ensured.
9. The dose of chlorine should be proper controlled in daily.

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