Performance Studies of Water Treatment Plant at Kailana Lake Jodhpur City, Rajasthan, India

Minakshi
Post Graduate Student,
Department of Civil Engineering,
M.B.M Engineering College, Jai Narayan Vyas University,
Jodhpur (India)

***Abstract*— Water constitutes are of the important physical environments of man and has a direct bearing on his health. There is no gainsaying that contamination of water leads to healthy hazards. Water is precious to man and therefore control of water supplies to ensure that it is potable and wholesome as one of the primary objectives of environmental sanitation. Water may be polluted by physical, chemical radioactive and bacterial agents. Therefore, safe water supply is a sine qua non of public health of a community.**

The aim of water treatment is to produce and maintain water that is hygienically safe, aesthetically attractive and palatable, in an economical manner. Though the treatment of water would achieve the desired quality, the evaluation of its quality should not be confined to the end of the treatment facilities but should be extended to the point of consumer use.

The total existing filtration capacity is 120 MLD at Kailana Lake filter house. An attempt has been made to study performance evaluation of the water treatment plant at Kailana Lake Jodhpur. The performance evaluations of the plant have been carried out and results are discussed.

Keywords– Water Treatment, Performance, Evaluation, Turbidity.

I. INTRODUCTION

This Jodhpur (Sun City) is the second largest city of Rajasthan and is located in the lower middle of the Thar Desert of western Rajasthan. It is about 280km from Indo-Pak border and is situated at 26° 18' North latitude and 73° 01' East longitudes. It has an altitude of 242 meter above MSL(mean sea level) at railway station while fort and old city being much higher (367.83 meters) and lies between 245 to 325 meters. The outer city area lies between contours 210-255 meter above MSL.

The estimated population Jodhpur is about 12 lakhs as per figures of 2011 census. The old city of Jodhpur is situated on a hill and extension of it is towards south east direction of hill. The area to the north –west of city is hilly areas and has stone quarries at Balsamand and Soorsagar. City growth, therefore has taken place mostly in the south – east side. Natural slope of the city is also towards south east to Jojari River. This river flows towards south-west. Jojari River is the tributary of Luni River. The climate is generally is dry, with peak temperature in summer reaching 48 and a minimum of 5 in winter.

Jodhpur is located in three pockets Viz Takhat Sagar, Kailana Lake and Umed Sagar. At Kailana water is stored in treated by state Public health engineering department (PHED). The water from Kailana filter house, Jodhpur is received in raw from Kailana Lake owned by PHED, Jodhpur, which is filtered and treated at Kailana treatment plant.

The total existing filtration capacity at Kailana treatment plant is 120 MLD. There is two plants first is 60 MLD in 1996 and second is 60 MLD capacity constructed in 2005.

II. WATER TREATMENT PLANT

The water supply to the city is provided from Kailana water treatment plant Jodhpur. Water treatment plant has capacity 120 MLD. Source of water is Kailana Lake at distance 8km.about 61% of total water supplied to the city is from this plant. The plant operates for 22 hours and 150 MLD water is being treated and supplied to the city. Daily water supply to the city 300 lakhs gallons in summer time or winter and monsoon time water supply 285-290 lakhs gallon. The design and construction of the plant is conventional one and comprises of various Clariflocculator, rapid sand filters, chemical house flash mixer, and clear water sump and pump house.

III. PROCESS DESCRIPTION

The brief description of all Water treatment plant units, components facilities are as follows.

A. Receiving chamber

Raw water from Kailana Lake is received in the receiving chamber through 1000 dia. pipe from where it is conveyed to parshall flume by gravity. No. of receiving chamber is one and material of construction RCC rated flow say 2863.34m3/hr.(63 mld with 24 hours). Size of receiving chamber 2.0m wide 5.5m long 3.6 LD, volume 23.6m3, retention period 49.7 sec.

B. Parshall flume

The object of this unit is to monitor the raw water flow to the treatment plant by means of the flow meter installed in the Parshall flume.

Process- Raw water from stilling chamber is received in the parshall flume by gravity. The parshall flume is constructed flume is constructed in an open channel. It is suitable for measuring the water flow in an open channel. The parshall flume has a contraction which gives level variation for various flows. The level measurement is directly correlated to the rate of flow. Flow is measured locally by a float operated indicator moving on a calibrated scale. The float is provided in a float chamber adjacent to the flume with access to the upstream end of flume. Raw water from parshall flume is conveyed to distribution chamber by gravity.

No. of flow measurement device one material of construction RCC flow measurement element parshall flume throat width

914.4 mm, flow meter one no. S.B. electro mechanical make type one channel local flow indicator.

C. Distribution chamber

Raw water from parshall flume is received in the distribution chamber from where it is conveyed to flash mixers by gravity. Provision is given to feed raw water directly from distribution chamber to filter beds. No. of distribution chamber one , size of the distribution chamber 2.0 m wide 5.5 m long 3.6 m, rated flow 28.6364 m3/ hr. effective volume 39.6 m3.

D. Flash mixers

This unit is provided for achieving an instantaneous and through mixing of chemicals that are added to row water for its treatment. The processes of through mixing aids in dispersing the chemicals throughout the volume of water, thus enhancing the coagulation process. No. of units 2 , material of construction Rcc , size 2.0m 2.0m 3.0 m (LD), effective capacity each 12 m3, C.I. gates 900 750 mm CI gates, two nos. one for each flash mixer inlet, design flow raw water is 1431.82 m3/ hr. and detention time in the flash mixer is 30 seconds.

E. Clariflocculators

The object of clariflocculator is to form distinct settle able flocks during flocculation and their removal by gravitational settling in the clarifying zone. The clear water overflows leaving behind the settle able solids. Two radial flow clarifier with concentric flocculator made up of RCC provided in this plant. design flow 1431.82 m3/hr, size of overall clariflocculator is 38.0 m dia. 3.1 m, overall volume 3514 m3 , and size is flocculator zone 13.3 m dia. 3.5 m volume of flocculate zone 486 m3 , surface over flow rate 1.43m3/hr.m2. Detention time for rated flow flocculator zone 20 minutes approx, and detention time for clarification zone 2.0 hours approx.

F. Filters Beds

The object of Filters bed is to remove the residual suspended impurities from clarified water. The type is Rapid Sand gravity filters. Numbers of filter beds are eight, made up of R.C.C. Size of each filter bed is 4.10 m 7.95 m. filtration area of each bed is 32.95 m2. Detention time is 30minutes. Rated flow is 346.0225 m3/ hr. Rate of filtrations 5.3 m3 /hr/m2.

G. Chemical House

Chemical house is provided for storage, preparation and distribution of chemicals that are added to the raw water for its treatment. There are three tanks made up of R.C.C. the tank is for Alum solution.

Alum solution preparation tank:-Size of tank is 3.2 m 2.9 m 1.6 m. Effective capacity of each tank is 10.67 m3. Alum to be dissolved in each tank is 1067 kg.Volume of each tank is 10.67 m3. Duration of each tank operation is 12 hrs. approx. alum solution dosing rate raw water flow 2863.64 and alum to be dose say as per jar test requirement 30 mg/l. rate of alum to be dosed 85.90kg/hr. rate of solution dosing 10% strength for a raw water flow of 859 ltr/hr, 2863.64 m3/hr.

H. Chlorination system

The object of Chlorination is to disinfect the filtered water to make it suitable for potable use. Size of chlorine contact tank (C.C.T.) is 6.8 m 3.0 m 2.25 m Chlorination is done using chlorine gas cylinder having 0 to 199 PPM. Chlorine 6 nos. 3 for pre chlorination (two working plus stand by) and 3 post chlorination (two working plus stand by) volume 45.6 m3, Capacity of chlorinator is 6 kg/hr.

I. Wash Water Tank

The object of wash water tank is to store water for back wash and for services like preparation for stock solution, for toilet, for drinking etc. Number of wash water filling pump are one having capacity of 400 m3 each.

IV. OBESERVATION

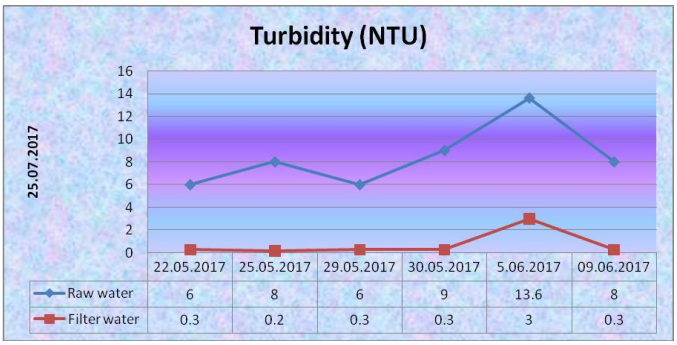
A. Figures and Tables.

Time	Turbidity Raw	Supply Filter	Supply Chlorine
6:00 AM	13.1	0.9 NTU	3.5 PPM
8:00 AM	13.8	0.9 NTU	3.5 PPM
10:00 AM	13.7	0.8 NTU	3.5 PPM
4:00 PM	13.6	0.8 NTU	3.5 PPM
8:00 PM	14.2	1.5 NTU	3.5 PPM

Time	pH	Turbidity		Chlorine	
		Raw Water	Online Water	Online Water	Raw Water
06:00 AM	7.5	12.8	0.9	3.5	0.5
10:00 AM	7.0	12.7	1.1	3.5	0.5
12:00 MD	7.0	12.3	1.2	3.0	0.5
4:00 PM	7.0	13.1	1.1	3.5	0.5
8:00 PM	7.0	13.3	1.2	3.5	0.5
12:00 MN	7.0	13.1	1.2	3.0	0.5

NTU-Nephelometric Turbidity Units

Date/ Month wise removal turbidity



V. RESULTS AND DISCUSSION

On the basis of various tests conducted at site laboratory on daily, weekly basis average results obtained and represented through various tables and graphs the following conclusions have been drawn.

1. Raw water was odourless.
2. Average temperature of water was 220 ℃
3. The average pH of raw water at the inlet of the receiving chamber is 7.70 to 8.1. After treatment the pH of treated water is 7.10. Therefore we can conclude that the treatment of water is satisfactory and the pH value of treated water is acceptable.
4. The average turbidity of raw water at the inlet of the receiving chamber is 8 NTU or monsoon time turbidity is very high below 30 NTU. After treatment the pH of treated water at outlet is 0.2, 0.3 NTU. Therefore the turbidity of treated water is well within the permissible limits of potable water standards.
5. Alkalinity of raw water was 75-120 mg/l and treatment it was 90-96 mg/l.

ACKNOWLEDGMENT

With deep reverence and profound gratitude I express sincere thanks to my teacher and supervisor Dr. A.N. Modi, Professor of Department of Civil Engineering, MBM Engineering College, Jodhpur for his valuable guidance, incessant encouragement and positive criticism throughout the period of my Dissertation . I am highly obliged to Dr. Kamlesh Purohit, Dean of M.B.M. Engineering College, Jodhpur for providing all the facilities during the period of Dissertation. I owe my deepest gratitude to Shri Tarun Vyas Assistant Engineer at Water Treatment Plant Kailana Lake, Jodhpur with all other staff members for providing all the possible facilities during the period of my field work. Also thankful to Mr. Sanjay purohit (JEN kailana). I am also thankful to my younger brother Mr. Parikahit Singh and Akash singh. I would like to convey my thanks to my parents Shri Rajkumar Singh and Smt. Chandravati Devi. Thanks also go to my dear friend Mr. Anil Kumar for contributing his valuable time. For their constant encouragement and cooperation extended during the entire course of my study. I am also thankful to all the other faculty members and staff members of the Department of Civil Engineering for their help.

REFERENCES

[1] Public health engineering (part I & II) EB Phelps & CJ Velj (John Wiley and sons, New York) 2003.
[2] Water supply engineering SR Kshirsagar (Roorkee publishing house Roorkee, India).
[3] Guideline for drinking water quality (Vol 1 to 3) WHO's Publications (CBS Publishers & Distributors Delhi -1999).
[4] Public Health Implications of Radioactive waste releases CP Straub (WHO Publication 1970).
[5] IS : 3025- Part 1 to 37 Methods of sampling and test (Physical & Chemical) for water & waste water Bureau of Indian Standards (Manak Bhawan , New Delhi).
[6] CPHEEO. "Manual on Water Supply and Treatment", Third Edition published by Ministry of Urban Development.
[7] Bureau of Indian standards: IS 10500:2012.