International Journal of Research in Engineering, Science and Management
Volume-3, Issue-6, June-2020
www.ijresm.com | ISSN (Online): 2581-5792

Study On RO Water Treatment Plant at Adakamaranahalli

A. H. Krishne Gowda[1*], V. Thamodaran[2], R. C. Harshith Reddy[3], C. Dhanush[4], T. P. Sanjeev[5]
[1,2,3,4]*Student, Department of Civil Engineering, Dayananda Sagar College of Engineering, Bengaluru, India*
[5]*Professor, Department of Civil Engineering, Dayananda Sagar College of Engineering, Bengaluru, India*
*Corresponding author: krishne.gowdaah@gmail.com

***Abstract*: Performance evaluation become mandatory to verify whether the water treatment plants (WTP) together with its units can purify the water according to the current drinking water standards. The current project aims to evaluate the performance of the R.O-water treatment plant located in Adakamaranahalli in Bangalore. Performance is measured by chemical parameters such as total dissolved solids, pH, chlorides, total hardness, calcium and magnesium hardness, sodium, potassium, acidity, conductivity, alkalinity, and fluorine. The water balance of the system is also calculated, for which the possible treatment methods for reuse are also determined. The samples were collected by R.O. The treatment plant and the parameters mentioned above were analyzed according to the current drinking water standards IS: 10500 raw water, discarding the water, and treated water for each 15-day interval. The results of the study show that the treated water meets the drinking water standards according to IS: 10500 at all times and that the treated water is again safe for human consumption, the wastewater can be reused after filtration.**

***Keywords*: Reverse osmosis, RO water treatment, Suggested treatment of RO rejected water, Re-Use rejected water.**

1. Introduction

India has been well endowed with large freshwater reserves, but the increase in population and the over-exploitation of surface and groundwater in recent decades has led to water scarcity in most regions. Existing freshwater reserves are polluted due to inadequate control and an unsafe system in view of urbanization, over-exploitation, and natural activity. It has been estimated that approximately 37.7 million Indians suffer from water-borne diseases each year, while an estimated 1.5 million children die from diarrhea alone. The problem of chemical contamination is also prevalent in India and most homes in the country are affected by poor water quality. The poor quality of raw water sources ensures the application of treatment technologies and adequate monitoring to ensure the supply of safe drinking water. In India, groundwater is considered a safe source of drinking water that is used intensively for drinking, irrigation, and industrial purposes. However, due to rapid population growth, urbanization, industrialization, and agricultural activities, Indian groundwater resources are under constant stress. There is developing worry about the decay of groundwater quality due to geogenic and anthropogenic exercises. The main groundwater quality problems in India are internal salinity, coastal salinity, fluorine, arsenic, iron, and nitrate. Many advanced technologies have been developed for the removal of these contaminants, including filtration, chemical treatment, advanced oxidation, and membrane separation process. The most common and widely used technology is REVERSE OSMOSIS thanks to its wide ability to remove a variety of pollutants.

2. Reverse Osmosis

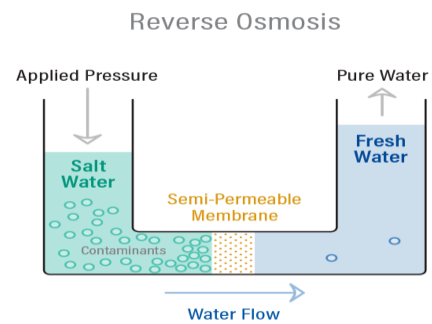

Fig. 1. Reverse osmosis

Reverse osmosis is the process by which and the pressure applied, more noteworthy than the osmotic pressure is applied to the compartment that once contained the high focus arrangement. This pressure powers water to go through the layer the other way to that of osmosis. The water presently moves from the compartment with the high focus answer for the compartment with the low fixation arrangement. Hence, generally unadulterated water goes through the film in one compartment while the broke up solids are held in the other compartment. At that point, the water in one compartment is decontaminated or "demineralized" and the solids in the other compartment are thought or got dried out.

A. Working of RO (Reverse Osmosis)

Reverse osmosis works by employing a high pump to extend the pressure on the salty side of the RO and force the water through the semipermeable RO membrane, leaving almost (about 95% to 99%) of dissolved salts within the flow of waste. The pressure required depends on the salt concentration of the feed water. The more concentrated the feed water, the higher the pressure required to overcome the osmotic pressure.

Desalinated water that is demineralized or deionized is called permeated water (or product). The flow of water carrying the concentrated contaminants that have not passed through the RO membrane is called the waste flow (or concentrate). From the data collected by the manufacturers of the reverse osmosis system, normally 40-60% of water is rejected during the reverse osmosis process.

The reverse osmosis membrane has a narrow pore structure (less than 0.0001 microns) which effectively removes up to 99% of all contaminants and impurities such as total dissolved solids, chemicals, bacteria, and viruses from drinking water. The antimicrobial filters used in reverse osmosis also help to remove unwanted odors, colors, and flavors from the water.

Reverse osmosis systems have very high effectiveness in the removal of protozoa, bacteria, and viruses compared to other systems. Reverse osmosis systems also can remove common chemical contaminants (metal ions, aqueous salts), including sodium, chloride, copper, chromium, lead, and may reduce arsenic, fluoride, radio, sulfate, calcium, magnesium, potassium, nitrate and phosphorus.

Reverse osmosis is able to remove up to 99% + of dissolved salts (ions), particles, colloids, organic substances, bacteria and pyrogens/pathogens from the feed water (although you should not rely on a RO system to remove 100% of bacteria and viruses). Reverse osmosis removes impurities from two distinct mechanisms. One is based on the resistance to the passage of ions, due to their electric charge. This mechanism is responsible for removing ionic impurities.

Since the RO membrane rejects contaminants supported their size and cargo, many gases like CO2, hydrogen sulfide, methane, and ethane that aren't ionized (charged) even have a really low relative molecular mass will undergo reverse osmosis. Any contaminant that features a relative molecular mass greater than 200 is perhaps rejected by a properly functioning RO system. Since a RO system doesn't remove gases, the permeated water may have a rather lower pH level counting on the CO2 levels within the feed water since the CO2 is converted into acid. Some ROs, pesticides, solvents, and volatile organic chemicals (VOCs) aren't removed.

3. Experiments Conducted

A. *Total Alkalinity*

25 ml of the sample are placed in an Erlenmeyer flask and 2-3 drops of methyl orange indicator are added and titrated against 0.02N H2SO4. The color change from light yellow to light pink shows the endpoint.

B. *Total dissolved solids*

Total dissolved solids were determined in water after filtration through Whatman paper.

C. *pH*

The pH of samples was measured by the electronic meter, after calibrating the pH meter with a buffer solution of pH of 4 and 7.

D. *Electrical Conductivity*

The Electrical conductivity of samples was measured by self-contained conductance instrument, after calibrating the instrument with standard 0.01M KCl solution of conductance 1.408milli mhos/cm.

E. *Total Hardness*

Total hardness: 50 ml of the water sample were taken and the EDTA titration method was used in the presence of an eriochrome black T indicator.

Permanent hardness: 50 ml of the sample with boiled water were removed and the EDTA titration method was used in the presence of an eriochrome black T indicator.

Temporary hardness: This is the difference between total and permanent hardness.

F. *Chlorides*

The chloride was determined using the volumetric titration method. Potassium chromate shows the end purpose of the silver nitrate titration of chloride. Silver chloride was quantitatively precipitated before red silver chromate was formed.

G. *Fluoride*

The fluoride estimation was carried out by a colorimetric method. This method is based on the bleaching of the zirconium-SPANDS dye complex with the addition of fluoride ions. Fluoride ions form a stronger complex with zirconium ions and can consequently displace the dye from the complex. The decreasing absorption of the complex can be measured calorimetrically at 570 nm.

H. *Sodium*

Sodium was determined by using the Flame photometer method. The instrument was calibrated and the emission at 589nm was noted down.

I. *Potassium*

Potassium was determined by using the Flame photometer method. The instrument was calibrated and the emission at 766.5nm was noted down.

4. Results and Discussion

The raw water, reject water and treated water samples were collected from the site 3 times, at an interval of 15 days, and analyzed for various physic-chemical properties and the results are tabulated in table 1.

5. Reuse of Reject Water

Around 45% of the water is returned from the selected RO wastewater treatment plant, which is left to the drains because the water does not meet drinking water standards. This wastewater left in the sewage system will pollute the sewage

Table 1
Characterization of Raw, Rejected, treated water

S. No.	Parameters	Units	Raw water	Rejected water	Treated water
1	pH	-	7.19	7.44	5.98
2	Conductivity	milli mhos/cm	1.731	2.95	0.103
3	TDS	mg/l	944	1470	26
4	Total alkalinity	mg/l	832	1288	60
5	Chlorides	mg/l	385.88	601.8	15.99
6	Hardness				
	Ø Calcium	mg/l of CaCO3	564	94	8
	Ø Magnesium		552	828	16
7	Total hardness	mg/l of CaCO3	1116	1772	24
8	Permanent hardness	mg/l of CaCO3	836	1422	12
9	Temporary hardness	mg/l of CaCO3	280	350	12
10	Potassium	mg/l	9	14.2	4.6
11	Sodium	mg/l	74	115.2	0.8
12	fluoride	mg/l	0.59	0.599	0.581

Table 2
Characterization of raw, before filtration of rejected and after filtration of rejected water

S. No.	Parameters	Unit	Raw Water	Before Filtration of Rejected Water	After Filtration of Rejected Water
1	pH	-	7.19	7.44	6.55
2	Conductivity	milli mhos/cm	1.731	2.95	1.997
3	TDS	mg/l	944	1470	851.3
4	Total Alkalinity	mg/l	832	1288	501
5	Chlorides	mg/l	385.88	601.8	490.08
6	Hardness Calcium Magnesium	mg/l of $CaCO_3$	564 552	94 828	0 254 481
7	Total Hardness	mg/l of CaCO3	1116	1772	1145
8	Permanent Hardness	mg/l of CaCO3	836	1422	1097
9	Temporary Hardness	mg/l of CaCO3	280	350	65
10	Potassium	mg/l	9	14.2	.5
11	Sodium	mg/l	74	115.2	83.2
12	Fluoride	mg/l	0.59	0.599	0.590

treatment plant, and this water can also be an important concern in areas with water shortages.

Appropriate measures must therefore be taken so that this water can be recycled or reused. Various literature studies have produced a dual media filter for the rejected water filtration to reduce the TDS of the rejected water so that the water can be recycled and reused as raw water or mixed with raw water.

A. *Materials Used*

Coarse Aggregates **–** The coarse aggregates of size of 20mm, 12mm and 8mm were used.

Sand or Fine aggregate **–** The sand of effective size 0.35 mm was used for the experiment.

Activated Carbon **–** The powdered activated carbon having an effective size of 0.75mm was used for the experiment.

B. *Procedure for filtration of reject water*

- A polyethylene tank with a capacity of 20 liters was removed for experimental purposes.
- First, a layer of coarse aggregates with a depth of approximately 10 cm was placed in the can.
- A layer of sand with an effective size of 0.35 mm and a depth of 3 cm was applied.
- Then a layer of powdered activated carbon with an effective size of 0.75 mm was placed on the sand with a depth of 7.5 cm.
- A constant 10 cm head was provided during this process.
- The rejected water was passed through this filter medium at a constant flow rate.
- Later, the various physio-chemical parameters such as total dissolve solids, fluoride, electrical conductivity, total hardness, calcium and magnesium hardness, pH value, potassium, sodium and total alkalinity were tested for the treated reject water.

The test results obtained after the treatment provided to the reject water are tabulated in table 2.

6. Conclusion

The R.O. Rejected Water Study affects the analysis of raw, treated, and rejected water that was collected and compared at regular 15-day intervals. The following were the conclusions derived from this experimental study.

1. The processes/processes involved in the RO processing plant are rapid sand filtration, carbon filtration, softening, chlorination, cartridge filtration and reverse osmosis.
2. The raw, discarded and treated water was analyzed. The treated water is good for drinking.
3. The rejected water contains very high concentrations of different ions and is not suitable for household purposes.
4. The overall efficiency of the RO sewage treatment

plant is 60 - 70%.

5. The amount of water rejected was calculated based on the water balance and it was found that almost 50% of the water was rejected, which is why it has to be reused for reasons of sustainability.
6. The rejected water that has been treated for reuse by double media filtration (sand and carbon).
7. The rejected water corresponds approximately to the raw water when filtering the different ion concentrations and can be reused either by mixing or by direct use as raw water.

References

[1] CPHEEO Manual on Water Supply and Treatment, Third Edition published by Ministry of Urban Development, Bureau of Indian Standards; IS10500:2012, Standard Method of American Water Works Association (AWWA), 21st Edition, 2009.
[2] Ashish R. Mishra and Prashant A. Kadu, "Performance evaluation of WTP at yavatmal (M.S): Case Study," International Journal of Research inAdvent Technology, Vol. 2, No. 5, May 2014.
[3] Ajay S. Mahinge and Isha P. Khedikar 'Performance Evaluation of Water Treatment Plant at Midc Hingna, Nagpur: A Case Study in India' International Journal for Scientific Research & Development Vol 4, 2016.
[4] Mohammad Shoaib khan and Prof. Deepak Rastogi, a case study 'Performance Evaluation of WTP at Motijheel, Gwalior' International Journal for Research in Applied Science & Engineering Technology, Vol. 5, 2017.
[5] Madhu K. M and Soumyashree S. H, 'Performance Evaluation of a Water Treatment Plant at Davangere(Karnataka)' International Research Journal of Engineering and Technology, 2016.
[6] M. S. Hossain, M. S. Reza, M. A. Halim and Habibur Reza, a case study 'Performance Evaluation of Drinking Water Treatment Plant in Gopalganj Town of Bangladesh' International Conference on Civil Engineering for Sustainable Development, 2016.
[7] Arshad Ali, Hashim Nisar Hashmi, Naseem Baig, Shahid Iqbal and Khurram Mumtaz, A case study Performance evaluation of the water treatment plants of Islamabad – Pakistan' Arch. Environ, 2012.
[8] Anipa, Helen Michelle Korkor 'Performance Evaluation of Lpong WTP' KNUST Space, 2001.
[9] Bhosale S. M, Kulkarni A and Pujari S. S, 'Performance Evaluation of WTP at Bhokarpada Navi Mumbai,' IJCSEIERD 2017.
[10] Karan M. Sadhwani, P. P. Bhave 'A review of Performance Evaluation and Optimisation of WTP,' IARJSET, 2016.
[11] Manoj H Mota, Shashiraj S Chougule and Yogesh SVatkar 'Performance Evaluation of Urban WaterTreatment Plant' IJSR 2013.
[12] Khurana I, Sen R, "Drinking water quality in rural India: Issues and approaches. Drinking Water Quality, Water Aid, India," 2010.
[13] Central Ground Water Board Ministry of Water Resources Government of India (2010) Ground Water Quality in Shallow Aquifers of India.