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Water Quality Assessment of Shubha Jala RO Plants at Ward no.160 at Rajarajeshwari Nagar Under BBMP

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Abstract*— This study evaluates water quality from Reverse Osmosis (RO) plants in Rajarajeshwari Nagar, ward no.160. It focuses on assessing RO efficiency in providing safe drinking water through extensive laboratory tests on physical and chemical parameters. Findings indicate RO plants meet regulatory standards, offering insights for water treatment process enhancement. Diverse water samples from various RO plants underwent rigorous testing, using state-of-the-art instrumentation and standardized protocols. Statistical analyses compared results with guidelines, assessing RO plants' consistent production of high-quality water. The study explores operational factors affecting water quality, such as feed water characteristics, membrane integrity, pre-treatment processes, and maintenance. Identifying key factors influencing water quality contributes to optimizing RO plant performance and ensuring long-term sustainability. Implications extend to the scientific community and water treatment industry, informing policy decisions, driving technological advancements, and enhancing public awareness. In addressing water scarcity and pollution, this research supports the development of effective water treatment strategies, safeguarding global community health.

Keywords: Laboratory tests, RO plant performance, Reverse Osmosis Plants, Statistical analyses, Water quality.

I. INTRODUCTION

Access to safe and clean drinking water is a fundamental human right crucial for public health. With the escalating demand for potable water and the increasing pollution of traditional water sources, Reverse Osmosis (RO) technology has emerged as a prominent solution for water purification. RO plants play a pivotal role in treating diverse water sources to provide safe drinking water for communities, industries, and households. This project focuses on a comprehensive analysis of water quality from RO plants, aiming to ensure the effectiveness and reliability of this vital water treatment method.

The study will assess the efficiency of RO plants in removing contaminants, guaranteeing the delivery of high-quality drinking water that adheres to national and international safety standards. The methodology involves collecting and analyzing water samples from multiple RO plants in ward no.160 at Rajarajeshwari Nagar. The analysis will delve into both the physical and chemical parameters of the water, including temperature, pH, turbidity, color, odor, heavy metals, total dissolved solids (TDS), hardness, and nitrates. These assessments will not only ensure compliance with safety regulations but also provide insights into the performance of RO technology.

Furthermore, the project will conduct a comparative study of different RO plants, evaluating their efficiency in removing impurities and meeting drinking water standards. Variations in performance will be identified, offering valuable insights into optimizing RO plant operations and maintenance. The findings of this study will culminate in recommendations and guidelines for stakeholders, including plant operators, water authorities, and regulatory bodies. Implementation of these recommendations is crucial for improving the performance and sustainability of RO plants, ultimately ensuring the provision of clean, safe, and reliable drinking water. This research contributes significantly to the well-being and health of the communities served by these essential water treatment facilities.

II. METHODOLOGY

The methodology for analyzing he water quality of RO plants involves a systematic approach to collect samples, perform various tests, and interpret the results. This process allows for a comprehensive assessment of the effectiveness of the RO treatment and the safety of the purified water.

2.1 Sample Collection

RO Plants water samples were collected at Ward No.160 at Rajarajeshwari Nagar for the analysis. 5 liters of both source water and filtered water were collected separately. These RO Plants have been installed five years ago and the source water to these are from groundwater, the capacity of the RO tank 2000 liters, on an average per day 5000 liters of purified drinking water is used.

Locations of sample points obtained from BBMP are shown in Table 1.

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Fig 1. Collection Source and Filtered Water from RO plant

2.2 Physical and Chemical Parameter Analysis

pH: Determining the pH level of the water samples using a pH meter.

- Conductivity: Determining the conductivity of water using tabletop digital conductivity meter.
- Turbidity: Determine turbidity, which is a measure of the cloudiness or haziness of the water, using a should be found out.
- Acidity: Determining the acidity of the water samples.
- Alkalinity: Determining the alkalinity of the water samples. • Total Hardness: Determining the total harness of the given water sample by EDTA method.
- Calcium: Measuring the calcium level by EDTA method.
- Magnesium: Measuring the Magnesium level by EDTA method.

Indicates the locations of the RO Plants

Fig 2. GPS location of RO Plants

- Dissolved Oxygen: Determining the quantity of DO present in the water sample Winkler's method.
- Chloride: Measure the Chloride Ion Concentration in a water sample by Mohr's method.
- Total Dissolved Solids (TDS): Measuring the TDS content using a TDS meter.

Table 1: Location of sample points

BRUHAT BENGALURU MAHANAGARA PALIKE					
RO plant locations in Ward no. 160, Rajarajeshwari Nagara					
SI.NO	**Ward No**	**Name of the Work**	**Location**	**Geo Locations**	
				Latitude	**Longitude**
1	160	Construction of Mineral water unit building at BEML Layout in ward no 160	Beml Layout	12.919043	77.5203
2	160	Construction of mineral water unit building at Pantharapalya in ward no 160	Pantharapalya	12.9033782	77.5167
3	160	Construction of mineral water unit building at Channasandra Colony in ward no 160	Channasandra Colony	12.9251271	77.5276
4	160	Construction of mineral water unit building at Channasandra in ward no 160	Channasandra	12.904678	77.5134

2.3 Data Interpretation

Comparing the obtained results with national or international water quality standards **(Indian Standards for Drinking Water)** for drinking water to assess compliance. Identifying any contaminants that exceed permissible limits and pose health risks or may impact the performance of the RO plant. Assess the RO plant's performance by comparing water quality at different stages of treatment and identifying the removal efficiencies for various contaminants.

Table 2: The BIS Standards For The Drinking Water In India

Test parameter	**Acceptable limit**	**Permissible limit (In the absence of alternate source of water)**
pH value	6.8-8.5	No relaxation

Conductivity (µS/cm)	200	800
Turbidity (NTU)	1	5
Turbidity (NTU)	0	0
Alkalinity mg/l	200	600
Total hardness as Calcium Carbonate, mg/l, Max	200	600
Calcium as Ca, mg/l, Max	75	200
Magnesium mg/l, Max	30	100
Dissolved Oxygen mg/l	500	2000
Chlorides, Max mg/l	250	1000
Total Dissolved Solids, Max mg/l	500	2000

III. RESULTS AND DISCUSSIONS

Table 3: For Sample 1 - RO Plant at BEML layout

Parameters	**Source water**	**Filtered water**	**Remarks**
pH	7.57	7.29	pH of Source water and Filtered water lies between the permissible limits. Hence accepted.
Conductivity	1 µS/cm	0.16 µS/cm	Conductivity value of Source water and Filtered water is less than the permissible limit.
Turbidity	1.2	0	Turbidity of Source water is between the permissible limit and Filtered water is less than the permissible limit.
Acidity	Nill	Nill	Acidity of Source water and Filtered water is 0. Hence accepted.
Alkalinity	Nill	Nill	Alkalinity of Source water and Filtered water is 0, it is less than the permissible limits.
Total hardness	364 mg/l as CaCo3	68 mg/l as CaCo3	After purification Total hardness is less than the permissible limits.
Calcium	129.85 mg/l	25.65 mg/l	After purification Calcium content is less than the permissible limits.
Magnesium	9.72 mg/l	0.972 mg/l	Magnesium content of Source water and Filtered water is less than the permissible limits.
Dissolved Oxygen	4.5 mg/l	4.1 mg/l	D.O of Source water and Filtered water is less than the permissible limits.
Chloride	115.99 mg/l	29.99 mg/l	Chloride content of Source water and Filtered water is less than the permissible limits.
Total Dissolved Solids	426	87	TDS of Filtered water is less than the permissible limits.

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Table 3 shows water quality of RO plant located at BEML layout. After comparing with BIS Standards, it was found that the obtained values of pH lies between permissible limits and Conductivity, Turbidity, Acidity, Alkalinity, Magnesium, Dissolved Oxygen, Chloride of source water were already less than permissible limits. After purification all the parameters of filtered water were less than permissible limits.

Table 4: Sample 2 - RO Plant at Pantharapalya

Parameters	Source water	Filtered water	Remarks
pH	8.19	6.97	After purification the pH of Filtered water lies between the permissible limits. Hence accepted.
Conductivity	1.09 µS/cm	0.02 µS/cm	Conductivity value of Source water and Filtered water is less than the permissible limit.
Turbidity	0	0	Turbidity of Source water and Filtered water is 0, it is less than the permissible limits.
Acidity	Nill	Nill	Acidity of Source water and Filtered water is 0. Hence accepted.
Alkalinity	Nill	Nill	Alkalinity of Source water and Filtered water is 0, it is less than the permissible limits.
Total hardness	472 mg/l as CaCo3	96 mg/l as CaCo3	After purification Total hardness of Filtered water is less than the permissible limits.
Calcium	145.8 mg/l	16.03 mg/l	After purification Calcium content is less than the permissible limits.
Magnesium	26.24 mg/l	13.60 mg/l	Magnesium content of Source water and Filtered water is less than the permissible limits.
Dissolved Oxygen	4.1 mg/l	4.65 mg/l	The value of D.O is increased by 0.55 mg/l after purification. D.O of Source water and Filtered water is less than the permissible limits.
Chloride	129.9 mg/l	40.5 mg/l	Chloride content of Source water and Filtered water is less than the permissible limits.
Total Dissolved Solids	405	17	TDS of Source water and Filtered water less than the permissible limits.

Table 4 shows water quality of RO plant located at Pantharapalya. After comparing with BIS Standards it was found that the obtained values of pH lies between permissible limits and Conductivity, Turbidity, Acidity, Alkalinity, Magnesium, Dissolved Oxygen, Chloride, TDS of source water were already less than permissible limits. After purification all the parameters of filtered water were less than permissible limits but the DO value was increased by 0.55 mg/l after purification.

Table 5: Sample 3 - RO Plant at Channasandra

Parameters	Source water	Filtered water	Remarks
pH	7.89	7.2	pH of Source water and Filtered water lies between the permissible limits Hence accepted.
Conductivity	0.94 µS/cm	0.18 µS/cm	Conductivity value of Source water and Filtered water less than the permissible limit.
Turbidity	0.1	0.1	Turbidity of Source water and Filtered water less than the permissible limit.

Acidity	Nill	Nill	Acidity of Source water and Filtered water is 0. Hence accepted.
Alkalinity	Nill	Nill	Alkalinity of Source water and Filtered water is 0, it is less than the permissible limits.
Total hardness	568 mg/l as CaCo3	96 mg/l as CaCo3	After purification Total hardness is less than the permissible limits.
Calcium	149 mg/l	22.4 mg/l	After purification Calcium content is less than the permissible limits.
Magnesium	47.6 mg/l	9.72 mg/l	After purification Magnesium content of Filtered water is less than the permissible limits.
Dissolved Oxygen	4.5 mg/l	5.1 mg/l	The value of D.O is increased by 0.6 mg/l after purification. D.O of Source water and Filtered water is less than the permissible limits
Chloride	205.9 mg/l	49.9 mg/l	Chloride content of Source water and Filtered water is less than the permissible limits.
Total Dissolved Solids	598	86	After purification TDS of Filtered water is less than the permissible limits.

Table 5 shows water quality of RO plant located at Channasandra. After comparing with BIS Standards it was found that the obtained values of pH lies between permissible limits and Conductivity, Turbidity, Acidity, Alkalinity, Magnesium, Dissolved Oxygen, Chloride of source water were already less than permissible limits. After purification all the parameters of filtered water were less than permissible limits but the DO value was increased by 0.6 mg/l after purification.

Table 6: Sample 4 - RO Plant at Channasandra Colony

Parameters	**Source water**	**Filtered water**	**Remarks**
pH	7.89	7.2	After purification the pH lies between the permissible limits Hence accepted.
Conductivity	0.94 µS/cm	0.18 µS/cm	Conductivity value of Source water and Filtered water is less than the permissible limit.
Turbidity	0.1	0.1	Turbidity of Source water and Filtered water is less than the permissible limit.
Acidity	Nill	Nill	Acidity of Source water and Filtered water is 0. Hence accepted.
Alkalinity	Nill	Nill	Alkalinity of Source water and Filtered water is 0, it is less than the permissible limits.
Total hardness	568 mg/l as CaCo3	96 mg/l as CaCo3	After purification Total hardness is less than the permissible limits.
Calcium	149 mg/l	22.4 mg/l	After purification Calcium content is less than the permissible limits.
Magnesium	47.6 mg/l	9.72 mg/l	Magnesium content of Source water and Filtered water is less than the permissible limits.
Dissolved Oxygen	4.5 mg/l	5.1 mg/l	The value of D.O is decreased by 0.1 mg/l after purification. D.O of Source water and Filtered water is less than the permissible limits.
Chloride	205.9 mg/l	49.9 mg/l	Chloride content of Source water and Filtered water is less than the permissible limits.
Total Dissolved Solids	598	86	After purification TDS of Filtered water is less than the permissible limits.

Table 6 shows water quality of RO plant located at Channasandra. After comparing with BIS Standards it was found that the obtained values of pH lies between permissible limits and Conductivity, Turbidity, Acidity, Alkalinity, Magnesium, Dissolved Oxygen, Chloride, TDS of source water were already less than permissible limits. After purification all the parameters of filtered water were less than permissible limits but the DO value was decreased by 0.1 mg/l after purification.

IV. CONCLUSION

The operation of a reverse osmosis (RO) plant has proven to be highly effective in ensuring that drinking water parameters consistently fall below the permissible limits set by the Bureau of Indian Standards (BIS). This technology represents a significant advancement in water treatment and purification, offering numerous benefits for public health and safety. By removing impurities, contaminants, and excess minerals from the water supply, RO plants play a crucial role in delivering safe, clean, and reliable drinking water to communities.

The adherence to permissible limits for various parameters, such as pH, total dissolved solids (TDS), turbidity, and other parameters demonstrates the robust performance of the RO plants. This outcome is crucial in ensuring that the treated water not only meets the basic criteria for potability but also aligns with the health and safety standards set by BIS. The successful alignment of RO plant output with drinking water standards suggests that the treatment process is efficient in removing impurities and contaminants, resulting in water that is not only visually clear and free of turbidity but also devoid of excessive mineral content.

It is essential to maintain proper operational and maintenance practices to sustain these positive results over time. It is important to note that while falling below permissible limits is generally a positive outcome, excessive treatment or over-purification of water can sometimes lead to issues like altered mineral content, which may affect taste. However, ongoing monitoring and periodic analysis are recommended to ensure the continued performance of the RO plants and to promptly address any potential deviations from the established standards. This will contribute to the long-term success of the RO treatment process in consistently delivering high-quality drinking water to the population it serves.

In summary, the analysis of the RO plants has confirmed their ability to produce drinking water that aligns with permissible limits for various parameters. This achievement reflects the dedication to water quality and safety, ultimately contributing to the well-being and health of the community.

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