RESEARCHERID
THOMSON REUTERS
[Vaibhav et al. , 4(3), Mar 2019]

ISSN : 2455-9679
Impact Factor : 2.865

IJRTSM

INTERNATIONAL JOURNAL OF RECENT TECHNOLOGY SCIENCE & MANAGEMENT

"UTILIZATION OF WASTE WATER FROM REVERSE OSMOSIS WATER FILTERS"

Vaibhav Jain [1], Vaibhav Goswami [2], Varun Nayak [3], Amir Khusru [4], Shreya Makoda [5], Madhavi Chouhan [6], Aditi Agrawal Shinde [7]

[1-6] UG Scholar, Dept. of Civil Engineering, MIT, Indore, Mp, India
[7]HOD, Dept. of Civil Engineering, MIT, Indore, Mp, India

ABSTRACT

Water is an important resource for the survival of life. The inadequate availability of surface water makes people depend on ground water for fulfilling their needs. However, ground water is generally too impure to satisfy the requirements for domestic as well as industrial applications. Removal of impurities involves various techniques such as lime soda process, ion exchange, reverse osmosis, nano-filtration, distillation, and, evaporation etc. This review study focuses onvarious literature that has been dedicated to utilizing electrocoagulation for water treatment. This review attempts to highlight the main achievement in the area and the process of purification of RO waste water.

In this work, the removal of impurities was studied from waste water taken from RO plants and home. A chemical tests are going to apply on a both plant and home RO waste water, and the purification methods depend on the impurities present in an excessive amount.

Keyword: *Nano-filtration, Distillation, RO*

I. INTRODUCTION

Freshwater scarcity is becoming obvious along with the population growth and the industrial expansion. The expanding industries are increasingly resorting to other water sources, mainly recycled water. India has the highest number of people wholack access to clean water, imposinga huge financial burden for some of the country's poorest population. As per UN Water, water security refers to the capacity of a population to safe guard sustainable access to adequate quantities of acceptable quality of water for supporting livelihoods. India's water crisis is often attributed to the urbanization, industrialization and human waste flowing into water sources and polluting groundwater, as well as corruption at different levels that delay various processes and tasks. In addition, water scarcity in India is expected to worsen as the overall population is expected to increase to 1.6 billion by year2050.

As per the report submitted by the Committee on Restructuring the Central Water Commission (CWC) and the Central Ground Water Board (CGWB), 2016 if the current pattern of demand continues, about half of the demand for water will be unmet by 2030. Water tables, the level below which the ground is saturated with water, are falling in most parts of India. Minerals like fluoride, arsenic, mercury, and uranium are present in the groundwater, which lead to chronic water borne diseases. Climate change poses fresh challenges as more extreme rates of rainfall and evapo transpiration intensify the impacts of floods and droughts.

ISSN : 2455-9679
Impact Factor : 2.865

Groundwater provides 80% of India's drinking water and nearly two-thirds of irrigation needs. Over the last four decades, around 84% of the total addition to irrigation has come from groundwater. Moreover, 60% of India's districts face groundwater over-exploitation and serious quality issues. In fact 11% of the rural water supply is based on groundwater. India's 251 cubic kilometer (cu km) annual groundwater extraction rate makes India the world's biggest consumer of groundwater, according to a 2012 United Nations Educational.

II. OBJECTIVE

- To study about the working of RO.
- To study the waste water produced from RO.
- To study the various physical and chemical characteristics of waste water from RO water filter.
- To suggest suitable methods to reduce the harmful components in the wastewater generated from RO

III. METHODOLOGY

Water quality testing is an important part of environmental monitoring. When water quality is poor, it affects not only aquatic life but the surrounding ecosystem as well.

In this section details of all the parameters that affect the quality of water in the environment are discussed. These properties can be physical, chemical or biological factors. Physical properties of water quality include temperature, total dissolved solid, colour, taste and odour. Chemical characteristics involve parameters such as PH, hardness, chloride and alkalinity. Biological indicators of water quality include ealgaeandphy to plankton. These parameters are relevant not only to surface water studies of the ocean, lakes and rivers, but to groundwater and industrial processes as well.

We follow IS 10500:2012 for drinking water standard.

Water quality is a measure of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose. The availability of a water supply adequately in terms of both quantity and quality is essential to human existence. Early people recognized the importance of water from a quantity view point. Recognition of the importance of water quality developed more slowly early human could judge water quality only through the physical seances of sight taste and smell.

The quality of water may be described in terms of the concentration and state (dissolved or particulate)of some or all of the organic and inorganic material present in the water, together with certain physical characteristics of the water. It is determined by in situ measurements and by examination of water samples on site or in the laboratory. The main elements of water quality monitoring are, therefore, on-site measurements, the collection and analysis of water samples, the study and evaluation of the analytical results, and the reporting of the findings. The results of analyses performed on a single water sample are only valid for the particular location and time at which that sample was taken. One purpose of a monitoring programme is, therefore, to gather sufficient data (by means of regular or intensive sampling and analysis) to assess spatial and/or temporal variations in water quality.

WATER QUALITYPARAMETERS

Physical characteristics:

- Turbidity
- Colour
- Taste and odour
- Temperature
- Total Dissolved Solid(TDS)

ISSN : 2455-9679
Impact Factor : 2.865

Chemical characteristics are:

- pH
- Hardness
- Chloridecontent
- Fluoridecontent
- Nitratecontent

TURBIDITY

Pure water is clear and do not absorb light. There foreifturbidity appears in water, it indicates water pollution. Turbidity in water is given by various materials like suspended solid, dissolved materials and microbial loads. In general turbidity increases with increases in quantity of these materials in water. However different materials differ in their light absorptioncapacity.

Drinking water should have turbidity less than 5 NTU (Naphthalometric turbidity unit)

COLOR

Pure water is colorless.Therefore any types of color appearance in water indicates water pollution. Natural water system is often colored by foreign material. If color is due to suspended material, it is called as apparent color. Color given by dissolved material that remains even after removal of suspended material is called true color or real color. The guideline value (maximum acceptable level) for color of drinking water is 15 TCU (True colorunit).

TASTE ANDODOUR

Pure water is always tasteless and odorless. Therefore if any types of taste and odor is present, it indicates water pollution. Water taste and odor may develops due to natural or artificial regions.

TEMPERATURE

Temperatureisnotdirectlyusedtoevaluatewhetherwaterispotable(drinkable)ornot. Innatural water system like lake and river, temperature is very important physical factor that determines water quality. If temperature increase, solubility of Oxygen in waterdecreases.

Furthermore rise in temperature increases the growth rate of aquatic microorganism, so they consume dissolved O2 faster and level of dissolved O2 decreases. Similarly, temperature affects disinfection process because efficiency of disinfection is lower at lower temperature.

We can measure the temperature of water by laboratory thermometer.

TOTAL DISSOLVEDSOLIDS

Total dissolved solids (TDS) is a measure of the dissolved combined content of all inorganic and organic substances contained in a liquid in molecular, ionized or micro-granular (colloidalsol) suspended form. Generally the operational definition is that the solids must be small enough to survive filtration through a filter with two-micrometre (nominal size, or smaller) pores. Total dissolved solids are normally discussed only for freshwater systems, as salinity includes some of the ions constituting the definition of TDS. The principal application of TDS is in the study of water quality for streams, rivers and lakes, although TDS is not generally considered a primary pollutant (e.g. it is not deemed to be associated with health effects) it is used as an indication of aesthetic characteristics of drinking water and as an aggregate indicator of the presence of a broad array of chemicalcontaminants.

Primary sources for TDS in receiving waters are agricultural and residential runoff, clay rich mountain waters, leaching of soil contamination and point source water pollution discharge from industrial or sewage treatment plants. The most common chemical constituents are calcium, phosphates, nitrates, sodium, potassium and chloride, which are found in nutrient runoff, general storm water runoff and runoff from snowy climates where road de- icing salts are applied. The chemicals may be cations, anions, molecules or agglomerations on theorder of one thousand or fewer molecules, so long as a soluble micro-granule is formed. More exotic and harmful elements of TDS are pesticides arising from surface run off. Certain naturally occurring total dissolved solids arise from the weathering and dissolution

ISSN : 2455-9679
Impact Factor : 2.865

of rocks and soils. The United States has established a secondary water quality standard of 500 mg/l to provide for palatability of drinking water.

To taldissolvedsolidsaredifferentiatedfromtotalsuspendedsolids(**TSS**),inthatthelattercannot pass through a sieve of two micrometres and yet are indefinitely suspended in solution. The term "settle able solids" refers to material of any size that will not remain suspended or dissolved in a holding tank not subject to motion, and excludes both TDS and TSS. Settleable solids may include larger particulate matter or insoluble molecules.

pH

It is defined as the potential exerted by H+ ions in water .It is represented as the inverse of logarithmic of H+ ions concentration in water. Similarly POH is potential exerted by OH- ions in water. pH is a scale of acidity from 0 to14. It tell show acidicor alkali substanceis. Moreacidic solutions have lower pH. More alkaline solutions have higher pH. Substances that aren't acidic or alkaline (that is, neutral solutions) usually have a pH of 7. Acid have a pH that is less than 7. Alkaline have a pH that is greater than 7. Acceptable limit:7-8.5

HARDNESS

Hardness is due to the presents of multivalent metallic cations in water. It is also defined as the inability of water to form sufficient lather or form with soaps. In natural water, cations which are predominantly present are Na+, Ca++ and Mg++ out of which Ca++ and Mg++ ,being multivalent metallic cations, are responsible for hardness. However other multivalentmetalliccationscanalso be present such as Al3+, Fe2+, Fe3+ in small proportions. The type of hardness is determined by the anions with which multivalent metallic cations was originally associated. Following are the type ofhardness

Temporary hardness is due to the presence of bicarbonates of calcium and magnesium. It can be easily removed by boiling.

Permanent hardness cannot be removed by boiling.This is due to the presence of chlorides and sulphates of calcium and magnesium. The hardness can be removed by the additionof someagents.

ALKALINITY

The values of pH higher than 7, shows alkalinity. The alkaline species in water can neutralize acids. The major constituents of alkalinity (or causticity) are OH-, CO32- and bicarbonates HCO3 ions. Alkalinity in water is usually caused by bicarbonate ions.

Alkalinity is defined as the quantity of ions in water that will react to neutralize hydrogen ions. Alkalinity is thus a measure of the ability of water to neutralize acids.

Constituents of alkalinity in natural water systems include CO32-, HCO3–, OH–, HSiO3– H2BO3–HPO42-,H2PO4– ,HS– and NH3O.These compounds result from the dissolution of mineral substances in the soil and atmosphere. Phosphates may also originate from detergents in waste water discharged and from fertilizers and insecticides from agricultural land. Hydrogen sulphide and ammonia may be products of microbial decomposition of organicmaterial.

The most common constituents of alkalinity are bicarbonates (HCO3–), carbonate (CO2–) and hydroxide (OH–). In addition to their mineral origin these substances can originate from carbon dioxide, a constituent of the atmosphere and a product of microbial decomposition of organic material. In larger quantities, alkalinity imparts a bitter taste to water.

Reaction can occur between alkalinity and certain cations in water. The resultant precipitate can foul pipes and other water systems appurtenances Alkalinity is expressed in mg/l as CaCO3 as its make the computation easy

IV. PROPOSED METHOD

There are a lot of methods to reduce the hardness and TDS from water according to the need some of the methods available are:

WATER SOFTENINGMETHOD

When water is referred to as 'hard' this simply means, that it contains more minerals thanordinary water. These are especially the minerals calcium and magnesium. The degree of hardness of the water increases, when more calcium and magnesium dissolves. Magnesium and calcium are positively charged ions. Because of their presence, other positively

ISSN : 2455-9679
Impact Factor : 2.865

charged ions will dissolveless easily in hard water than in water that does not contain calcium and magnesium. This is the cause of the fact that soap doesn't really dissolve in hardwater.

When water contains a significant amount of calcium and magnesium, it iscalled hard water.Hard water is known to clog pipes and to complicate soap and detergent dissolving in water. Water softening is a technique that serves the removal of the ions that cause the water to behard, in most cases calcium and magnesiumions. Iron ions may also be removed during softening.The best way to soften water is to use a water softener unit and connect it directly to the water supply.

Water softeners are specific ion exchangers that are designed to remove ions, which arepositively charged. Softeners mainly remove calcium (Ca2+) and magnesium (Mg2+) ions. Calcium and magnesium are often referred to as 'hardness minerals'. Softeners are sometimes even applied to remove iron. The softening devices are able to remove up to five milligrams per litre (5 mg/L) of dissolved iron. Softeners can operate automatic, semi-automatic, or manual. Each type is rated on theamountofhardnessitcanremovebeforeregenerationisnecessary.

A water softener collects hardness minerals within its conditioning tank and from time to time flushes them away to drain. Ion exchangers are often used for water softening. When an ion exchanger is applied for water softening, it will replace the calcium and magnesium ions in the water with other ions, for instance sodium or potassium. The exchanger ions are added to the ion exchanger reservoir as sodium and potassium salts (NaCl and KCl) Chemical precipitation is one of the more common methods used to soften water. Chemicals normally used are lime (calcium hydroxide, Ca(OH)2) and soda ash (sodium carbonate, Na2CO3). Lime is used to remove chemicals that cause carbonate hardness. Soda as his used to remove chemicals that cause non-carbonate hardness. When lime and soda ash are added, hardness-causing minerals form nearly in soluble precipitates. Calcium hardness is precipitated as calcium carbonate (CaCO3). Magnesium hardness is precipitated as magnesium hydroxide (Mg(OH)2). These precipitates are then removed by conventional processes of coagulation/flocculation, sedimentation, and filtration. Because precipitates are very slightly soluble, some hardness remains in the water--usually about 50 to 85 mg/l (as CaCO3). This hardness level is desirable to prevent corrosion problems associated with water being too soft and having little or nohardness.

ELECTROLYSISMETHOD

A method for removing contaminants from a flow of waste water using an electrolytic oxidation vessel having a chamber and at least one elongate cathode electrode and a plurality of elongate sacrificial anode electrodes aligned parallel with the cathode electrode in the chamber.The flow of waste water is directed through the chamber of the electrolytic oxidation vessel in a direction parallel with the cathode and anode electrodes so that the flow of waste water engages the cathode and anode electrodes. A voltage is applied across the cathode electrode and the sacrificial anode electrodes to create a current having a density ranging from approximately 5-7 ma/sq. cm so as to release ions from the anode electrodes which oxidize and render in soluble contaminants in the flow of waste water and create insoluble contaminants and substantially cleansed water. The insoluble contaminants are separated from the substantially cleansed water. An apparatus for use with the method isprovided.

Fig 4.1 Filteration

Fig 4.2 Filter Equipment

ISSN : 2455-9679
Impact Factor : 2.865

V. OBSERVATION AND RESULT

DATA COLLECTION

According to the survey knowledge about the amount of waste water RO's produces daily in our homeandROwatertreatmentplantwasacquired.Firstlyinthissurveytheonesampleiscollected From respective plant and home and the number of RO filters wascalculated.

We know that the daily water consumption per person for a commercial building is 1 liter from IS Code 10500: 2012

Using this data the daily water need for house and RO plant was calculated and accordingly the amount of waste water produced daily was found.

For RO used in plant

- Efficiency of ROfilter: It produces 0.625 litre of waste water for every 1 litre filtered water
- Total wastewater: Per capita daily demand of water consumption in a commercial building is 1 litre per person.
  According to IS code 10500: 2012
  Total number of people is 350
  Therefore amount of waste water produced per station is
  Per capita demand * number of people * waste water
  1*350*0.625 = **218.75 litre/day**
  Total amount of waste water is 218.75 litre/day

For RO used in homes

- Efficiency of ROfilter: It produces 0.430 litre of waste water for every 1 litre filtered water.
- Total wastewater: Per capita daily demand of water consumption in a commercial building is 1 litre per person.
  According to IS code 10500: 2012
  Total number of people is 5
  Therefore amount of waste water produced per station is
  Per capita demand * number of people * waste water
  1*5*.430 = **2.15 litre/day**
  Total amount of waste water is 2.15 litre /day

OBSERVATION FOR TOTAL DISSOLVED SOLID

Table 5.1: Observation of TDS

Samples	Weight of dish	Weight of dish after evaporation
Plant RO waste water	113.07g	113.08g
Home RO waste water	113.07g	113.08g

For plant RO waste water = 333.33mg/L
For home RO waste water = 333.33mg/L

LIMIT
Acceptance limit: 500mg/l

ISSN : 2455-9679
Impact Factor : 2.865

OBSERVATION FOR HARDNESS

Table 5.2: Observation of hardness

Sno.	Volume of Sample	Initial Reading	Final Reading	Volume of EDTA
1	20 ml (waste water of RO plant)	0	14	14ml
2	20 ml (RO waste water from home)	0	12.8	12.8ml

For plant RO waste water hardness = 700 mg/L
For home RO waste water hardness= 640mg/L

OBSERVATION FOR ALKLINITY

Figure 5.3 Observation of alkalinity

Sample	Burette reading Phenolphalin indicator		Volume of acid	Burette reading Methyl orange indicator		Volume ofacid
	initial	final		initial	final	
Plant RO waste water	0	2.7	2.7mL	2.7	8.7	6mL
Home RO waste water	0	3	3mL	3	8.8	5.8mL

For plant RO waste water

Phenolphthalein alkalinity = 135mg/L
Total alkalinity = 300mg/L

For home RO waste water

Phenolphthalein alkalinity = 150mg/L
Total alkalinity = 290mg/L

RO plant waste water has carbonate and bicarbonate alkalinity. Home RO waste water has hydroxide and carbonatealkalinity.

OBSERVATION FOR PURIFIED WATER

Table 5.4: Hardness of purified water

S .no.	Purified water sample	Initial	Final	EDTA volume
1	Plant RO water	0	3.5	3.5mL
2	Home RO water	0	3.1	3.1mL

`

For purified plant RO water hardness = 175mg/L
For purified home RO water hardness = 155mg/L

RESULTS ON RO WASTE WATER

After testing the waste water on the physical and chemical parameters according to the IS code 10500: 2012 we found out that

Physical parameters

1. The turbidity of the sample was under the acceptancelimit.
2. There was no considerable change in the color of waterobtained.
3. The sample was tasteless andodourless.
4. The temperature of the sample was at roomtemperature.

ISSN : 2455-9679
Impact Factor : 2.865

5. The total dissolved solids (TDS) was less thenacceptance limit.

Chemical parameters

1. The pH of the sample obtained was as of the tapwater.
2. The hardness of the sample obtained was more than the acceptancelimit.
3. The alkalinity content of the sample obtained was under the acceptancelimit.

According to the results obtained we found that the basic problem with the waste water is high amount of Hardness.

RESULTS OBTAINED FOR PURIFIED WATER

After testing the purified water by the method of electrolysis, on the physical and chemical parameters according to the IS code 10500: 2012 we found out that the hardness of a purified water is in under acceptable limit i.e. 175mg/L for RO plant water and 155mg/L for home used RO water.

VI. CONCLUSION

A series of experiments was performed in order to find the parameters for the RO waste water from plant and home. We conduct a chemical experiments for finding the amount of total dissolved solid, hardness, alkalinity, pH etc. purification of waste water is done by the water softening method and electrolysis method. It was seen that Electrolysis method is more efficient then water softening methods. The indian standard code was used for the standard values and experiments were implemented in it. On study, it can be concluded that the plant RO waste water has much similar properties as home RO waste water. The purification of waste water carried out by the water softening method and electrolysis method. Lime soda water softening method was one of the most commonly used chemical treatment method for the hardness removal of water. The main issue of that treatment process is the addition of unnecessary excess sodium ions into the water and increment of pH value. It can remove hardness of water in some amount but not up to an acceptable limit. The hardness value of Water treated from the lime soda method exceed limiting value that's way we cannot use water in a drinking purposes, but it will give soap lather so we can use this water in a washing and other use. Electrolysis method has been found to be feasible, economical in treatment of various types of water, waste water and heavy metals with promising result due to this the interest on electrolysis method is seems to be rise. It is expanding due to its high removal efficiency of various pollutants. It was seen that electrolysis method remove hardness effectively and make water drinkable.

VII. FUTURE SCOPE

There is number of possible chemical treatment methods which can beimplemented to increase the percentage of hardness removal in RO waste water. The above treatment methods can be further evaluated by getting different water samples from different water bodies and getting more samples from the same bodies at different times. Considering the above facts, the research can be developed with further extensions. Additionally theoretical model of determination of calcium and magnesium ions in RO waste water connected with the hardness of the water can be developed by related set of chemical equations.

REFERENCES

1. IS CODE 10500: 2012 Drinking waterstandard
2. IS CODE 3025-1 Methods of sampling and test (physical and chemical) forwater and wastewater.
3. Water Supply Engineering by Dr. S.KGarg
4. Garud R. M., Kore S. V., Kore V. S., Kulkarni G. S. A Short Review on Processand Applications of Reverse Osmosis Universal Journal of Environmental Research and Technology All Rights Reserved Euresian Publications 2011 eISSN 22490256
5. Virapana , R. Saravananeb , and V Murugaiyanb Treatment of ReverseOsmosis Reject Water from Industries International Journal of Applied Environmental Sciences ISSN 0973-6077 Volume 12, Number 3 (2017), pp.489-503.
6. Navin Kumar, Vidushi Bharadwaj, Shikha Mitra, Debajyoti Bose* RO RejectWater Management Techniques WNOFNS 14 (2017)1-10