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Study Of Reverse Osmosis Process

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Abstract: Reverse osmosis (RO) systems can often improve the quality of water. The reverse osmosis water treatment method has been used extensively to convert brackish or seawater to drinking water, to clean up wastewater, and to recover dissolved salts from industrial processes. It is becoming more popular in the home market as homeowners are increasingly concerned about contaminants that affect their health, as well as about non-hazardous chemicals that affect the taste, odor, or color of their drinking water.

Keywords: R.O.

I. INTRODUCTION

Reverse osmosis is an effective method of reducing the concentration of total dissolved solids (TDS) and many impurities found in water. Some of the compounds which RO systems are commonly used are listed below. These compounds may or may not be present in your water. The rate of reduction of each specific compound will depend on the RO membrane type and the system's operating conditions.

II. THEORY

People considering the installation of a water treatment system to reduce toxic chemicals should first have their water tested to determine how much if any hazardous compounds are in the water. Public water supplies are routinely monitored and treated as required under the federal Safe Drinking Water Act and state regulations. Private water systems should be tested at the owner's initiative based on knowledge of land use and contamination incidents in the area. Reducing contaminants through RO Reverse osmosis treatment reduces the concentration of dissolved solids, including a variety of ions and metals and very fine suspended particles such as asbestos that may be found in water. An RO device may be installed following a water softener to reduce the concentration of sodium ions exchanged for hardness ions. RO also removes certain organic contaminants, some detergents, and specific pesticides. Although RO membranes can remove virtually all microorganisms, it is currently recommended that only microbiologically safe (i.e., coliform negative) water be fed into RO systems.

Ions and Metals Organic Chemicals

Arsenic (As)
Aluminum (Al)
Barium (Ba)
Bicarbonate (HCO_3^{--})
Cadmium (Cd)
Calcium (Ca)
Carbonate (CO_3^{--})
Chloride (Cl)
Chromium (Cr)
Copper (Cu)
Fluoride (F)
Iron (Fe)
Lead (Pb)
Magnesium (Mg)
Manganese (Mn)
Mercury (Hg)
Nitrate / Nitrite (NO_3^- / NO_2^-)
Potassium (K)
Radium (Ra)
Selenium (Se)
Silver Sodium (Na)
Sulfate (SO_4^{--})
Zinc (Zn)

Organic Chemicals-
Benzene
Carbon tetrachloride
Dichlorobenzene
Trichloroethylene
Total Trihalomethanes (THMs)
Particles -
Asbestos
Protozoan cysts
Pesticides-
1,2,4-trichlorobenzene
Pentachlorophenol

III. METHODOLOGY

In the reverse osmosis process a cellophane-like membrane separates purified water from contaminated water. An understanding of osmosis is needed before further describing RO. Osmosis occurs when two solutions containing different quantities of dissolved chemicals are separated by a semi permeable membrane (allowing only some compounds to pass through). Osmotic pressure of the dissolved chemical causes pure water to pass through the membrane from the dilute to the more concentrated solution (Figure 1) There is a natural tendency for chemicals to reach equal concentrations on both sides of the membrane.

In reverse osmosis, water pressure applied to the concentrated side forces the process of osmosis into reverse. Under enough pressure, pure water is "squeezed" through the membrane from the concentrated to the dilute side (Figure 2). Salts dissolved in water as charged ions are repelled by the RO membrane. Treated water is collected in a storage container. The rejected impurities on the concentrated side of the membrane are washed away in a stream of wastewater, not accumulated as on a traditional filter. The RO membrane also functions as an ultrafiltration device, screening out particles, including microorganisms that are physically too large to pass through the membrane’s pores. RO membranes can remove compounds in the 0.0001 to 0.1 micron size range (thousands of times smaller than a human hair).

IV. RO MEMBRANE MATERIALS

The most common RO membrane materials are polyamide thin film composites (TFC) or cellulosic types (cellulose acetate [CA], cellulose triacetate [CTA], or blends). Very thin membranes are made from these synthetic fibers. Membrane material can be spiralwound around a tube, or hollow fibers can be bundled together, providing a tremendous surface area for water treatment inside a compact cylindrical element (Figure 4). Hollow fiber membranes have greater surface area (and therefore greater capacity) but are more easily clogged than the spiral-wound membranes commonly used in home RO systems.

V. EFFICIENCY OF RO SYSTEMS

The performance of an RO system depends on membrane type, flow control, feed water quality (e.g., turbidity, TDS, and pH), temperature, and pressure. The standard at which manufacturers rate RO system performance is 77 °F, 60 pounds per square inch (psi), and TDS at 500 parts per million (ppm). Only part of the water that flows into an RO system comes out as treated water. Part of the water fed into the system is used to wash away the rejected compounds and goes down the drain as waste.

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The recovery rate, or efficiency, of the system is calculated by dividing the volume of treated water produced by the volume of water fed into the system:

% Recovery = (Volume of Treated Water Produced/ Volume of Feed Water Used)*100

If not properly designed, RO systems can use large quantities of water to produce relatively little treated water. Most home RO systems are designed for 20 to 30% recovery.

VI. ADVANTAGES

The main health advantage R.O. water has over tap water is that an R.O. system removes many unhealthy contaminants.

A good R.O. system can remove contaminants such as arsenic, nitrates, sodium, copper and lead, some organic chemicals, and the municipal additive fluoride.

VII. DISADVANTAGES

A. THE WATER IS DEMINERALIZED

Since most mineral particles (including sodium, calcium, magnesium, magnesium, and iron) are larger than water molecules, they are removed by the semi-permeable membrane of the R.O. system.

The World Health Organization conducted a study that revealed some of the health risks associated with drinking demineralized water.

Just a few of the risks include gastrointestinal problems, bone density issues, joint conditions, and cardiovascular disease.

Removing the naturally occurring minerals also leaves the water tasteless. Many people thus have to add liquid minerals to their R.O. water to improve the taste.

B. THE WATER IS USUALLY ACIDIC

One of the primary reasons R.O. water is unhealthy is because removing the minerals makes the water acidic (often well below 7.0 pH). Drinking acidic water will not help maintain a healthy pH balance in the blood, which should be slightly alkaline.

C. SOME CRITICAL CONTAMINANTS ARE NOT REMOVED

While reverse osmosis is effective for removing a variety of contaminants in water, the reverse osmosis membrane alone does NOT remove volatile organic chemical (VOCs), chlorine and chloramines, pharmaceuticals, and a host of other synthetic chemicals found in municipal water.

However, some R.O. systems now have multi-stage filtration media (in addition to the R.O. membrane), such as Activated Carbon, which does remove chlorine and certain pesticides.

VIII. CONCLUSION

From above comparative study we observe that the use of RO is depend on the requirement.

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