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Water Softning Techniques From Brine Solution

Mrs. S. S Shaikh

M.Sc. Chemistry, Assistant Professor,
Basic Engineering Science Department,
Guru Gobind Singh College Of Engineering And Research Centre, Nashik

Abstract: Soft water and hard water are common terms used in households .Most of Earth's water (97%) is in the ocean. Seawater has unique properties: it is saline, its freezing point is Slightly lower than fresh water, its density is slightly higher, its electrical conductivity is much higher, and it is slightly basic. We cannot used brine water for domestic purpose. So it is needed to convert it into soft water. In this paper we observe the techniques of softening water. Seawater is water from a sea or ocean. On average, seawater in the world's oceans has a salinity of approximately 3.5%, or 35 parts per thousand. This means that for every 1 litre (1000 mL) of seawater there are 35 grams of salts (mostly, but not entirely, sodium chloride) dissolved in it.

Keywords: Water softening, Brine solution, Pervaporation process, Osmosis, recharge process, nanofiltration.

I. INTRODUCTION

Chemistry is everywhere in every phenomenon, technology, observation, experiment etc. All we need to do is to understand the logic hidden behind. Since Chemical reactions give way to the ultimate results of every experiment, it becomes quite pertinent to analyse those experiments before making conclusions.

Every household and every factory uses water, and none of it is pure. One class of impurity that is of special interest is "hardness".

A new, patented treatment system has been developed to recover most of the brine from the water softening regeneration process. It utilizes nanofiltration (NF) technology to separate hardness ions from brine solution, discharging the hardness to the drain and returning recovered sodium / potassium chloride to the brine tank for reuse. Production-sized units have been manufactured and testing is ongoing. The preliminary results show that approximately 75 to 85 percent of the brine can be recovered. This provide

Significant cost savings for the end user. Example: a Mexican restaurant located in Las Vegas, NV spent month on salt for their two five-cubic-foot water softeners. Less maintenance required for the end user, reducing time spent adding salt to the water softener by 80 percent (+/- 5 percent)

A dramatic reduction of salt (monovalent ions), being added to our water supplies

A new potential to get water softeners reapproved in brine-restricted areas. Approximately 35 to 40-percent reduction in water used during the regeneration Process.

II. BRINE SOLUTION

Brine is a solution of salt (usually sodium chloride) in water. In different contexts, brine may refer to salt solutions ranging from about 3.5% (a typical concentration of seawater, or the lower end of solutions used for brining foods) up to about 26% (a typical saturated solution, depending on temperature).

Sea water is similar to a 3.5 percent brine solution. Fresh water also contains some amount of salt dissolved in it.

III. TREATMENT PRINCIPLES

Household water softeners are ion exchange devices. Ion exchange involves removing the hardness ions calcium and magnesium and replacing them with non-hardness ions, typically sodium supplied by dissolved sodium chloride salt, or brine. The softener contains a micro porous exchange resin, usually sulfonated polystyrene beads that are supersaturated with sodium to cover the bead surfaces. As water passes through this resin bed, calcium and magnesium ions attach to the resin beads and the loosely held sodium is released from the resin into the water. The softening process is illustrated in Figure 1.

After softening a large quantity of hard water the beads become saturated with calcium and magnesium ions. When this occurs, the exchange resin must be regenerated, or recharged. To regenerate, the ion exchange resin is flushed with a salt brine solution (Figure 1). The sodium ions in the salt brine solution are exchanged with the calcium and magnesium ions on the resin and excess calcium and magnesium is flushed out with wastewater.

IV. PERVAPORATION PROCESS

To purify sea water using materials that can be manufactured easily and cheaply in most countries, and a method that does not rely on electricity. The technology uses a method of separating liquids and solids called pervaporation.

Pervaporation processes are able to separate mixtures in contact with a membrane via preferentially removing one component from the mixture due to its higher affinity with, and/or faster diffusion through the membrane. In order to ensure continuous mass transport, very low absolute pressures are usually maintained on the downstream side of the membrane, removing all molecules migrating to the surface, and thus rendering a concentration difference across the membrane.

Pervaporation is a simple, two-step process.

FIRST STEP:

It involves filtering the liquid through a ceramic or polymeric membrane.

SECOND STEP:

It requires vaporizing and collecting the condensed water. Pervaporation is faster, cleaner and more energy efficient than conventional methods, not least because the heat required for the vaporization stage does not necessarily have to be electrically generated electricity. Pervaporation is not new – it has been in use for many years. But the membrane used in step one has been expensive and complicated to manufacture. The breakthrough in this is new salt-attracting membrane embedded with cellulose acetate powder for use in step one of the pervaporation process. Cellulose acetate powder is a fibre derived from wood pulp and is, cheap and easy to make in any laboratory .The membrane can quickly desalinate highly concentrated seawater and purify even badly contaminated seawater. It can also be used to capture pollutants and salt crystals to minimize pollution of the environment. The membrane can be used in very remote situations using fire to vaporize the water.

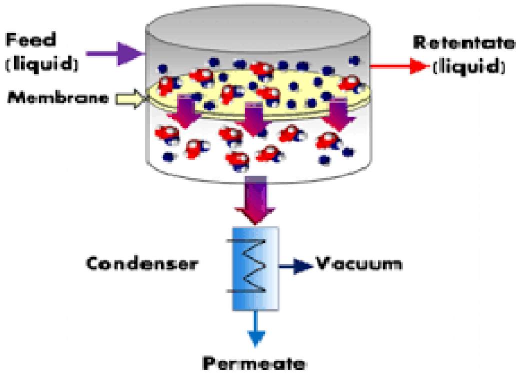

Fig1:Pervaporation Process

Figure 1

The main advantages of a pervaporation or vapour permeation process may be summarised as follows:

Since only the properties of the membrane determine the distribution of a component in the permeate phase, mixtures which at normal distillation form a zeotropes and require a large number of theoretical stages (like the dehydration of acetone), can easily and economically be separated even without the use of entrainers. Therefore, high product purity is obtained (no entrainer required) and no environmental pollution occurs (no entrainer emitted).

Multi component mixtures even with just small differences in boiling points can be dehydrated effectively and economically.

The feed mixtures to be treated may be supplied in either liquid (→ pervaporation) or vapour (→ vapour permeation) form.

Low energy consumption for pervaporation and vapour permeation processes.

Significantly reduced energy consumption for hybrid systems (pervaporation and vapour permeation in combination with rectification/distillation).

High degrees of flexibility regarding the feed mixtures that may be accommodated (multi-purpose systems, various feed mixtures can be treated in one unit), throughputs, and final product qualities.

Modularly, compactly designed, and factory-preassembled systems simplify their adaptation to suit the desired performance parameters and shorten the time required for system installation and start-up.

Pervaporation and vapour permeation systems are simple to operate and can be started up and shut down rapidly.

V. ADVANTAGES

Pervaporation process is a very effective pocess. It involves separation of Heat Sensitive Substances. No Chance of Product Contamination during the process. It involves Simple Process Schematics. No Need of Heavy Equipments (e.g. Distillation Columns, Condensers, Reboilers etc.).It is an energy Saving Process .It involves Low Operational temperature, pressure and flexibility in Operating System .It has low Operating Cost, low Maintenance Cost, low Capital Cost. This process is environment friendly and pollution free technique. (Green Separation Technique) It results in high purity product.

VI. DISADVANTAGES

Temperature reduction in Pervaporation reduces the transmembrane flux.

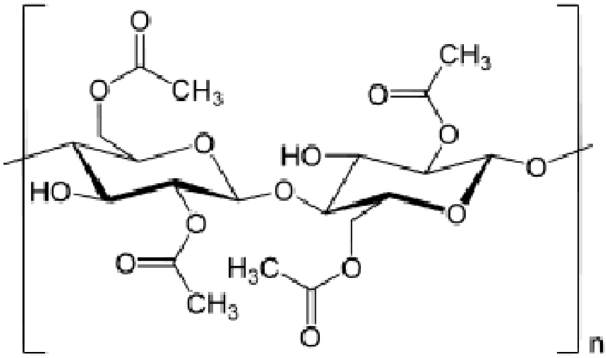

Fig2: Structural formula of cellulose acetate.

Figure 2

The chemical formula shows a section of cellulose with two acetyl groups per glucose module.

VII. APPLICATIONS

Pervaporation has a large list of industrial applications for the separation of liquid mixtures. Although it is a developing industrial membrane separation process but still its leading perspectives have compelled the industrialist to fabricate pervaporation plants which are effectively playing their role in production. Typical separations being conducted by pervaporation technique are separation of azeotropic mixtures in chemical process industries, organic-organic separation, separation of dissolved organics from water, separations in petroleum and petrochemical industries, increasing distillation column efficiency by hybrid pervaporation unit, increasing reaction yield by Perstillation and water and waste water treatment.

VIII. CONCLUSION

This present paper reviews pervaporation process.

Low energy consumption during pervaporation and vapour permeation processes. Due to the modular design of the membrane system even small units can operate economically

Pervaporation carried out to evaluate the separation performance of aqueous salt solution through the cellulose acetate membrane.

In general, pervaporation and vapour permeation will especially be used in removing salt from brine solution. Pervaporation and vapour permeation have been identified as areas of vast potential for future research and commercial development.

It is also an energy efficient combination of membrane permeation and evaporation. It's considered an attractive alternative to other separation methods for a variety of processes.

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