Difference Between Ultrafiltration and Reverse Osmosis

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Key Difference – Ultrafiltration vs Reverse Osmosis

Water purification is an important process in providing clean water to the community. There are many steps involved in the water purification process which includes biological, chemical and physical procedures. Ultrafiltration is the process in which water is filtered through a membrane filter to separate out molecules present in the water sample which has a molecular weight between 103 – 106 Da. Reverse osmosis is a procedure in which water is passed through a semi-permeable membrane against a concentration gradient. The Reverse osmosis membrane is capable of rejecting particles which have a molecular weight >300 Da. The **key difference** between the two procedures is the size of the particles filtered from the two membranes. **Ultrafiltration filters smaller molecules with low molecular weight whereas Reverse osmosis can filter out larger molecules with higher molecular weight.**

What is Ultrafiltration?

Ultrafiltration (UF) is a type of membrane filtration. It uses hydrostatic pressure to force liquid – water sample across the semi-permeable membrane. The membrane is composed of nitrocellulose with a small pore size of about 0.22µm or 0.45µm. Ultrafiltration is mainly used to remove bacteria and other organisms in the sample. It is also used to remove small ions, low molecular weight particles and organic matter which impart color, taste, and odor to water.

Figure 01: Ultrafiltration

The Ultrafiltration setup employs a hollow long fiber composed of a membranous material. The feed water flows either inside the cell or in the lumen of the fiber. The flow of water through the pores of the membrane filter will allow the suspended solutes and particles to retain. The filtered water and the low molecular weight particles pass through the membrane. The outlet water then undergoes other downstream purification procedures which include chemical treatment procedures.

The process of Ultrafiltration is ideally used for purifying and concentrating macromolecular (103 - 106 Da) solutions, especially protein solutions. The primary principal of separation is based on the size. The material in which the membrane is prepared can also sometimes have an effect on the filtration speed and efficiency.

The main advantages of Ultrafiltration are;

- It does not use chemicals to purify.
- It is based upon the simple process of size separation.
- It can be used to remove both particles and microorganisms.
- It can be automated.

What is Reverse Osmosis?

Reverse Osmosis is the process where a pressure greater than the hydraulic pressure is applied to the system in order to allow movement of water through a semi-permeable membrane. The movement takes place against a concentration gradient. The membranes which are used in reverse osmosis are termed as Reverse Osmosis (RO) Membranes. The materials which are commonly used to prepare commercial RO membranes are polyamide thin film composites (TFC), cellulose acetate (CA) and cellulose triacetate (CTA). Depending upon the type of membrane material the efficiency and the speed of the technique is altered.

Figure 02: Reverse osmosis

The reverse osmosis setup is composed of a hollow fiber with the membrane material being spirally wound around the fiber. These fibers are bound together to increase the surface area for reverse osmosis. Once the flowing water is subjected to high pressure, the water and small molecules pass through the semi-permeable membrane. This retains the large particles and the rest of the unwanted particles. The filtered water is then passed for downstream processing.

RO membranes can filter out virtually all particles including germs, organic matter, ions and other particulate matter. Filtration of large molecules upto a molecular weight of >300 Da is possible with reverse osmosis technique.

The advantages of reverse osmosis in water purification are,

- Cost-effectiveness.
- Can filter out almost all the particles including ions and heavy metals.
- Can be used to eliminate radioactive particles from water samples.
- Chemical usage is minimized.

What are the Similarities Between Ultrafiltration and Reverse Osmosis?

- Both are water purification techniques based on physical separation / filtration.
- Both utilize membranes in the filtration procedure.

- Both system setups are prepared in a hollow fiber coated with the membrane.
- In both procedures, particulate matter including organic, inorganic substances, ions, microbes and small dust or germ particles are filtered out and retained.
- The membranes used in both techniques are made of a cellulose material or a synthetic carbon material.

What is the Difference Between Ultrafiltration and Reverse Osmosis?

Ultrafiltration vs Reverse Osmosis	
Ultrafiltration is the process in which water is filtered through a membrane filter to separate out molecules present in the water sample.	Reverse osmosis is the process where the water is passed through a semi permeable membrane against the concentration gradient which is facilitated by high pressure.
Molecular weight of separated particles	
103 -106 Da	>300 Da

Summary - Ultrafiltration vs Reverse Osmosis

The techniques ultrafiltration and reverse osmosis are employed in the downstream processing of drinking water. The main purpose of both these techniques is to provide safe, drinking water for thepublic. Ultrafiltration uses a membrane filter to filter out very minute particles and especially microorganisms. Reverse osmosis can filter out large molecules and therefore is more cost effective and efficient.

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How to Cite this Article?

APA: Difference Between Ultrafiltration and Reverse Osmosis. (2017, October 17). Retrieved (date),from http://differencebetween.com/ difference-between-ultrafiltration-and-vs-reverse-osmosis/

MLA: "Difference Between Ultrafiltration and Reverse Osmosis" Difference Between.Com. 17 October 2017. Web.

Chicago: “Difference Between Ultrafiltration and Reverse Osmosis.” Difference Between.Com.http://differencebetween.com/ difference-between-ultrafiltration-and-vs-reverse-osmosis/ accessed(accessed [date]).