REVERSE OSMOSIS

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Definition:

Reverse osmosis (RO) is a membrane-technology filtration method that removes many types of large molecules and ions from solutions by applying pressure to the solution when it is on one side of a selective membrane. The result is that the solute is retained on the pressurized side of the membrane and the pure solvent is allowed to pass to the other side. To be "selective," this membrane should not allow large molecules or ions through the pores (holes), but should allow smaller components of the solution (such as the solvent) to pass freely.

“In the normal osmosis process, the solvent naturally moves from an area of low solute concentration (High Water Potential), through a membrane, to an area of high solute concentration (Low Water Potential). The movement of a pure solvent to equalize solute concentrations on each side of a membrane generates osmotic pressure. Applying an external pressure to reverse the natural flow of pure solvent, thus, is reverse osmosis. The process is similar to other membrane technology applications. However, there are key differences between reverse osmosis and filtration. The predominant removal mechanism in membrane filtration is straining, or size exclusion, so the process can theoretically achieve perfect exclusion of particles regardless of operational parameters such as influent pressure and concentration. Reverse osmosis, however, involves a diffusive mechanism so that separation efficiency is dependent on solute concentration, pressure, and water flux rate. Reverse osmosis is most commonly known for its use in drinking water purification from seawater, removing the salt and other substances from the water molecules.” (Crittenden)

Common Uses:

Around the world, household drinking water purification, including a reverse osmosis step, are commonly used for improving water for drinking and cooking.

Such systems typically include a number of steps:

- a sediment filter to trap particles, including rust and calcium carbonate
- optionally, a second sediment filter with smaller pores
- an activated carbon filter to trap organic chemicals and chlorine, which will attack and degrade TFC reverse osmosis membranes
- a reverse osmosis (RO) filter, which is a thin film composite membrane (TFM or TFC)
- optionally, a second carbon filter to capture those chemicals not removed by the RO membrane
- optionally an ultra-violet lamp for disinfecting any microbes that may escape filtering by the reverse osmosis membrane

In some systems, the carbon pre-filter is omitted, and cellulose triacetate membrane (CTA) is used. The CTA membrane is prone to rotting unless protected by chlorinated water, while the TFC membrane is prone to breaking down under the influence of chlorine. In CTA systems, a carbon post-filter is needed to remove chlorine from the final product, water.

Portable reverse osmosis (RO) water processors are sold for personal water purification in various locations. To work effectively, the water feeding to these units should be under some pressure (40 psi or greater is the norm). Portable RO water processors can be used by people who live in rural areas without clean water, far away from the city's water pipes. Rural people filter river or ocean water themselves, as the device is easy to use (saline water may need special membranes). Some travelers on long boating, fishing, or island camping trips, or in countries where the local water supply is polluted or substandard, use RO water processors coupled with one or more UV sterilizers. RO systems are also now extensively used by marine aquarium enthusiasts. In the production of bottled mineral water, the water passes through an RO water processor to remove pollutants and microorganisms. In European countries, though, such processing of Natural Mineral Water (as defined by a European Directive) is not allowed under European law. In practice, a fraction of the living bacteria can and do pass through RO membranes through minor imperfections, or bypass the membrane entirely through tiny leaks in surrounding seals. Thus, complete RO systems may include additional water treatment stages that use ultraviolet light or ozone to prevent microbiological contamination.

Membrane pore sizes can vary from 0.1 nanometres (3.9×10^{-9} in) to 5,000 nanometres (0.00020 in) depending on filter type. "Particle filtration" removes particles of 1 micrometre (3.9×10^{-5} in) or larger. Micro-filtration removes particles of 50 nm or larger. "Ultra filtration" removes particles of roughly 3 nm or larger. "Nano-filtration" removes particles of 1 nm or larger. Reverse osmosis is in the final category of membrane filtration, "Hyper-filtration", and removes particles larger than 0.1 nm.

In the United States military, Reverse Osmosis Purification Units are used on the battlefield and in training. Capacities range from 1,500 to 150,000 imperial gallons (6,800 to 680,000 l) per day, depending on the need. The most common of these are the 600 and 3,000 gallons per hour units; both are able to purify salt water and water contaminated with chemical, biological, radiological, and nuclear agents from the water. During a 24 hour period, at normal operating parameters, one unit can produce 12,000 to 60,000 imperial gallons (55,000 to 270,000 l) of water, with a required 4-hour maintenance window to check systems, pumps, RO elements and the engine generator. A single ROWPU can sustain a force the size of a battalion, or roughly 1,000 to 6,000 service members.

Current System used by Las Alamos Labs:

On February, 27 1998 LANL Radioactive Liquid Waste Treatment Facility (RLWTF) replaced its 30-year-old system with a new integrated membrane filtration system by SpinTek Systems. The system will be designed to treat 5 million to 8 million gallons of radioactive water per year generated by LANL research organizations.

The RLWTF system consists of a tubular cross-flow ultra-filter, a centrifugal microfilter and a spiral-wound reverse osmosis unit. The tubular system concentrates radioactive contaminants of the feed water 70 times and the centrifugal microfilter further concentrates this to l0,000 times. The reverse osmosis system polishes filtrate from both units.[3]

Our Proposal:

Basically we propose that the filter be changed to a a tow chamber system that should be much more cost effective. The system will consist of a Dead end nano filtration system that will be transported to the second chamber. This chamber will be a cross flow unit with a spiral wound grid, this grids pours will be coated in a positively charged sand paper, this will coat the negatively charged ions with a positive charge which should neutralize any contaminates. The use of flocculation is a reverse osmosis machine should increase efficiency.

Results:

We tested the ability for our machine to filter contaminates out of an 8 oz glass of water assuming that there are 7.2*10^23 atoms, which would be equal to 720,000,000,000,000,000,000,000 or seven hundred twenty octillion. Sadly the graph had no real value as there were points everywhere and there was no way to interpret the graph, we are still currently working on a remedy to the equation to demonstrate rate of filtration success.

The first algorithm that we wrote was basically to determine how many molecules passed over the defined line segment. The method that updates the molecules' positions also says that if they pass over the line segment plotted here within these specified boundaries, add 1 to the current count. The double to store the information of molecules through the permeable membrane a second is than entered into an algorithm to round out the decimals and then multiply it by 4 as when we put in the exact amount we got ArrayIndexOutofBounds Exception. To fix the loop we had running 300 times without a delay, we added a try/catch statement and defined Thread.Sleep(1000); to make the loop, loop through its declarations every 1000 milliseconds or 1 second.

Conclusion:

In conclusion our system is incapable of being tested due to miscalculations within the equation we entered into the script therefore when the process was looped it created very large numbers that were unable to be kept track of and spikes in both directions of the graph, our equation should be changed so that instead of representing a numbed it will represent a success percentage.

BIBLIOGRAPHY

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[2]; Council Directive of 15 July 1980 on the approximation of the laws of the Member States relating to the exploitation and marketing of natural mineral waters

[3]; http://www.spintek.com/article4.htm