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Opinion Article

Applications of Nano Filtration Membrane as a Water Treatment Solution

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DESCRIPTION

When in contact with the aqueous solution, ionizable groups on the surface of a Nano Filtration (NF) membrane, such as carboxylic acid, sulfonic acid, or amine, become charged as a result of the dissociation of functional groups. NF membranes can weaken the solution's ionic charge. NF membranes can also eliminate pollutants that are hard, organic, and particle-based. NF has been employed by numerous researchers to accomplish these goals. Some academics have looked at NF systems ability to soften groundwater. The outcomes were all accurate in their data. Multivalent ions had retentions of more than 90%, while monovalent ions had retentions of roughly 60%-70%. We compared NF membranes for water softening that use pellet softening and granular activated carbon. All approaches produced positive outcomes, but NF membranes provided a number of advantages in terms of health and cheaper investment costs.

Because NF membranes essentially eliminate all hardness, NF softening has the advantage of being able to soften a smaller stream of water. The use of NF membranes enables side-stream treatment because it is not necessary to remove hardness to extremely low values in municipal water treatment facilities. Only a fraction of the flow that has to be softened is then sent to the membranes, and permeate is subsequently mixed with the bulk flow stream to get the desired blended value. Contrarily, precipitated lime softening is unable to lower hardness below 50 mg/L $CaCO_3$, hence side-stream treatment is typically not feasible.

Pretreatment, membrane processes, and posttreatment are the three distinct subsystems that make up a conventional NF membrane system. Saline, surface, or groundwater desalination is the main use of NF membranes. Due to seasonal fluctuations or after being diluted by rain, surface waters frequently have an unstable chemistry or composition. Although the emphasis is on eliminating organics rather than softening, NF is a dependable alternative for surface water treatment. DBPs, or disinfection byproducts, are a major regulatory concern. In order to eliminate DBP precursors such as Natural Organic Matter (NOM), which can react with different disinfectants used in the water treatment process to create possible carcinogens, NF membranes are being employed more and more. For many utilities, NOM removal is a key goal in the water treatment process. Numerous studies have demonstrated that using NF alone can lower Total Organic Carbon (TOC) to under 0.5 mg/L.

Since organic carbon makes up the majority of both the precursors to DBP and the naturally occurring colour, NF is also more efficient than RO at softening lime. Semipermeable NF membranes have the capacity to screen bacteria and particle materials in the feed water despite not being porous. Numerous studies have supported this capability, including one that showed that NF membranes can remove viruses by between 4 logs and 5 logs. The phrase "nanofiltration" is actually a misnomer. When nanofiltration membranes are charged, osmotic removal occurs in addition to filtration, unlike with ultrafiltration membranes. As a result, they bridge the gap between reverse osmosis and ultrafiltration membranes in the spectrum of membrane treatment options. In general, the membrane material (charge of the membrane), concentration polarisation at the membrane face (buildup of concentration at the membrane face), and fouling of the membrane are few main elements that determine the performance of the membranes. Therefore, the elimination of components cannot be predicted just by pore size.

There is no easy approach for estimating removals because each manufacturer's membranes are slightly different, further complicating the issue. When building a system to concentrate on a particular ingredient, pilot testing of the nanofiltration membranes is essential. The industry currently offers a wide variety of nanofiltration membranes, with a variety of alternatives for focusing bulk removals of certain elements or groups of elements. Even though existing, reverse osmosis technology can filter out more of the same elements than nanofiltration membranes, this approach might not be the best one. In addition to the problematic elements, reverse osmosis membranes significantly reduce hardness and dissolved minerals, resulting in water that is aggressive toward concrete and metal conduits.

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Then, some of these minerals and hardness must be reintroduced through treatment systems. The effort to exceed the water quality goal and then bring it back to a usable level is wasted as a result. Constituent-specific membranes are a possibility because of recent advances in membrane technology. Since the early nanofiltration membranes could only remove 20 percent of the salt, membrane companies have created nanofiltration membranes that can remove 95 percent of the salt. The use of embedded "nanoparticles" in reverse osmosis membranes has also been studied, and it has shown promise in lowering transmembrane pressure and raising flow. Similar enhancements to the flux and removal efficiency of nanofiltration might be made by this kind of technology.