

ROCKERHILL

Ultrafiltration System

Maximizing Flexibility, Reliability and Efficiency

What is Nanofiltration



A nanofiltration (NF) system is a type of membrane filtration that uses a semi-permeable membrane to separate substances based on their size and sometimes charge. It falls between ultrafiltration and reverse osmosis in terms of pore size, effectively removing divalent ions (like calcium and magnesium), some monovalent ions (like sodium and chloride), organic molecules, and other contaminants. Nanofiltration is used in various applications, including water softening, wastewater treatment, and purification in industries like food, pharmaceuticals, and textiles.

The benefits of using Nanofiltration

1. Targeted Removal with High Efficiency

- **Removes hardness ions (Ca^{2+}, Mg^{2+})**: Softens water without chemicals (e.g., for boilers, textiles, or preventing scale in appliances).
- **Rejects divalent salts (SO_4^{2-}) & organics**: Removes 90–98% of sulfates, pesticides, dyes, antibiotics, and natural organic matter (NOM).
- **Partial salt reduction**: Retains beneficial monovalent ions (e.g., sodium, potassium) in drinking water or food processing.

2. Lower Energy Costs vs. Reverse Osmosis (RO)

- Operates at **5–30 bar pressure** (vs. RO's 15–80+ bar), reducing pumping energy by **20–50%**.
- Ideal for brackish water or applications not requiring ultra-pure water (e.g., municipal drinking water).

3. Reduced Fouling & Longer Membrane Life

- Larger pores than RO allow higher flow rates and easier cleaning.
- Charge-based rejection (Donnan effect) repels organics/colloids, slowing fouling.

4. Minimal Chemical Usage

- Replaces lime/soda softening or ion-exchange resins, avoiding chemical sludge and regeneration waste.
- Environmentally friendly for industries like dairy, beverages, or pharmaceuticals.

5. Concentrate Recovery & Resource Efficiency

- **Gentle concentration**: Preserves heat-sensitive compounds (e.g., vitamins in fruit juice, proteins in whey).
- **Salt fractionation**: Separates divalent/monovalent ions in mining or wastewater recovery.

6.Cost-Effectiveness

- Lower capital/operational costs than RO for partial desalination.
- Reduced scaling risk extends equipment life and cuts maintenance.



How Nanofiltration Works

1. Feed Solution:
A solution containing various substances (like water with dissolved salts, organic molecules, etc.) is passed through the nanofiltration membrane.

2. Semi-permeable Membrane:
The membrane has tiny pores that act as a molecular sieve. The size of these pores is crucial for separation.

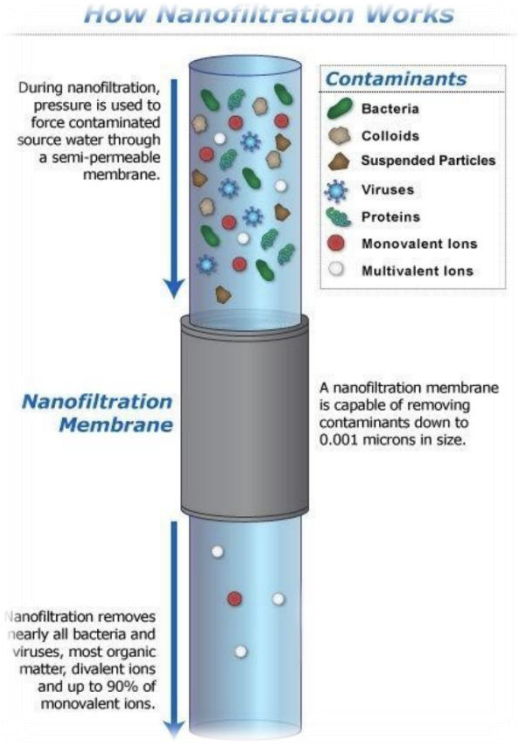
3. Pressure:
Pressure is applied to the feed solution to force it through the membrane. This pressure overcomes the osmotic pressure and drives the flow of the solvent (usually water) and smaller solutes through the membrane.

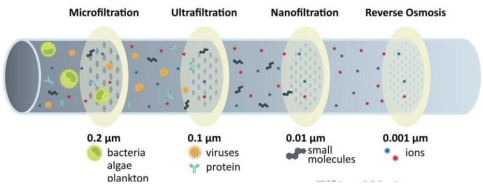
4. Separation:
Larger molecules and ions, as well as some smaller ones based on their charge, are unable to pass through the membrane's pores and are retained on the feed side. This concentrated solution is called the retentate or concentrate.

5. Permeate:
The water and smaller solutes that pass through the membrane are called the permeate. This stream is now cleaner than the original feed solution.

6. Key Separation Mechanisms:
Nanofiltration relies on a combination of size exclusion (molecules too big to fit through the pores), and the Donnan effect (charge-based repulsion of ions).

In essence, nanofiltration selectively allows smaller molecules and ions to pass through the membrane while rejecting larger ones, effectively purifying the water and separating out specific components of the feed solution.





Applications of NF System

- Drinking Water Treatment
- Wastewater Reclamation
- Dairy & Beverage:
- Pharmaceuticals
- Oil & Gas
- Biotech



Choosing the Right NF System

1. **Analyze Feed Water**: Test composition (TDS, hardness, organics, pH).
2. **Define Goals**: Clarify targets (e.g., softening, partial desalination, contaminant removal).
3. **Size & Capacity**: Match flow rate needs (e.g., 1 m^3/hr vs. 100 m^3/hr).
4. **Membrane Selection**: Pick materials (e.g., polyamide) based on rejection rates and fouling resistance.
5. **Pre-treatment**: Include UF/media filters if feed has high turbidity/organics.
6. **Energy & Costs**: Opt for low-pressure membranes if energy savings are critical.
7. **Industry-Specific Needs**: Prioritize food-grade/compliance for sensitive sectors.
8. **Modular Design**: Ensure scalability for future expansion.

Customization of NF Systems



1. Membrane Specifications:
- **Pore size** (0.01–0.1 µm) tailored to remove target contaminants (e.g., 0.03 µm for viruses).
- **Material choice**: PVDF for chemical/chlorine resistance; PES for low-fouling applications.

2.System Design:
- **Configuration**: Hollow fiber for municipal water; spiral-wound for high-viscosity fluids (e.g., dairy, biopharma).
- **Skid-mounted vs. containerized**: Modular setups for space-constrained sites.
- **Material compatibility**: Stainless steel for food/medical; FRP for corrosive environments.



3.Flow & Pressure:
- Adjustable **feed pumps** and **valve controls** to handle specific flow rates (1–1,000+ m^3/day).
- Optimized **transmembrane pressure** (TMP) for energy efficiency.

4. Automation & Integration:
- **PLC/SCADA controls** for auto-backwash, chemical cleaning, and remote monitoring.
- Integration with **pre-treatment** (e.g., activated carbon) or **post-treatment** (e.g., RO).

5. Compliance & Certifications:
- Meet industry standards (e.g., NSF/ANSI 61 for drinking water, FDA for food).





Project Reference



Hefei Gongyi power plant project

- Owner: Hefei Gongyi group
- Commissioning by: 2014
- Total treatment capacity :1,000 t/day,
- Process: UF+NF+RO
- Recovery rate: 55%
- Application: power plant



Jiangsu yancheng water treatment plant project

- Owner: Yancheng municipality
- Commissioning by: 2014
- Total treatment capacity :1,200 t/day,
- Process: UF+NF+RO
- Recovery rate: 55%
- Application: Sea water desalination



Fujian Jinmen No.1 water treatment plant project

- Owner: Xiamen municipality
- Commissioning by: 2019
- Total treatment capacity :1,300 t/day,
- Process: UF+NF+RO
- Recovery rate: 65%
- Application: Sea water desalination

Project Reference

Henan Zhengzhou industry park sewage treatment plant project

- Owner: Zhengzhou municipality
- Commissioning by: 2021
- Total treatment capacity :1100 t/day,
- Process: UF+NF+RO
- Recovery rate: 65%
- Application: Factory waste water



Oman Sea water desalination project

- Owner: Oman
- Commissioning by: 2017
- Total treatment capacity :1100 t/day,
- Process: UF+NF+RO
- Recovery rate: 60%
- Application: Sea water desalination



Dali Power Plant project

- Owner: Dali power plant
- Commissioning by: 2019
- Total treatment capacity :800 t/day,
- Process: UF+NF+RO
- Recovery rate: 70%
- Application: power plant



ROCKERHILL®

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Advanced water treatment solutions



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