



Nafion™

**Ion Exchange
Materials**

Product Bulletin P-01

Ion Exchange Membranes Product Overview

Technology that enables today's
most demanding applications.



Chemours™



Product Information

Introduction

Nafion™ membranes are made from ion exchange polymers. The perfluorinated polymer provides chemical and thermal stability similar to that of Teflon™ fluoropolymer resin. Attached to the polymer chains are perfluorinated cation exchange sites that provide permeability to many cations and polar compounds, while almost completely blocking transport of anions and nonpolar species. Therefore, membranes made from these polymers are used to selectively transport materials, with mobility determined by the size and electrical properties of the material passing through.

Nafion™ membranes are thin polymer films that are usually reinforced with a chemically durable fabric. They are useful as separators in a wide range of applications. In a typical membrane process, a fluid containing one or more components is in contact with one side of the membrane. The membrane is normally more permeable to one

component than the others. The preferred component is transferred through the membrane under the influence of a driving force, such as concentration difference, electric potential, or hydrostatic pressure.

Nafion™ Membranes for Production of Chlorine and Caustic

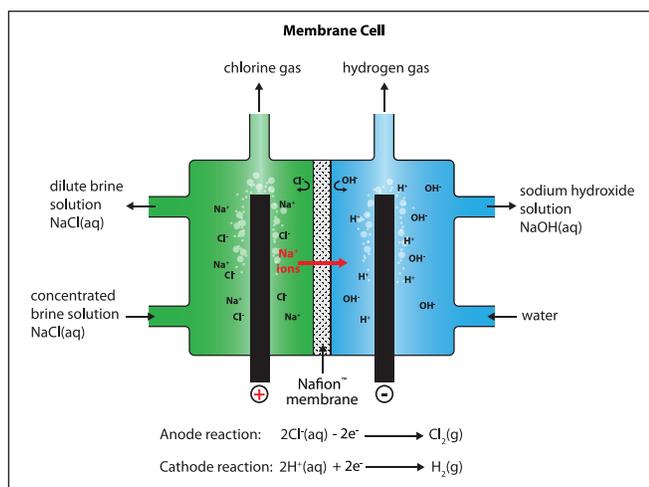
The primary application for Nafion™ membranes is production of chlorine and caustic by electrolysis, as illustrated in Figure 1. This technology is environmentally sound and has become the preferred method for chlorine and caustic production, having significant operating cost advantages over the older mercury and diaphragm technologies.

Chemours introduced the world's first commercial perfluorinated ion exchange membrane in 1969, capping a 10-year research and development effort. Nafion™ membranes were first used in a commercial chlor-alkali plant in 1975.

Nafion™ 900 and 2000 series membranes are designed to give optimum performance in the production of chlorine and caustic soda (NaOH). They are reinforced composite membranes, having sulfonate and carboxylate polymer layers, as shown in Figure 2. They also have surface modifications to enhance gas release from the membrane. Descriptions and laboratory cell performance for chlor-alkali membranes used in caustic soda production are shown in Tables 1 and 2.

Nafion™ 400 and 500 series membranes are reinforced, all-sulfonate polymer membranes designed for dilute caustic soda and caustic potash (KOH) production. Nafion™ 500 series membranes have surface modifications on both sides for enhanced gas release.

Figure 1. Nafion™ Membranes in Chlor-Alkali Electrolysis



Recommendations for KOH operation are different than for NaOH. Refer to technical bulletin T-09, "Nafion™ Perfluorinated Membranes for KOH Production."

Figure 2. Structure of Nafion™

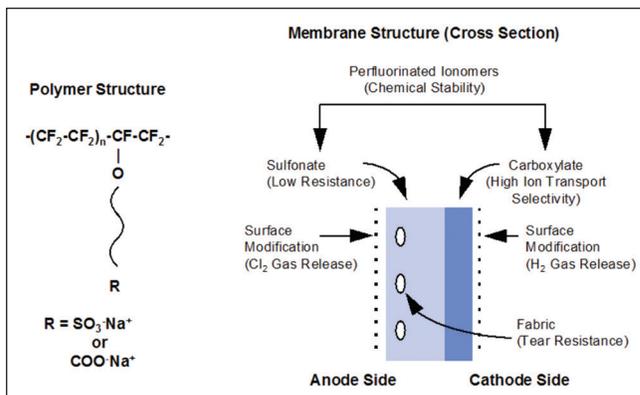


Table 1. Features of Nafion™ Membranes for Chlorine and Caustic Soda Production

Membrane Type	Features
Nafion™ N966	Very high strength provides easier handling and more resistance to operational physical upsets.
Nafion™ N982	Polymers proven to give excellent performance, even in challenging brine conditions. Excellent durability and proven long and stable performance.
Nafion™ N2030	Same strength and proven polymers as Nafion™ N982, with lower voltage.
Nafion™ N2050	Same ion exchange polymer and fabric reinforcement as Nafion™ N2030, with lower voltage.
Nafion™ N2060	Lowest-voltage Nafion™ membrane, using new high elasticity reinforcement and optimized membrane polymer.

Note: All membranes are surface modified on the anode and cathode side for gas release and can be used in finite and zero gap applications.

Table 2. Laboratory Performance Comparison

Membrane Family	Test Conditions	Membrane Type	Cell Voltage, V	Current Efficiency, %
High Durability	Legacy 0.0045 m ² test cell, 4 kA/m ²	Nafion™ N966	<3.30	>96
		Nafion™ N982	<3.15	>96
High Performance	Modern 0.01 m ² test cell, 6 kA/m ²	Nafion™ N2030	<3.02	>96
		Nafion™ N2050	<2.96	>96
		Nafion™ N2060	<2.92	>96

Conditions: 0 mm gap, DSA anode, 32% NaOH, 200 g/L anolyte, 90 °C (194 °F)

Other Applications for Nafion™ Membranes

Other applications for Nafion™ membranes include electrochemical syntheses, water electrolysis, spent acid regeneration, metal ion recovery, and fuel cells. To meet the diverse end-use applications for Nafion™ membranes, a variety of process-specific membranes have been developed, including:

- Nafion™ 100, 200, and 1000 series sulfonate membranes are used for H₂O electrolysis and fuel cells.
- Nafion™ 400 series membranes are reinforced sulfonate films that are frequently applied to spent acid regeneration, metal ion recovery, HCl electrolysis, production of 8–10% NaOH, and production of 30–32% KOH.

Available Forms of Nafion™ Membranes

Nafion™ membranes are available in various forms, depending on the intended use. For instance, there are different ionic forms of Nafion™ membrane available, including H⁺, Na⁺, and K⁺. Likewise, membranes are provided in different states of pretreatment, including dry, wet (WX and PW), and dry expanded (TX).

Contact your Nafion™ membrane representative for more information on membrane forms available in your application and for technical support in membrane selection.¹

Size and Packaging

Nafion™ membranes are available in custom sizes, with widths up to 1.5 meters and lengths up to 4 meters.

Dry sheets are rolled on fiberboard tubes, wrapped with a polyethylene sheet, and shipped in a plastic tube.

WX membranes are shipped wet in a pH 10 solution. PW membranes are shipped wet in a pH neutral solution. Small sheets are sealed in polyethylene pouches and shipped flat in wooden containers. Large sheets are rolled on plastic tubes, wrapped with a polyethylene sheet, and shipped in a watertight plastic container.

TX membranes are shipped dry and rolled on a polyethylene-covered fiberboard tube, wrapped with a polyethylene sheet, and shipped in a plastic container.

Chlor-Alkali Operation Using Nafion™ Membranes

Refer to technical bulletin T-10, "Nafion™ User's Guide," for detailed information regarding the use of Nafion™ membranes for chlor-alkali production.

¹ Additional resources available with detailed information on specific Nafion™ forms:

Dry H⁺ — Technical bulletin T-08, "Nafion™ Hydrogen-Form Membrane Expansion"

Dry Na⁺ — Technical bulletin T-06, "Nafion™ Sodium-Form Membrane Expansion in Alkaline Water"

WX — Technical bulletin T-04, "Nafion™ Membrane WX Products"

K⁺ — Technical bulletin T-09, "Nafion™ Perfluorinated Membranes for KOH Production"

TX — Technical bulletin T-05, "Nafion™ Membrane TX Products"

The Nafion™ Ion Exchange Materials Advantage

As you face the pressure to lower costs and reduce downtime, Nafion™ membranes deliver the efficiency and dependability you need to get the most out of your product and plant.

Cost-effectiveness: Nafion™ membranes are designed to provide superior voltage and current efficiency performance throughout the life of the membrane, making your production more cost efficient. Mechanical durability and stable performance reduce process interruptions and maintenance downtime, for a lower total cost of ownership.

Experience: As the inventors of ion exchange membranes, we have over 50 years of knowledge and experience. You can feel confident that you will be getting well-designed, quality membranes from us.

Reliability: With the backing of Chemours, we have a fully integrated supply chain and strong access to high-quality upstream raw materials. So you can always count on a reliable and stable supply of Nafion™ membranes when you need it.

Support: Whether it is through pre-sales consultations, membrane installations, technical troubleshoots, or routine site visits, our dedicated technical service team is willing to spend the time to help you pick the right membrane and optimize its performance over time.

It's time to let the future in.
Won't you join us?

Visit [Nafion.com](https://www.nafion.com) or call one of our technical experts.

The data listed here fall within the normal range of product properties, but they should not be used to establish specification limits nor used alone as the basis of design. This information is based on technical data that Chemours believes to be reliable. It is intended for use by persons having technical skill and at their own discretion and risk. This information is given with the understanding that those using it will satisfy themselves that their particular conditions of use present no health or safety hazards. Because conditions of product use are outside our control, Chemours makes no warranties, express or implied, and assumes no obligation or liability in connection with any use of this information or for results obtained in reliance thereon. The disclosure of the information is not a license to operate under or a recommendation to infringe any patent of Chemours or others.

Medical Statement: Please contact your Chemours representative to discuss limitations regarding medical applications.

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