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HYDRANAUTICS
High Performance Membrane Products
A Nitto Denko Corporation

New!

LFC Low Fouling Composite Membrane Series

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LFC – Low Fouling Composite Membrane Series

LFC (Low Fouling Composite) membrane series represents another breakthrough in the long line of Hydranautics' advanced polymer membrane achievements. This product release is intended to educate customers on the applications and product offerings of the LFC membrane series.

Description

LFC represents Low Fouling Composite. LFC membranes have all the advantages of composite membrane technology – low pressure, high flow, and high rejection, in addition to membrane chemistry advances that enhance resistance to fouling. The line consists of two product types: LFC1 and LFC2. Both membranes have the same durable aromatic polyamide composition as traditional composite RO membrane material. However, unlike negatively surface charged traditional composite RO membranes, the LFC1 membrane surface has a neutral charge, while the LFC2 membrane surface has a cationic charge.

LFC's flow and operating pressure is comparable to that of CPA2 elements (10,000 to 11,000 GPD/37.8 – 41.6 m^3/d). LFC1 rejection is in the range of an ESPA1 element (99.0% minimum). LFC2 rejection varies with type and concentration of the feed solute.

Product Offering

Hydranautics offers two types of 8 inch Low Fouling Composite membrane: LFC1 and LFC2. For smaller systems, LFC1-4040 and LFC2-4040 are also offered. The following table presents flow, area, and rejection specifications for the LFC family of products.

Designation	Area - ft^2 (m^2)	Flow - GPD (m^3/d)	% Minimum Rejection
8 inch models			
LFC1	365 (33.9)	10,000 (37.8)	99.0
LFC2	365 (33.9)	11,000 (41.6)	95.0
4 inch models			
LFC1-4040	85 (7.9)	2,300 (8.7)	99.0
LFC2-4040	85 (7.9)	2,500 (9.5)	95.0

*All elements tested at 225 psi, 25 C, 15% product recovery, pH 6.5-7.0, on water of 1500 ppm NaCl for 30 minutes.

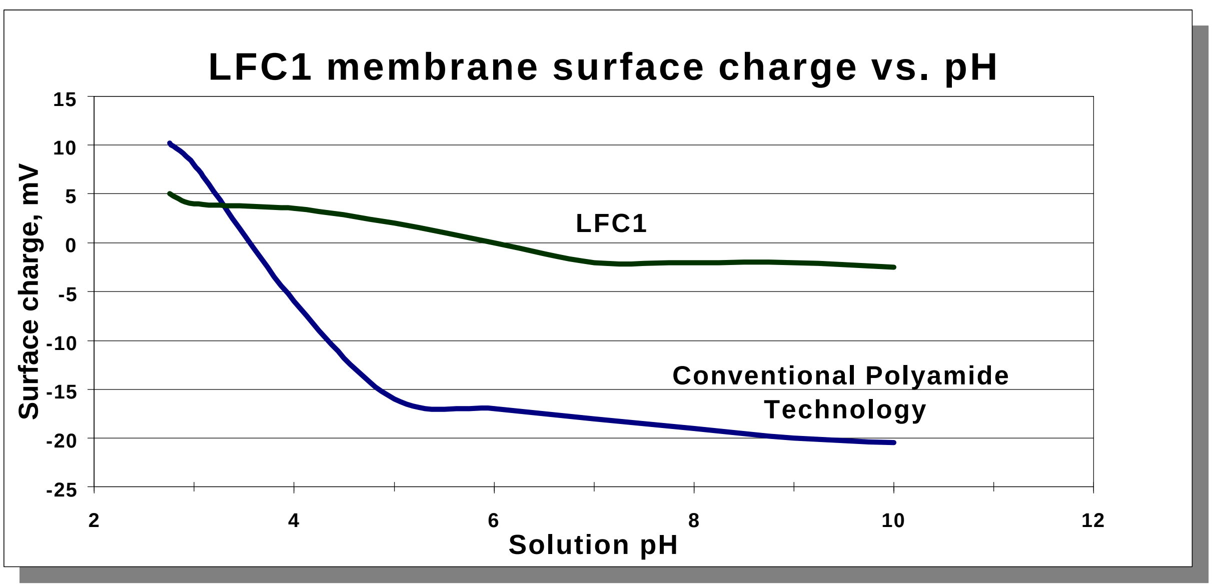
In 1998, all 4040 elements will be fiberglass wrapped.

LFC1

Neutrally charged, LFC1 is designed to minimize the adsorption of organic foulants onto the membrane surface. Flux degradation due to build up of organic foulants is minimized. This section presents data that compares the new LFC1 to conventional membrane technology regarding fouling resistance and surface charge. First, data showing how the surface charge changes with respect to pH is presented. Then, information on how LFC1 responds to different types of foulants will be given. Finally, actual field data on wastewater is offered to show how LFC1 performs under real world conditions as compared to conventional composite membranes.

pH Effects

The neutral surface charge of LFC1 membrane is preserved over both acidic and basic pH environments as demonstrated in Graph 1. This means that a system designer can be assured of preserving the neutral charge of LFC1 no matter what the feedwater pH. A graph of how conventional membranes' surface potential changes with a change in pH is given for comparison.



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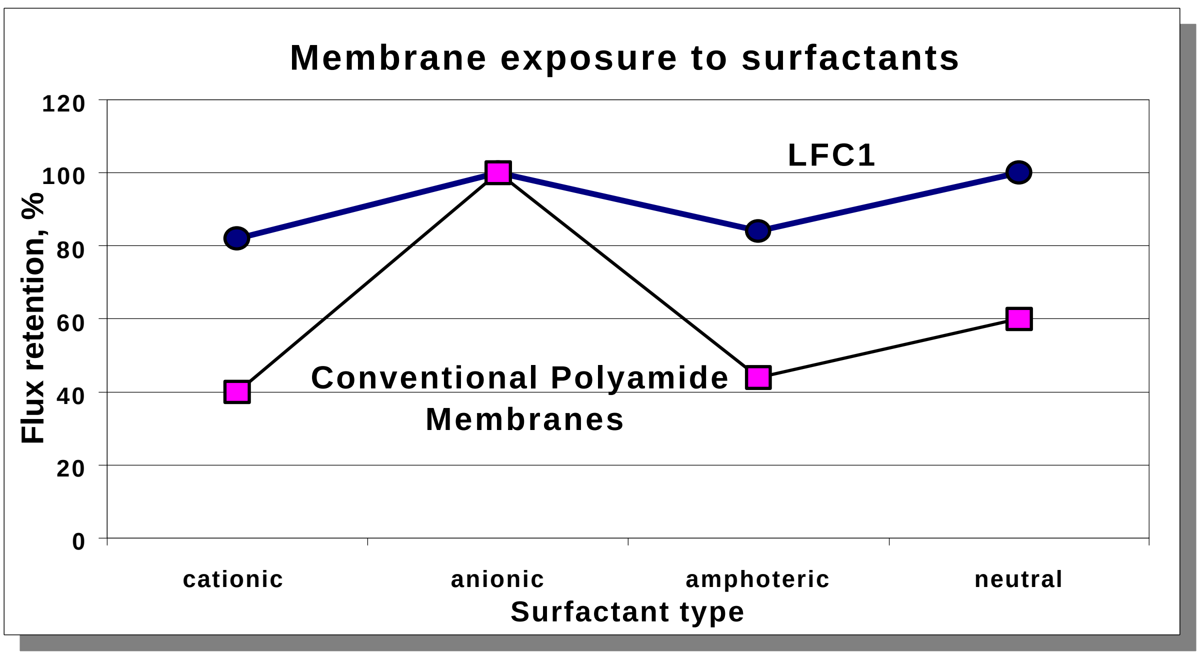
Graph 1: *LFC1 membrane charge as a function of pH compared to conventional technology*

Foulant Chemical Properties

The type of foulant can have a profound effect on the flux of a membrane. The following chart shows how LFC1 resists fouling of compounds with different charge properties. The performance of an anionically charged polyamide membrane is given for comparison.

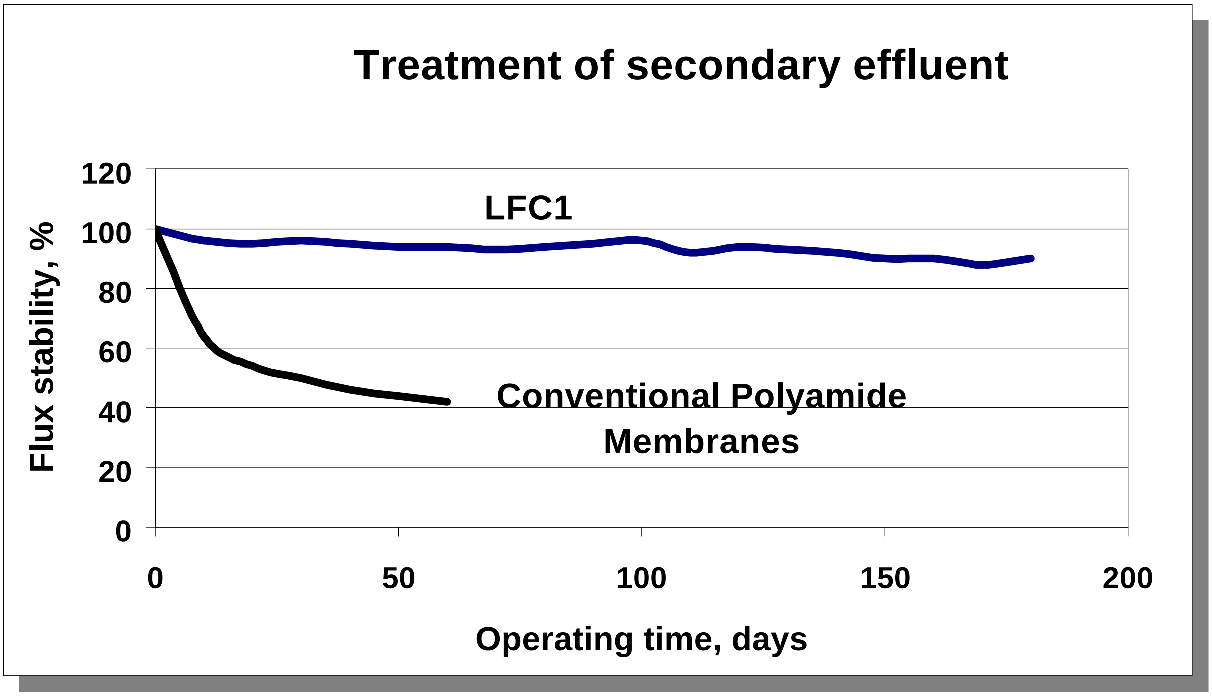
While an anionically (negatively) charged membrane can retain flux in the presence of anionic surfactants, it loses significant flux after being exposed to cationic (positively) charged, amphoteric (i.e., those compounds that can be either positive or negative depending on pH), or neutrally charged surfactants. LFC1 membrane, however, retains a significant percentage of flux regardless of the type of surfactant present.



Graph 2: *Surfactant effects on LFC1 and conventional membranes.*

Flux Stability

In field operation on treated secondary effluent, LFC1 maintains flux stability while traditional composite RO membranes experience a sharp flux decline immediately. As illustrated by the following graph, LFC1 membrane maintains flow in a high fouling environment over significant lengths of time.



Graph 3: Use of the LFC1 in the treatment of secondary effluent
<u>Conditions for both elements</u>: 13 gfd at 200 psi and 25° C

Applications

Applications of LFC1 membrane elements include treatment of municipal wastewater, boiler blow-down, and high fouling surface waters. Many applications typically utilizing Cellulose Acetate (CAB) membrane can benefit by the introduction of LFC1 membrane. Using LFC1 membrane in place of CAB membrane has the advantage of lower feed pressure combined with higher flow and rejection. Another significant advantage is that LFC1 is not limited to operation between pH 4-6. Both costly acid consumption and specialized control mechanisms to prevent membrane degradation due to operation outside these limits are eliminated.

The membrane is composite polyamide; therefore, free chlorine cannot be used in systems operating with LFC. However, chloramines may be used to control biological activity under some conditions. Please contact Hydranautics for guidance on when chloramine use is acceptable.

LFC2

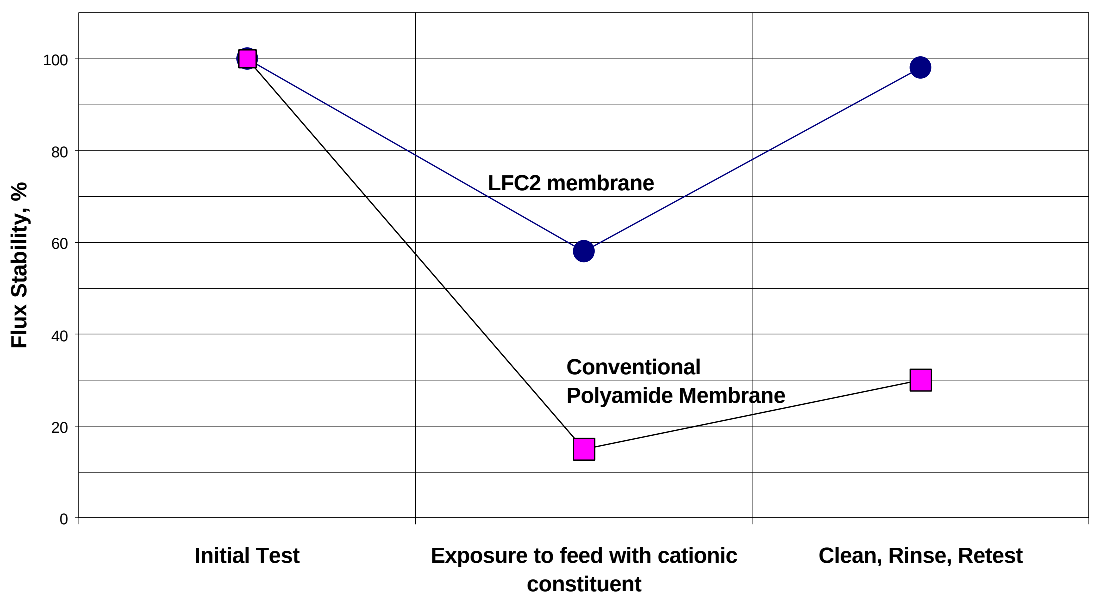
LFC2 membrane is a cationically (positively) charged polyamide. Positive charge creates unique properties not found in traditional anionically charged membranes. When exposed to cationic surfactants, the flux of LFC2 membrane can be restored after cleaning. With anionically charged membranes, flux cannot be restored. Secondly, at low TDS, LFC2 rejects sodium and other positive ions more effectively than other anionically charged high rejecting membranes.

Due to the charge of the membrane, it is recommended to avoid the use of anionic polymers with LFC2 as they may irreversibly foul the polymer if they contact the membrane surface.

Flux Stability in the Presence of Cationic Polymers

As illustrated by Graph 4, LFC2 membrane is able to regain flux after contact with cationic polymers. Also, the loss in flow associated with this type of fouling prior to cleaning is far less than the severe loss associated with anionic membranes.

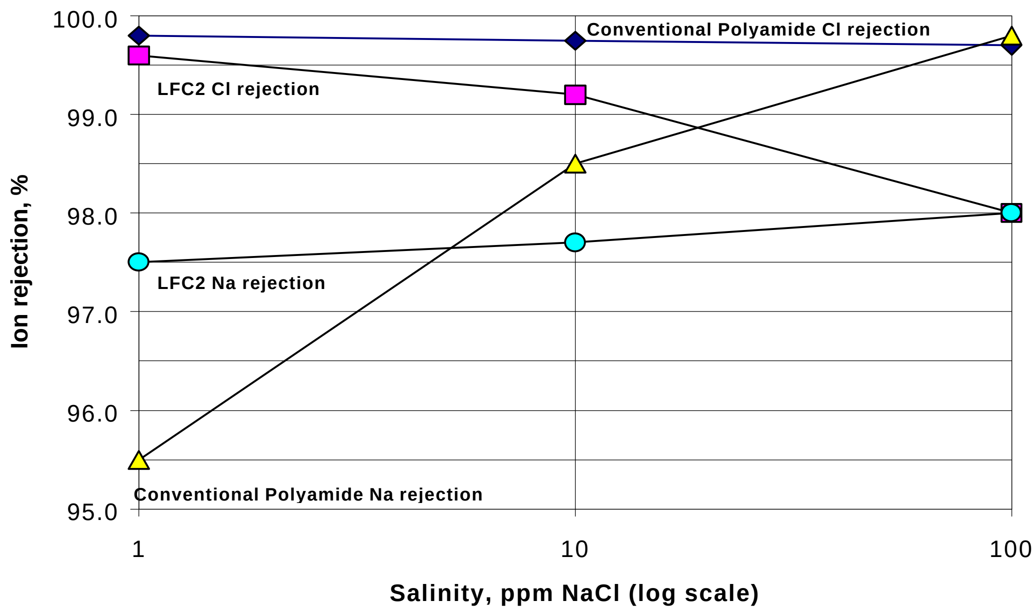
Graph 4: Restoration of Flux after Cationic Polymer and Cleaning



Rejection as a Function of Salinity

Although LFC2 membrane has an advertised minimum salt rejection of 95% at standard test conditions (1500 ppm NaCl TDS and 225 psi), it has higher rejection than a conventional anionic polyamide membrane at very low TDS. A conventional membrane can have very high rejection (>99.5%) at TDS over 100 ppm. However, the rejection of sodium falls substantially at a TDS less than 10 ppm. As a result, overall rejection also suffers. LFC2, due to its surface charge, provides a higher rejection of sodium at low concentrations. Overall rejection is better than a conventional polyamide at low TDS values. LFC2 provides better rejection than conventional polyamide membranes when operating in the second pass of a two-pass RO system. Graph 5 illustrates this point.

~~Graph 5~~: LFC2 Membrane Rejection vs. Salinity



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