

ภาคผนวก ก

ข้อมูลทางด้านเทคนิคของระบบ

(1) RO membrane

quantity	1 pcs
manufacturer	FILMTEC RO membrane, The Dow Chemical Company, USA
configuration	spiral wound
type	Reverse Osmosis
feed spacer	...-...ml
active area	... ๗.๖ m ²
diameter/length	4" x 40"

(2) Membrane housing

quantity	1 set
material of construction	fiber glass
size	40 in. in length, 4 in. in diameter
number of membrane per module	1

(3) Feed/circulation tank

quantity	1 set
working volume (maximum)	25 liters
material of construction	SS304
tank accessories:	
feed / recycle inlet valve (½ in.)	2 pc
drain / outlet valve (½ in.)	2 pc

(4) Permeate tank

quantity	1 set
working volume (max)	25 liters
material of construction	SS304
tank accessories:	
drain / outlet valve (½ in.)	1 pc

(5) Feed pump

quantity	1 set
manufacturer	ABE ELECTRIC CO. LTD.
Model	CPM-130
type	horizontal centrifugal
material	-
flow	100 L/min
pressure	2.0 bar
power	0.37 kW

(6) High pressure pump

quantity	1 set
manufacturer	Salmson
model	MULTI-V214-FSE12
type	Vertical centrifugal
material	stainless steel
maximum flow	5 m ³ /hr
maximum pressure	25 bar
power	2.2 kW (3 HP)

(7) 50 micron filter

quantity	1 set
manufacturer	USFilter, Plymouth Products
filter housing model	20 in. Opaque Slim Line, Polypropylene
maximum pressure	8.8 bar (880 kPa)
catridge filter model	Series FC FilterCor, 1 pc

(8) Instruments – accessories – control

(8.1) flow meter 1 pcs

(8.2) pressure gauges

quantity	1 pcs.
manufacturer
model

range 0-50 bar

(8.3) frequency inverter

quantity 1 set

manufacturer HITACHI

model SJ100

(9) Piping and valve system

(9.1) high pressure piping and fitting

material SS304

(9.2) low pressure piping and fitting

material PVC sch.80

(9.3) permeate valve

quantity 1 pc

material SS 304, ½"

(9.4) concentrate control valve

quantity 1 pc

material SS 304, ½"

(10) Control panel

The control panel includes:

- main power switch
- electrical components push buttons and lamps

ภาคผนวก ข

ผลการตรวจคุณภาพน้ำบาดาล

โดยศูนย์อนามัยสิ่งแวดล้อม เขต 12

เดือน สิงหาคม และเดือนกันยายน 2545

รายงานผลการวิเคราะห์คุณภาพตัวอย่างน้ำบริโภค

กลุ่มงานวิเคราะห์คุณภาพและสิ่งแวดล้อม ศูนย์อนามัยสิ่งแวดล้อมเขต 12

ตัวอย่างที่.....988.....สัญลักษณ์ห้องทดลอง.....สัญลักษณ์ผู้ส่ง.....HDW/998.....
 หน่วยงานที่ส่ง.....รพ.สทิงพระ.....ประเภทน้ำ.....บาดาล.....
 ชื่อแหล่งน้ำดิบ.....ชื่อกาปรปะปา.....
 สถานที่เก็บ.....โรงพยาบาลสทิงพระ.....ตำบล.....อำเภอ.....สทิงพระ.....จังหวัด.....สงขลา.....
 วันที่เก็บ.....เวลา.....น. วันที่ส่ง.....23 ส.ค. 45.....เวลา.....น.วันที่รับตัวอย่าง.....24 ส.ค. 45.....

พารามิเตอร์ที่ตรวจวิเคราะห์	หน่วย	ผลการวิเคราะห์	เกณฑ์คุณภาพน้ำประปากรมอนามัย	วิธีที่ตรวจวิเคราะห์	วันที่วิเคราะห์
ความเป็นกรดต่าง (pH)	-	7.0 / 7.2	6.5 - 8.5	Electrometric	
สี (Colour)	(แพลตตินัมโคบอลต์)	5	15	Visual Comparison	
ความขุ่น (Turbidity)	(เอ็นทียู)	1.64 / 1.61	10	Nephelometric	
ปริมาณสารละลายทั้งหมดที่เหลือจากการระเหย (TDS)	(มก./ล.)	4664 / 5073	1,000	Gravimetric	
ความกระด้าง CaCO ₃ (Hardness)	(มก./ล.)	720 / 725	500	EDTA Titrimetric	
เหล็ก (Fe)	(มก./ล.)	0.37	0.5	AAS (FLAME)	
แมงกานีส (Mn)	(มก./ล.)	0.47	0.3	AAS (FLAME)	
ทองแดง (Cu)	(มก./ล.)	0.14	1.0	AAS (FLAME)	
สังกะสี (Zn)	(มก./ล.)	1.2	3.0	AAS (FLAME)	
ตะกั่ว (Pb)	(มก./ล.)	0.01	0.03	AAS (FLAME)	
โครเมียม (Cr)	(มก./ล.)	0.02	0.05	AAS (FLAME)	
แคดเมียม (Cd)	(มก./ล.)	0.001	0.003	AAS (FLAME)	
สารหนู (As)	(มก./ล.)	-	0.01	AAS (Hydride - Generation)	
ปรอท (Hg)	(มก./ล.)	-	0.001	AAS (Hydride - Generation)	
ซัลเฟต (SO ₄ ²⁻)	(มก./ล.)	✓ 160	250	Turbidimetric	
คลอไรด์ (Cl ⁻)	(มก./ล.)	552 / 560	250	Argentometric	
ไนเตรท (NO ₃ ⁻ as NO ₃ ⁻)	(มก./ล.)	0.1	50	Ion Selective Electrode	
ฟลูออไรด์ (F ⁻)	(มก./ล.)	1.22	0.7	Ion Selective Electrode	
โคลิฟอร์มแบคทีเรีย (เอ็มทีเอ็น/100มล.)		-	0	MPN Technique	
ฟิซิลโคลิฟอร์มแบคทีเรีย (เอ็มทีเอ็น/100มล.)		-	0	MPN Technique	

หมายเหตุ ND = ตรวจแล้วไม่พบ
 - = ไม่ได้ทำการตรวจวิเคราะห์
 รายงานนี้ - รับรองเฉพาะตัวอย่างที่ได้ตรวจวิเคราะห์เท่านั้น
 - ห้ามนำรายงานนี้ไปประกาศโฆษณา
 - ห้ามคัดถ่ายใบรับรองหรือรายงานผลเพียงบางส่วน
 โดยไม่ได้รับอนุญาตจากห้องปฏิบัติการเป็นลายลักษณ์

ลงชื่อ.....
 (นางสาววราพร ฐปรมณี)
 นักวิทยาศาสตร์การแพทย์ 6 ปฏิบัติหน้าที่
 หัวหน้ากลุ่มงานวิเคราะห์คุณภาพสิ่งแวดล้อม
 วันที่ 12/9/45

รายงานผลการวิเคราะห์คุณภาพตัวอย่างน้ำบริโภค

กลุ่มงานวิเคราะห์คุณภาพและสิ่งแวดล้อม ศูนย์อนามัยสิ่งแวดล้อมเขต 12

ตัวอย่างที่..... 1047..... สัญลักษณ์ห้องทดลอง..... สัญลักษณ์ผู้ส่ง..... HDW/1047.....
หน่วยงานที่ส่ง..... โรงพยาบาลสทิงพระ..... ประเภทน้ำ..... ประปา.....
ชื่อแหล่งน้ำดิบ..... ชื่อการประปา.....
สถานที่เก็บ..... โรงพยาบาลสทิงพระ..... ตำบล..... อำเภอ..... สทิงพระ..... จังหวัด..... สมุทรสาคร.....
วันที่เก็บ..... เวลา..... น. วันที่ส่ง..... 26 ก.ย. 45..... เวลา..... น. วันที่รับตัวอย่าง..... 27 ก.ย. 45.....
วิเคราะห์โดย..... น.วิจิตร สัตย์ดี, 1/10

พารามิเตอร์ที่ตรวจวิเคราะห์	หน่วย	ผลการวิเคราะห์	เกณฑ์คุณภาพน้ำประปากรมอนามัย	วิธีที่ตรวจวิเคราะห์	วันที่วิเคราะห์
ความเป็นกรดต่าง (pH)	-	7.2	6.5 - 8.5	Electrometric	
สี (Colour)	(แพลตตินัมโคบอลต์)	5	15	Visual Comparison	
ความขุ่น (Turbidity)	(เอ็นทียู)	0.61	10	Nephelometric	
ปริมาณสารละลายทั้งหมดที่เหลือจากการระเหย (TDS)	(มก./ล.)	5,073	1,000	Gravimetric	
ความกระด้าง HCO_3^- (Hardness)	CO_3^{2-} (มก./ล.)	725	500	EDTA Titrimetric	
เหล็ก (Fe)	(มก./ล.)	0.10	0.5	AAS (FLAME)	
แมงกานีส (Mn)	(มก./ล.)	ND	0.3	AAS (FLAME)	
ทองแดง (Cu)	(มก./ล.)	0.01	1.0	AAS (FLAME)	
สังกะสี (Zn)	(มก./ล.)	0.05	3.0	AAS (FLAME)	
ตะกั่ว (Pb)	(มก./ล.)	ND	0.03	AAS (FLAME)	
โครเมียม (Cr)	(มก./ล.)	ND	0.05	AAS (FLAME)	
แคดเมียม (Cd)	(มก./ล.)	ND	0.003	AAS (FLAME)	
สารหนู (As)	(มก./ล.)	-	0.01	AAS (Hydride - Generation)	
ปรอท (Hg)	(มก./ล.)	-	0.001	AAS (Hydride - Generation)	
ซัลเฟต (SO_4^{2-})	(มก./ล.)	260	250	Turbidimetric	
คลอไรด์ $NaCl, KCl$ (Cl^-) $CaCl_2$ etc	(มก./ล.)	560	250	Argentometric	
ไนเตรท (NO_3^- as NO_3^-)	(มก./ล.)	0.1	50	Ion Selective Electrode	
ฟลูออไรด์ (F)	(มก./ล.)	1.21	0.7	Ion Selective Electrode	
โคลิฟอร์มแบคทีเรีย (เอ็มทีเอ็น/100มล.)		-	0	MPN Technique	
ฟิคัลโคลิฟอร์มแบคทีเรีย (เอ็มทีเอ็น/100มล.)		-	0	MPN Technique	

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- ห้ามคัดถ่ายใบรับรองหรือรายงานผลเพียงบางส่วน
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ลงชื่อ.....
(นางสาวกฤษณา จุปมนต์)
นักวิทยาศาสตร์การแพทย์ 6 ปฏิบัติหน้าที่
หัวหน้ากลุ่มงานวิเคราะห์คุณภาพสิ่งแวดล้อม
วันที่ 1/10/45

Note: ควบคุมค่าเหล็ก 1,500 (ซีจี)
ก่อนรับตรวจ ผด. คังเพนเคียว

ภาคผนวก ค

ข้อมูลเมมเบรนชนิด

Cartridge Micro Filter

บริษัท USFilter Plymouth Products

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นาง. อ.พิภา

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PAGE 01

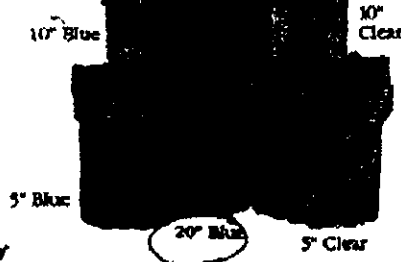
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Spec. 100 200 300 400 500



SLIM LINE
FILTER HOUSINGS

SLIM LINE™ FILTER HOUSINGS

Slim design reduces space required for installation without sacrificing capacity
FDA-grade



Slim Line™ filter housings are available in either reinforced polypropylene or clear FDA-approved Styrene-Acrylonitrile in 5", 10" and 20" lengths. The black or blue reinforced polypropylene housing caps are available with 1/4", 3/8" or 1/2" FPT connections. Four bosses are molded into every cap for mounting purposes.

Slim Line™ filter housings are an excellent choice for low-flow applications and when space and chemical compatibility are primary concerns.

Clear Slim Line™ Filter Housings
Clear Slim Line™ filter housings offer on-site examination of flow, performance, and cartridge life. They are ideal for a variety of applications.

Manufactured of clear, FDA-approved Styrene-Acrylonitrile (SAN), the bumps are stress relieved for added clarity and strength. They offer excellent chemical compatibility. The blue polypropylene caps can be ordered with an optional pressure-relief button on the inlet side to relieve pressure inside the housing when changing filter cartridges.

Opaque Slim Line™ Filter Housings
Molded from rugged reinforced polypropylene, Opaque Slim Line™ filter housings offer outstanding chemical compatibility and are ideal for use in a variety of low-flow applications. These applications include under-sink and countertop residential filtration, pre- and post-reverse osmosis filtration, recreational vehicle filtration, food service, humidifying systems and infant dialysis equipment. They are equipped with a black, reinforced polypropylene cap and can be ordered with an optional pressure-relief button on the inlet side to relieve pressure inside the housing when changing filter cartridges.

USFilter
Plymouth Products

ตั้ง อ.พิบูล

10/03/2003 09:02

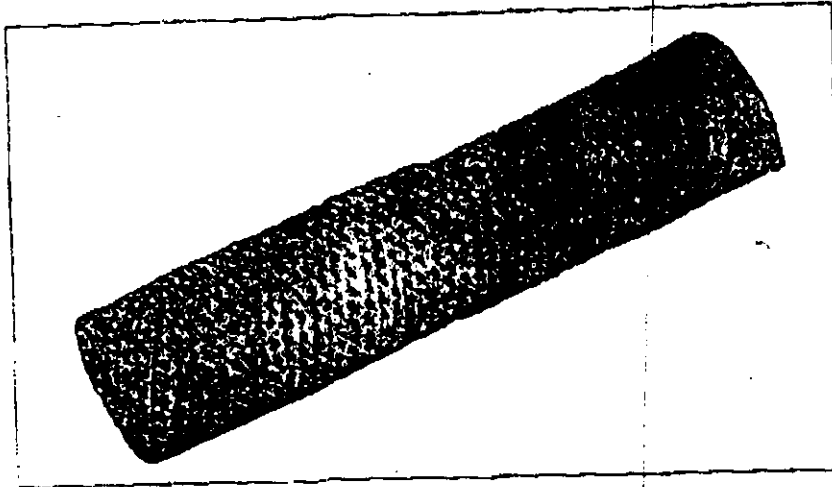
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CHAINARIS

PAGE 03

FilterCor

FILTERCOR WOUND CARTRIDGE FILTERS SERIES FC



Standard Polypropylene

Fibrillated Polypropylene

Utility Grade Polypropylene

Use for :

Mineral Acid

Organic solvents

Zinc Chloride

Caustic Soda

Sodium Hydroxide

Vegetable Oils

Oxidizing Agents

Alkalies

Organic Acids

Potable Water

Demineralized Water

Plating Solutions

Photographic Solution

Pre-membrane Filtration

Ethyl Alcohol

Animal, Petroleum

- Tapered pores for longer life

FilterCor all polypropylene depth filter elements feature tapered pores that narrow to an inner (downstream) nominal rate section. This thick depth structure provides high capacity for larger solids and as well as for fine particles.

FILTERCOR (S.E.A.) PTE LTD

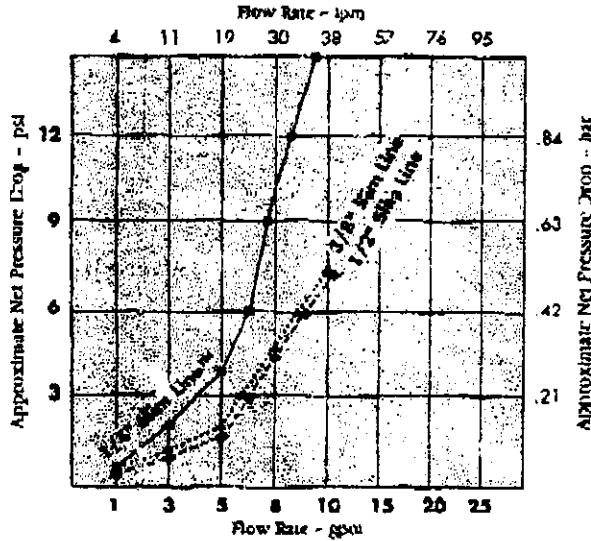
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CHAINARIS

PAGE 02

SLIM LINE Filter Housings



COMPONENT

The 158110, 158114, 158120, 158125, 158129, 158131, 158177, 158205, 158206, 158208, 158149, 158128, 158129, 158196, 158196, 158204, and 158205 are Tested and Certified by NSF International under ANSI/NSF Standard 42 - Conforms for material and structural integrity requirements only.

Housing Specifications and Performance Data

Model	Maximum Dimensions	Performance Data
→ Clear	7-3/8" x 4-5/8" (187 mm x 118 mm)	1/4" NPT - 2 psi @ 3 gpm (0.14 bar @ 11 lpm)
→ 10 Clear	12-1/8" x 4-5/8" (304 mm x 118 mm)	3/8" NPT - 2 psi @ 5 gpm (0.14 bar @ 19 lpm)
→ Opaque	7" x 4-3/8" (178 mm x 111 mm)	1/4" NPT - 2 psi @ 3 gpm (0.14 bar @ 11 lpm)
→ 10 Opaque	11-3/4" x 4-5/8" (298 mm x 111 mm)	1/2" NPT - 2 psi @ 5 gpm (0.14 bar @ 19 lpm)
→ 20 Opaque	21-7/8" x 4-3/8" (556 mm x 111 mm)	1/2" NPT - 2 psi @ 5 gpm (0.14 bar @ 19 lpm)

Materials of Construction

- Housing: SAN (Clear) and Polypropylene (Opaque)
- Cap: Reinforced Polypropylene
- Button Assembly: 300-series Stainless Steel
- O-Ring: Buna-N
- Maximum Temperature: 125°F (52°C)
- Maximum Pressure: 125 psi (8.6 bar)

CAUTION: Filter must be protected against freezing, which can cause cracking of the filter and water leakage

USFilter
Plymouth Products

VIVENDI
water company

502 Indiana Avenue • Sheboygan, WI 53081
Domestic: 800-645-0267 phone • 800-862-6652 fax
International: 920-451-9322 phone • 920-457-6653 fax

www.plymouthwater.com
Printed in U.S.A. 2/00 310/00

ภาคผนวก ง

**ข้อมูล RO FILMTEC Membrane
บริษัท Dow Chemical Company**



FILMTEC Membranes

FT30 Membrane Description

FILMTEC® FT30 thin-film composite reverse osmosis (RO) membrane gives excellent performance for a wide variety of applications, including low-pressure tapwater use, single-pass seawater and brackish water desalination, chemical processing, and waste treatment. This membrane exhibits excellent performance in terms of flux, salt rejection, and microbiological resistance. FT30 elements can operate over a pH range of 2 to 11, are resistant to compaction, and are suitable for temperatures up to 45°C.

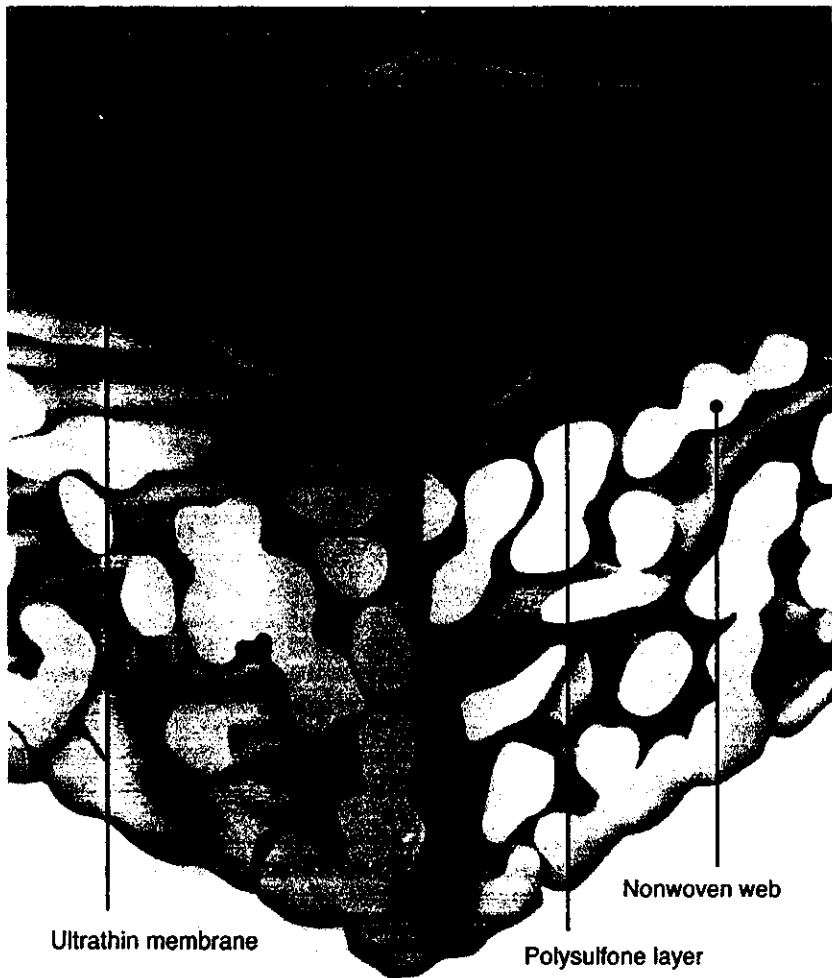
FILMTEC spiral-wound elements of FT30 membrane have been extensively used since 1980 both in the United States and abroad. In numerous installations under actual seawater conditions, FT30 elements have provided salt rejections of better than 99.5 percent and fluxes of 10 gfd (24 l/h m²). On a 0.2 percent salt solution at 225 psi (1.6 MPa), rejections above 99 percent and fluxes of 26 gfd (51 l/h m²) are routinely obtained.

Several long-term tests have been completed. A continuous three-year test operating at about 25°C and 350 psi on 3000 ppm feed did not show any membrane compaction or deterioration in salt rejection. Elements have also operated in shipboard seawater systems with normal intermittent use for over three years with no significant loss in performance.

FILMTEC FT30 thin-film composite RO membrane complies with Food Additive Regulation 21 CFR 177.2550 for use in processing foods and purifying water for food applications.

Thin-Film Composite Configuration

The membrane composite consists of three layers: a polyester support



FT30 Membrane Composite

web, a microporous polysulfone interlayer, and an ultrathin barrier coating on the top surface.

A schematic diagram of the membrane is shown above.

Description of the FT30 Membrane

The major structural support is provided by the nonwoven web, which has been calendered to

produce a hard, smooth surface free of loose fibers. Since the polyester web is too irregular and porous to provide a proper substrate for the salt barrier layer, a microporous layer of engineering plastic (polysulfone) is cast onto the surface of the web. The polysulfone coating is remarkable in that it has surface pores controlled to a diameter of approximately 150 angstroms. The FT30 barrier layer,

*Trademark of The Dow Chemical Company

FILMTEC Membranes

For more information about FILMTEC membranes, call Dow Liquid Separations:

North America 1-800-447-4369
Latin America (+55) 11-5188-9345
Europe (+31) 20-691-6268
Japan (+81) 3-5460-2100
Australia (+61) 2-9776-3226
<http://www.dow.com/liquidseps>

about 2000 angstroms thick, can withstand high pressures because of the support provided by the polysulfone layer. Because of its barrier layer thickness, FT30 is very resistant to mechanical stresses and chemical degradation.

Biological Protection and Disinfection

Various storage tests have been conducted on FT30 elements to determine biological protection procedures. The best procedure recommended for storage is to immerse the element in a protective solution which contains 1.5 percent (by weight) sodium metabisulfite (food grade). This treatment maintains initial membrane flux and performance.

Disinfection with chlorinating agents can be practiced within limits but is not recommended. The FT30 membrane is resistant to chloramine, chloramine-T, N-chloroisocyanurates to the extent that these mild agents can be used, but their disinfectant properties are not very great. Pure chlorine dioxide can be used successfully at 500 ppm concentration if the storage period is less than one week, but it is not an effective biocide for longer periods. Chlorine dioxide that is generated on site from chlorine and sodium chlorate is always contaminated with

free chlorine, which attacks the membrane. The FT30 membrane is permeable to chloramine and to chlorine dioxide. Either of these will pass through the membrane resulting in a small residual disinfectant in the permeate.

The membrane has only limited resistance to free chlorine. Chlorine attack is slowest at neutral and acidic pH levels and fastest at alkaline pH levels. It is noteworthy, however, that short-term exposure of the membrane to chlorine does not destroy the membrane. Thus, it can be used effectively in installations where system upsets may result in temporary exposure of the membrane to free chlorine.

Alternative disinfectants that may be used are hydrogen peroxide and peracetic acid. Hydrogen peroxide or peracetic acid can be used at concentrations up to 0.2 percent at 25°C as specified in the warranty on FILMTEC membranes but not at higher temperatures. Continuous exposure to hydrogen peroxide at this concentration will eventually damage the membrane.

Copper sulfate can be used to control algae growth. Iodine, quaternary germicides, and phenolic compounds should not be used as tests show that all of these agents cause flux losses.

Cleaning

Because of the FT30 membrane's combination of pH stability and temperature resistance, cleaning can be done very effectively. Both acidic and alkaline cleaners can be used at temperatures to 50°C. Acid cleaning to remove mineral scale is best done at pH 2 or lower with phosphoric, hydrochloric, sulfamic or nitric acid. Citric acid can also be used. Alkaline cleaning to remove organic fouling is generally done with sodium hydroxide and sodium lauryl sulfate. Various combinations of agents such as sodium EDTA, sodium tripolyphosphate, and trisodium phosphate can also be used.

Generally, anionic surfactants can be used for alkaline cleaning. Cationic surfactants cause an irreversible flux loss and must be avoided. Nonionic surfactants can sometimes be used, but they must be used sparingly and thoroughly rinsed out before the membrane is pressurized.

See bulletins *Cleaning Procedures* (Form No. 609-23010/CH 172-086-E) and *Biological Protection and Disinfection* (Form No. 609-24010/CH172-120-E) for further information.

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Published April 1998.



*Trademark of The Dow Chemical Company

Form No. 609-01010-498CRP
CH 172-041-E-498



FILMTEC Membranes

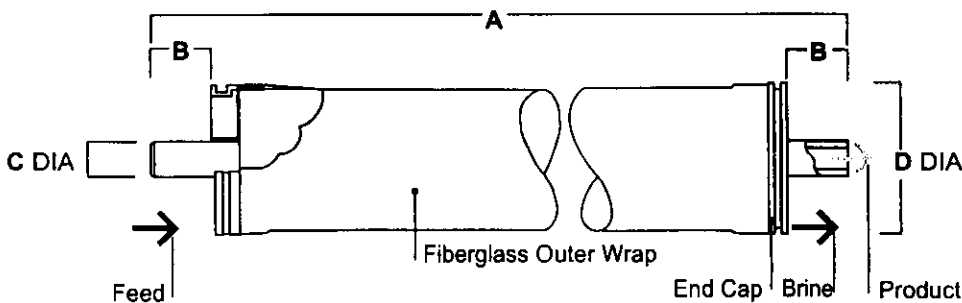
FILMTEC Fiberglassed Elements for Light Industrial Systems

FILMTEC™ fiberglassed brackish water elements consistently provide outstanding system performance. Fiberglassed elements are recommended for multiple-element housings containing three or more membrane elements as they are designed to withstand higher pressure drops. BW30 elements are designed for systems requiring the highest possible rejection. BW30LE elements are designed for customers wanting savings from lower energy requirements.

Product Specifications

Product	Part Number	Active Area ft ² (m ²)	Applied Pressure psig (bar)	Permeate Flow Rate gpd (m ³ /d)	Stabilized Salt Rejection (%)
BW30-2540	80766	28 (2.6)	225 (15.5)	800 (3.0)	99.5
BW30-4040	80783	82 (7.6)	225 (15.5)	2200 (8.3)	99.5
BW30LE-4040	80604	82 (7.6)	150 (10.3)	2200 (8.3)	99.0

1. Permeate flow and salt rejection based on the following test conditions: 2000 ppm NaCl, 77°F (25°C) and 15% recovery.
2. Permeate flows for individual elements may vary +/-20%.
3. Minimum initial salt rejection is 98.0%.
4. Product specifications may vary slightly as improvements are implemented.
5. BW30LE-4040 was previously named BW30HP-4040.



FilmTec sells coupler part number 89055 for use in multiple element housings. Each coupler includes two 2-210 EPR o-rings, FilmTec part number 89255.

Product	Maximum Feed Flow Rate, gpm (m ³ /h)	Typical Recovery Rate (%)	Dimensions – Inches (mm)			
			A	B	C	D
BW30-2540	6 (1.4)	15	40.0 (1016)	1.19 (30.2)	0.75 (19)	2.4 (61)
BW30-4040	16 (3.6)	15	40.0 (1016)	1.05 (26.7)	0.75 (19)	3.9 (99)
BW30LE-4040	16 (3.6)	15	40.0 (1016)	1.05 (26.7)	0.75 (19)	3.9 (99)

1. Typical recovery rate shown is for a single element. Recovery rate is calculated by dividing permeate flow rate by feed flow rate.
2. Refer to FilmTec Design Guidelines for multiple-element systems.
3. BW30-2540 elements fit nominal 2.5-inch I.D. pressure vessel. BW30-4040 and BW30LE-4040 elements fit nominal 4-inch I.D. pressure vessel.

1 inch = 25.4 mm

Operating Limits

Membrane Type	Polyamide Thin-Film Composite
Maximum Operating Temperature	113°F (45°C)
Maximum Operating Pressure	600 psig (41 bar)
Maximum Pressure Drop	15 psig (1.0 bar)
pH Range, Continuous Operation ^a	2–11
pH Range, Short-Term Cleaning (30 min.) ^b	1–12
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance ^c	<0.1 ppm

^a Maximum temperature for continuous operation above pH 10 is 95°F (35°C).

^b Refer to Cleaning Guidelines in specification sheet 609-23010.

^c Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, FilmTec recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to technical bulletin 609-22010 for more information.

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FILMTEC Membranes

For more information about FILMTEC membranes, call the Dow Liquid Separations business:

North America 1-800-447-4369
Latin America (+55) 11-5188-9277
Europe (+32) 3-450-2240
Japan (+81) 3-5460-2100
Australia (+61) 3-9226-3545
<http://www.filmtec.com>

Important Information

Proper start up of reverse osmosis water treatment systems is essential to prepare the membranes for operating service and to prevent membrane damage due to overfeeding or hydraulic shock. Following the proper start up sequence also helps ensure that system operating parameters conform to design specifications so that system water quality and productivity goals can be achieved.

Before initiating system start up procedures, membrane pretreatment, loading of the membrane elements, instrument calibration and other system checks should be completed.

Please refer to the application information literature entitled "How to

Start Up an RO Membrane System" (Form No. 609-00070) for more information.

Operation Guidelines

Avoid any abrupt pressure or cross-flow variations on the spiral elements during start-up, shutdown, cleaning or other sequences to prevent possible membrane damage. During start-up, a gradual change from a standstill to operating state is recommended as follows:

- Feed pressure should be increased gradually over a 30-60 second time frame.
- Cross-flow velocity at set operating point should be achieved gradually over 15-20 seconds.
- Permeate obtained from first hour of operation should be discarded.

General Information

- Keep elements moist at all times after initial wetting.
- If operating limits and guidelines given in this bulletin are not strictly followed, the limited warranty will be null and void.
- To prevent biological growth during system shutdowns, it is recommended that membrane elements be immersed in a preservative solution.
- The customer is fully responsible for the effects of incompatible chemicals and lubricants on elements.
- Maximum pressure drop across an entire pressure vessel (housing) is 50 psi (3.4 bar).
- Avoid permeate-side backpressure at all times.

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