TECHNICAL MANUAL

“RO MEMBRANES CLEANING PROGRAMS”

RO MEMBRANES CLEANING PROGRAMS

EVERBLUE'S PRODUCT RANGE

Everblue's range of products consists of a series of acid and alkaline detergent products designed to remove most of the clogging and restore the performance of all membrane systems. Formulated and tested in the company's laboratories, they have been applied to plants/filtration systems all around the world.
An extensive practical experience on various product combinations has allowed Everblue to identify a number of cleaning sheets/cards to remove the most common deposits. These procedures include suggestions for cleaning reverse osmosis, nano-filtration, and ultra-filtration membranes in spirally wound, hollow fiber, flat, and tubular configurations.

EB-CLEANER INDEX

The product data sheets provide detailed information on the entire range of products **EVERBLUE:**

EB-Biocide PLUS

EB-Cleaner B1
EB-Cleaner B2

EB-Cleaner A1

Everblue's ranhe of products includes both acid and alkaline products.
Most of these products are classified as dangerous.
For this reason, the user must know the characteristics of the compounds and make sure that all safety procedures are respected before using any of EVERBLUE's product as well as any other industrial chemicals.
Safety and handling information is provided on the back of the technical sheet of each product. Material Safety Data Sheets (MSDS) are available for each product.

It is always important that you consult the instructions of the membrane's manufacturer before performing any cleaning operation.

EVERBLUE: USER GUIDE

The following products can be used for cleaning polyamide and polysulfide membranes.

You must always strictly follow the instructions of the membrane manufacturers.

The approvals of the membrane manufacturers can be provided on request.

PRODUCT	PRODUCT TYPE	CLOGGING TYPE	% TIPICAL CONCENTRATION Volume/Volume	OPTIUM CONDITIONS Temperature-pH
EB-Biocide PLUS	Non-oxidizing quick-acting Biocide	Bacterial Microorganisms	0,03% for 60 minutes	pH 6.0 -7.5 25°C
EB-Cleaner B1	Alkaline Product High levels of active substances	Insoluble Iron Sulphates	2.0% - 3.0%	pH 10.0 – 11.0 25 – 30 °C
EB-Cleaner B2	Alkaline Product High levels of active substances	Organic deposits and Biofilm	1.0% – 2.0%	pH 10.0 – 11.0 25 – 30°C
EB-Cleaner A1	Acid Product High levels of active substances	Iron Oxide CaCO3	1.0% – 2.0%	pH 2.0 – 4.0 25 – 30°C

The following table shows the correct function of each product:

PRODUCT	TYPE	CaCO3	CaSO4	BaSO4	SiO2	CaPO4	Fe/Mn	Organic	Clay Colloids	Bacteria
EB-Biocide PLUS	Biodice									■
EB-Cleaner B1	Alkali Chalating Agent		■	■			■	■		
EB-Cleaner B2	Alkaline Detergent							■		
EB-Cleaner A1	Acid	■				■	■			

RECOMMENDATIONS ON CLEANING PROCEDURES

The choice of cleaning products depends on the type of clogging on the membranes.
It is often advisable to use a combination of several EB-Cleaner products divided into one or more cleaning steps.

In many cases the order of use of the products is very important.
Laboratory studies have shown that under certain conditions the application of acid CLEANING before using an alkaline detergent can cause a loss of irreversible production.

So, as a precaution, if the clogging type has not been identified, it is better to start the cleaning process with an alkaline detergent.

CLEANING PROCEDURE TABLE

CLEANING PROCEDURE

Program	Deposit Type	Phase 1	Phase 2	Phase 3	Phase 4
1	Generic clogging	EB-Cleaner B2	EB-Cleaner A1		
2	Inorganic precipitation (CaCo3)	EB-Cleaner A1			
3	Iron Oxide	EB-Cleaner A1	EB-Cleaner B2		
4	Calcium Sulphate	EB-Cleaner B1	EB-Cleaner B2		
5	Silica	EB-Cleaner B2 + EB-Cleaner B1			
6	Organic deposits	EB-Cleaner B2	EB-Cleaner A1		
7	Medially strong organic deposits	EB-Cleaner B2 + EB-Cleaner B1	EB-Cleaner A1		
8	Biofilm	EB-Cleaner B2 + EB-Cleaner B1	EB-Biocide Plus	EB-Cleaner B2	EB-Cleaner A1 (opzionale)
9	UF membrane clogging	EB-Cleaner B2	EB-Cleaner A1		

“EVERBLUE DEVELOPMENT PRODUCTS”

Many other products called "Everblue Development Products", such as enzymatic compounds, are available for special applications in the food, dairy and wastewater treatment industries.
Cellulose acetate membrane cleaning products are also available.
For more information about these compounds and others not listed, contact Everblue.

CLEANING PROCEDURE GUIDE

Everblue recommends regular cleaning procedures to keep the membranes in perfect efficiency.
The cleaning frequency can be monthly or yearly depending on the characteristics of the system and the frequency of clogging. It is essential to wash the membranes in the initial clogging stage.
Cleaning is recommended when one or more of the following parameters changes by 10-15%

- increased permeate conductivity
- Increased differential pressure
- increased feed pressure
- decrease in production

If the system performance decreases more than 30% it is often impossible, with normal procedures, to bring the plant back to optimal conditions and in some cases, irreversible damage to the membranes may occur during cleaning operations.

OPTIMIZATION OF CLEANING

The manufacturer's instructions for cleaning the membranes must be followed, respecting the pH, temperature, flow and differential pressure values.
The membranes must always be flushed abundantly between one phase and the next with good quality chlorine-free water.

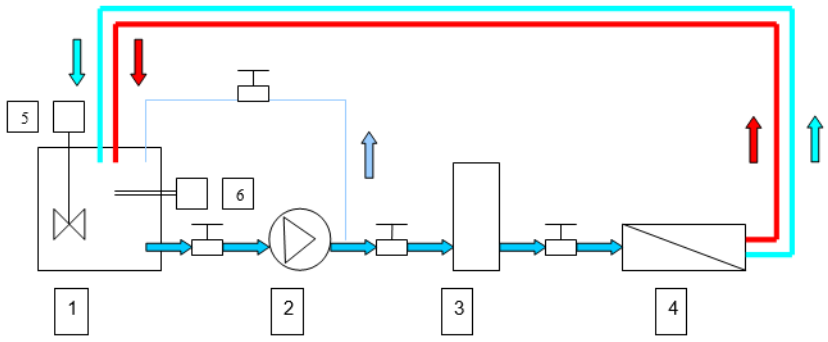
PH Many membranes can be washed with low pH acid solution followed by high pH alkaline solutions or vice versa.
Raising or lowering pH is often the easiest and most effective way to remove deposits from the membranes

Temperature Temperature Chemical reactions are facilitated by increasing the temperature of the solutions.
All membranes have maximum temperature limits at certain pH levels; these values must never be exceeded.

Pressure and flow The pressure and flow limits recommended by the membrane manufacturers must always be respected.

Hydraulic Features Many cleaning programs require a high flow to facilitate removal of deposits from the membrane surface, which means that minimum flow rates must always be maintained.
Avoid using excessive pressures that can cause telescoping of the membrane and may introduce particles into the porosity of its surface.

DIAGRAM OF WASHING SYSTEM



1 - WASHING TANK
2 - PUMP
3 - CARTRIDGE FILTER 10 MICRONES
4 - REVERSE OSMOSIS SYSTEM
5 - MIXER
6 - HEATING SYSTEM WASH

THE 10 ESSENTIAL RULES FOR AN EFFECTIVE CLEANING

1 Wash the membranes regularly or when the differential pressure, the product flow rate or conductivity vary by 10-15% from the designed conditions.

2 A) **Organic Deposits**. Wash with an alkaline **EB-Cleaner** detergent to remove inorganic deposits and biofilm.
This step may eventually be followed by an acid wash.
B) **Inorganic precipitation**. Use an **EB-Cleaner** acid product to remove inorganic precipitation.

3 During cleaning procedures, the flow should not exceed the limits indicated by membrane manufacturers.

The operating limits to be met during the cleaning operations are those shown in the table below.

Membranes 2.5”	3-5 GPM	0.7-1.1 M3/H	60 PSI 4 BAR
Membranes 4”	8-10 GMP	1.8-2.3 M3/H	60 PSI 4 BAR
Membranes 8”	30-40 GMP	7-9 M3/H	60 PSI 4 BAR

4 The cleaning solution must pass through the membranes at a maximum pressure not exceeding 4 bar.

5 The recommended solution volume for an 8 "x 40" diaphragm is 40 liters (excluding tube volume). The minimum recommended volume is 25-30 liters.

6 It is advisable to use washing solutions at 25 - 30 ° C. Ultrafiltration membranes (UF) and polysulfide can also be washed at a temperature of 50 ° C.

7 Allow the membranes to soak in the cleaning solution for at least 15 minutes before starting the recirculation phase. This operation must be repeated several times during the same cleaning procedure.

8 Between each cleaning phase and before re-starting the plant, flush (rinse) membranes, piping, and the cleaning solution container abundantly with chlorine-free good water.

9 When you need to wash a multi-stage system, it is advisable to wash each stage individually.

10 Do not be alarmed if when the system is being restarted, performance has remained unaltered or even worse than before the cleaning procedure.
Many cleaning products cause temporary effects on the membranes or polysulfide supports and therefore a continuous service of 4 to 24 hours may be necessary to stabilize the operating conditions of the membranes.

PROGRAM 1 - CLEANING PROCEDURE

DEPOSIT TYPE: GENERIC CLOGGING
FOR REVERSE OSMOSIS POLYAMIDE MEMBRANES – TFC

Recommended cleaning program for removing organic, inorganic and biofilm deposits.

CLEANING PHASES

Phase 1 – Perform an alkaline detergent wash to remove biofilm, colloidal material and inorganic deposits.
Phase 2 – Perform an acid wash to remove iron and organic deposits.

Phase 1

- Prepare a 1% v / v solution of **EB-Cleaner B2** at pH 10.0-11.0 at a temperature of 30 ° C
- Flush 20% of the solution through the drainage membranes.
- Recycle and stop the remaining solution at 15-minute intervals for 4 hours.
- Drain and flush abundantly with good quality chlorine-free water.

If the cleaning solution shows a marked change in pH and / or strong staining, discharge, prepare a new solution and repeat the cleaning phase.

Phase 2

- Prepare a 2% v / v solution of **EB-Cleaner A2** at 20 - 25°C.
- Flush 20% of the solution through the drainage membranes.
- Recycle and stop the remaining solution at 15-minute intervals for approximately 2 hours.
- Drain and flush abundantly with good quality chlorine-free water.

If the cleaning solution shows a marked change in pH and / or strong staining, discharge, prepare a new solution and repeat the cleaning phase.

NOTES
• The instructions of the membrane constructors for CLEANING the must always be followed, respecting the pH, temperature, flow and differential pressure limits.
• The membranes must always be luxated, between one phase and the next, with good quality chlorine-free water.
• Before returning the system to service ensure that the residues of the CLEANING product are removed from the surface of the membranes with an abundant rinse.

WARNING
All information present in this document are based on published data, laboratory studies/projects and direct plant experience in the field. Since the conditions under which these products are used are outside the Everblue control, the results obtained cannot be guaranteed.

DISCLAIMER OF RESPONSIBILITY
Everblue assumes no responsibility for any damage to things or people due to misuse, handling, or storage of their products.

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PROGRAM 2 - CLEANING PROCEDURE

DEPOSIT TYPE: INORGANIC PRECIPITATION (CaCO3)
FOR REVERSE OSMOSIS POLYAMIDE MEMBRANES – TFC

Cleaning program recommended to remove inorganic deposits from polyamide membranes.

CLEANING PHASES

Phase 1 – Perform an acid wash for inorganic deposits.
Phase 2 – Perform an alkaline detergent wash to remove organic contaminants.

Phase 1

- Prepare a 2% v / v solution of **EB-Cleaner A1** at pH 3.6 at a temperature of 20 - 25°C.
- Flush 20% of the solution through the drainage membranes.
- Recycle and stop the remaining solution at 15-minute intervals for approximately 2 hours.
- Drain and flush abundantly with good quality chlorine-free water.

If the cleaning solution shows a marked change in pH and / or strong staining, discharge, prepare a new solution and repeat the cleaning phase.

Phase 2

- Prepare a 2% v / v solution of **EB-Cleaner B2** at pH 10.0 – 11 at a temperature of 20 - 25°C.
- Flush 20% of the solution through the drainage membranes.
- Recycle and stop the remaining solution at 15 minute intervals for 4 hours.
- Drain and flush abundantly with good quality chlorine-free water.

If the cleaning solution shows a marked change in pH and / or strong staining, discharge, prepare a new solution and repeat the cleaning phase.

NOTES
• The instructions of the membrane constructors for CLEANING the must always be followed, respecting the pH, temperature, flow and differential pressure limits.
• The membranes must always be luxated, between one phase and the next, with good quality chlorine-free water.
• Before returning the system to service ensure that the residues of the CLEANING product are removed from the surface of the membranes with an abundant rinse.

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PROGRAM 3 - CLEANING PROCEDURE

DEPOSIT TYPE: IRON OXIDE
FOR REVERSE OSMOSIS POLYAMIDE MEMBRANES - TFC

Cleaning program recommended to remove iron from polyamide membranes.

CLEANING PHASES

Phase 1 – Perform an acid wash to remove iron and inorganic deposits.
Phase 2 – Perform an alkaline detergent wash to remove organic contaminants.

Phase 1

- Prepare a 2% v / v solution of **EB-Cleaner A1** at pH 3.6 at a temperature of 20 - 25°C.
- Flush 20% of the solution through the drainage membranes.
- Recycle and stop the remaining solution at 15 minute intervals for approximately 2 hours.
- Drain and flush abundantly with good quality chlorine-free water.

If the cleaning solution shows a marked change in pH and / or strong staining, discharge, prepare a new solution and repeat the cleaning phase.

Phase 2

- Prepare a 2% v / v solution of **EB-Cleaner B2** at pH 10.0 – 11 at a temperature of 20 - 30°C.
- Flush 20% of the solution through the drainage membranes.
- Recycle and stop the remaining solution at 15 minute intervals for 4 hours.
- Drain and flush abundantly with good quality chlorine-free water.

If the cleaning solution shows a marked change in pH and / or strong staining, discharge, prepare a new solution and repeat the cleaning phase

NOTES
• The instructions of the membrane constructors for CLEANING the must always be followed, respecting the pH, temperature, flow and differential pressure limits.
• The membranes must always be luxated, between one phase and the next, with good quality chlorine-free water.
• Before returning the system to service ensure that the residues of the CLEANING product are removed from the surface of the membranes with an abundant rinse.

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PROGRAM 4 - CLEANING PROCEDURE

DEPOSIT TYPE: CALCIUM SULPHATE
FOR REVERSE OSMOSIS POLYAMIDE MEMBRANES - TFC

Cleaning program recommended to remove sulphates from polyamide membranes.

CLEANING PHASES

Phase 1 – Perform an alkaline wash with EB-Cleaner B1 to remove the calcium sulphate.
Phase 2 – Perform an alkaline detergent wash to remove organic contaminants.

Phase 1

- Prepare a 2% v / v solution of **EB-Cleaner B1** at pH 10.0 – 11 at a temperature of 25 - 30°C.
- Flush 20% of the solution through the drainage membranes.
- Recycle and stop the remaining solution at 15 minute intervals for approximately 4 hours.
- Drain and flush abundantly with good quality chlorine-free water.

If the cleaning solution shows a marked change in pH and / or strong staining, discharge, prepare a new solution and repeat the cleaning phase.

Phase 2

- Prepare a 2% v / v solution of **EB-Cleaner B2** at pH 10.0 – 11 at a temperature of 25 - 30°C.
- Flush 20% of the solution through the drainage membranes.
- Recycle and stop the remaining solution at 15 minute intervals for approximately 4 hours.
- Drain and flush abundantly with good quality chlorine-free water.

If the cleaning solution shows a marked change in pH and / or strong staining, discharge, prepare a new solution and repeat the cleaning phase.

NOTES
• The instructions of the membrane constructors for CLEANING the must always be followed, respecting the pH, temperature, flow and differential pressure limits.
• The membranes must always be luxated, between one phase and the next, with good quality chlorine-free water.
• Before returning the system to service ensure that the residues of the CLEANING product are removed from the surface of the membranes with an abundant rinse.

PROGRAM 5 - CLEANING PROCEDURE

DEPOSIT TYPE: SILICA
FOR REVERSE OSMOSIS POLYAMIDE MEMBRANES - TFC

Cleaning program recommended to remove silica from polyamide membranes.

CLEANING PHASES

Phase 1 – Perform an alkaline detergent wash combined with a chelating agent to removebiofilm, colloidal material and organic deposits.
Phase 2 – Perform an acid wash to remove iron and inorganic deposits.

Phase 1

- Prepare a 1% v / v solution of **EB-Cleaner B2** at pH 10.0 – 11 at a temperature of 30°C.
- Add 1% v / v of **EB-Cleaner B1** (restore pH <11.0 with HCl)
- Flush 20% of the solution through the drainage membranes.
- Recycle and stop the remaining solution at 15 minute intervals for approximately 4 hours.
- Drain and flush abundantly with good quality chlorine-free water.

If the cleaning solution shows a marked change in pH and / or strong staining, discharge, prepare a new solution and repeat the cleaning phase.

Phase 2

- Prepare a 2% v / v solution of **EB-Cleaner A1** at 20 - 25°C.
- Flush 20% of the solution through the drainage membranes.
- Recycle and stop the remaining solution at 15 minute intervals for approximately 2 hours.
- Drain and flush abundantly with good quality chlorine-free water.

If the cleaning solution shows a marked change in pH and / or strong staining, discharge, prepare a new solution and repeat the cleaning phase.

NOTES
• The instructions of the membrane constructors for CLEANING the must always be followed, respecting the pH, temperature, flow and differential pressure limits.
• The membranes must always be luxated, between one phase and the next, with good quality chlorine-free water.
• Before returning the system to service ensure that the residues of the CLEANING product are removed from the surface of the membranes with an abundant rinse.

PROGRAM 6 - CLEANING PROCEDURE

DEPOSIT TYPE: ORGANIC DEPOSITS
FOR REVERSE OSMOSIS POLYAMIDE MEMBRANES – TFC

Cleaning program recommended to remove organic deposits from polyamide membranes.

CLEANING PHASES

Phase 1 – Perform an alkaline detergent wash to remove biofilm, colloidal material and organic deposits.
Phase 2 – Perform an acid wash to remove traces of iron and inorganic deposits of calcium carbonate.

Phase 1

- Prepare a 2% v / v solution of **EB-Cleaner B2** at pH 10.0 – 11.0 at a temperature of 30°C.
- Flush 20% of the solution through the drainage membranes.
- Recycle and stop the remaining solution at 15 minute intervals for approximately 4 hours.
- Drain and flush abundantly with good quality chlorine-free water.

If the cleaning solution shows a marked change in pH and / or strong staining, discharge, prepare a new solution and repeat the cleaning phase.

Phase 2

- Prepare a 2% v / v solution of **EB-Cleaner A1** at 20 - 25°C.
- Flush 20% of the solution through the drainage membranes.
- Recycle and stop the remaining solution at 15 minute intervals for approximately 2 hours.
- Drain and flush abundantly with good quality chlorine-free water.

If the cleaning solution shows a marked change in pH and / or strong staining, discharge, prepare a new solution and repeat the cleaning phase.

NOTES
• The instructions of the membrane constructors for CLEANING the must always be followed, respecting the pH, temperature, flow and differential pressure limits.
• The membranes must always be luxated, between one phase and the next, with good quality chlorine-free water.
• Before returning the system to service ensure that the residues of the CLEANING product are removed from the surface of the membranes with an abundant rinse.

PROGRAM 7 - CLEANING PROCEDURE

DEPOSIT TYPE: MEDIALLY STRONG ORGANIC DEPOSITS
FOR REVERSE OSMOSIS POLYAMIDE MEMBRANES - TFC

Cleaning program recommended to remove medially strong organic deposits from polyamide membranes.

CLEANING PHASES

Phase 1 – Perform an alkaline detergent wash to remove biofilm, colloidal material and organic deposits.
Phase 2 – Perform an acid wash to remove traces of iron and inorganic deposits of calcium carbonate.

Phase 1

- Prepare a 2% v / v solution of **EB-Cleaner B2** and add a 2% v/v solution of EB-Cleaner B1 at pH 10.0 – 11.0 at a temperature of 30°C.
- Flush 20% of the solution through the drainage membranes.
- Recycle and stop the remaining solution at 15 minute intervals for approximately 4 hours.
- Drain and flush abundantly with good quality chlorine-free water.

If the cleaning solution shows a marked change in pH and / or strong staining, discharge, prepare a new solution and repeat the cleaning phase.

Phase 2

- Prepare a 2% v / v solution of **EB-Cleaner A1** at 20 - 25°C.
- Flush 20% of the solution through the drainage membranes.
- Recycle and stop the remaining solution at 15 minute intervals for approximately 2 hours.
- Drain and flush abundantly with good quality chlorine-free water.

If the cleaning solution shows a marked change in pH and / or strong staining, discharge, prepare a new solution and repeat the cleaning phase.

NOTES
• The instructions of the membrane constructors for CLEANING the must always be followed, respecting the pH, temperature, flow and differential pressure limits.
• The membranes must always be luxated, between one phase and the next, with good quality chlorine-free water.
• Before returning the system to service ensure that the residues of the CLEANING product are removed from the surface of the membranes with an abundant rinse.

PROGRAM 8 - CLEANING PROCEDURE

DEPOSIT TYPE: BIOFILM
FOR REVERSE OSMOSIS POLYAMIDE MEMBRANES - TFC

Cleaning program recommended to remove biofilm from polyamide membranes.

CLEANING PHASES

Phase 1 – Perform an alkaline detergent wash to remove biofilm.

Phase 2 – Use non-oxidizing biocide to eliminate bacteria, molds and fungi.

Phase 3 – Perform an alkaline detergent wash to remove the organic part.

Phase 4 – Perform an acid wash to remove iron and inorganic deposits.

Phase 1

- Prepare a 1% v / v solution of **EB-Cleaner B2** at pH 11.0 at a temperature of 25 - 30°C.
- Flush 20% of the solution through the drainage membranes.
- Recycle and stop the remaining solution at 15 minute intervals for approximately 4 hours.
- Drain and flush abundantly with good quality chlorine-free water.

If the cleaning solution shows a marked change in pH and / or strong staining, discharge, prepare a new solution and repeat the cleaning phase.

Phase 2

- Prepare a 0.03% v / v solution of **EB-Biocide PLUS** at 30°C.
- Flush 20% of the solution through the drainage membranes.
- Recycle and stop the remaining solution at 15 minute intervals for 1 hour.
- Drain and flush abundantly with good quality chlorine-free water.

If the cleaning solution shows a marked change in pH and / or strong staining, discharge, prepare a new solution and repeat the cleaning phase.

Phase 3

- Prepare a 1% v / v solution of **EB-Cleaner B2** at pH 11.0 at a temperature of 25 - 30°C.
- Flush 20% of the solution through the drainage membranes.
- Recycle and stop the remaining solution at 15 minute intervals for 2 hours.
- Drain and flush abundantly with good quality chlorine-free water.

If the cleaning solution shows a marked change in pH and / or strong staining, discharge, prepare a new solution and repeat the cleaning phase.

Phase 4 Optional

- Prepare a 2% v / v solution of EB-Cleaner A1 at 20 - 30°C.
- Flush 20% of the solution through the drainage membranes.
- Recycle and stop the remaining solution at 30 minute intervals for 2 hours.
- Drain and flush abundantly with good quality chlorine-free water.

If the cleaning solution shows a marked change in pH and / or strong staining, discharge, prepare a new solution and repeat the cleaning phase.

NOTES
• The instructions of the membrane constructors for CLEANING the must always be followed, respecting the pH, temperature, flow and differential pressure limits.
• The membranes must always be luxated, between one phase and the next, with good quality chlorine-free water.
• Before returning the system to service ensure that the residues of the CLEANING product are removed from the surface of the membranes with an abundant rinse.

PROGRAM 9 - CLEANING PROCEDURE

DEPOSIT TYPE: GENERIC CLOGGING
FOR UF MEMBRANES

Cleaning program recommended to remove organic deposits from polyamide membranes.

CLEANING PHASES

Phase 1 – Perform an alkaline detergent wash to remove biofilm, colloidal material and organic deposits.
Phase 2 – Perform an acid wash to remove traces of iron and inorganic deposits of calcium carbonate.

Phase 1

- Prepare a 2% v / v solution of EB-Cleaner B2 at pH 10.0 – 11.0 at a temperature of 30°C.
- Flush 20% of the solution through the drainage membranes.
- Recycle and stop the remaining solution at 15 minute intervals for 4 hours.
- Drain and flush abundantly with good quality chlorine-free water.

If the cleaning solution shows a marked change in pH and / or strong staining, discharge, prepare a new solution and repeat the cleaning phase.

Phase 2

- Prepare a 2% v / v solution of EB-Cleaner A1 at 20 - 25°C.
- Flush 20% of the solution through the drainage membranes.
- Recycle and stop the remaining solution at 15 minute intervals for approximately 2 hours.
- Drain and flush abundantly with good quality chlorine-free water.

If the cleaning solution shows a marked change in pH and / or strong staining, discharge, prepare a new solution and repeat the cleaning phase

NOTES
• The instructions of the membrane constructors for CLEANING the must always be followed, respecting the pH, temperature, flow and differential pressure limits.
• The membranes must always be luxated, between one phase and the next, with good quality chlorine-free water.
• Before returning the system to service ensure that the residues of the CLEANING product are removed from the surface of the membranes with an abundant rinse.

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