TECHNICAL MANUAL

“RO MEMBRANES CLEANING”

RO MEMBRANES CLEANING

INTRODUCTION

The cleaning of the membranes is an important phase of the maintenance program of each reverse osmosis, nanofiltration and ultra-filtration plant.
For an effective cleaning operation, you must know the type of clogging and the characteristics of the main products available on the market.
The Everblue range of products, approved by the main membrane manufacturers, is specially designed to improve the effectiveness of the cleaning process.

WHEN TO WASH THE MEMBRANES

Even with careful precautions, effective pre-treatment and proper maintenance of the system, a progressive clogging of the membranes can occur over time.
This occurs more frequently with cellulose acetate membranes than with TFC (Thin Film Composit) membranes. The clogging period of the membranes depends on the efficiency of the pre-treatment system and the effectiveness of the anti-precipitation product used.
For some systems you don't need to carry out washing procedures while for other systems these operations must be performed only once a year or even once every two years.
However, Everblue recommends performing regular cleaning, at least once a year, to maintain a perfect efficiency of the membranes.

It is essential to wash the membranes in the initial stage of clogging.
Washing is recommended when one or more of the following parameters changes by 10-15%:

- **increase in the conductivity of the permeate**
- **increase in pressure difference**
- **increase in feed pressure**
- **decrease in production**

If the performance of the system deteriorates by more than 30%, it is often impossible, with normal procedures, to restore the system to its optimal conditions or in some cases, irreversible damage to the membranes may occur during washing operations.

To better understand the problems that can occur on membrane systems, and identify the related solutions, Everblue wanted to prepare the following information pages:

- **MEMBRANES CLOGGING**
- **EVERBLUE'S RANGE OF PRODUCTS**
- **GUIDE FOR CLEANING PROCEDURES**

CLOGGING OF THE MEMBRANES

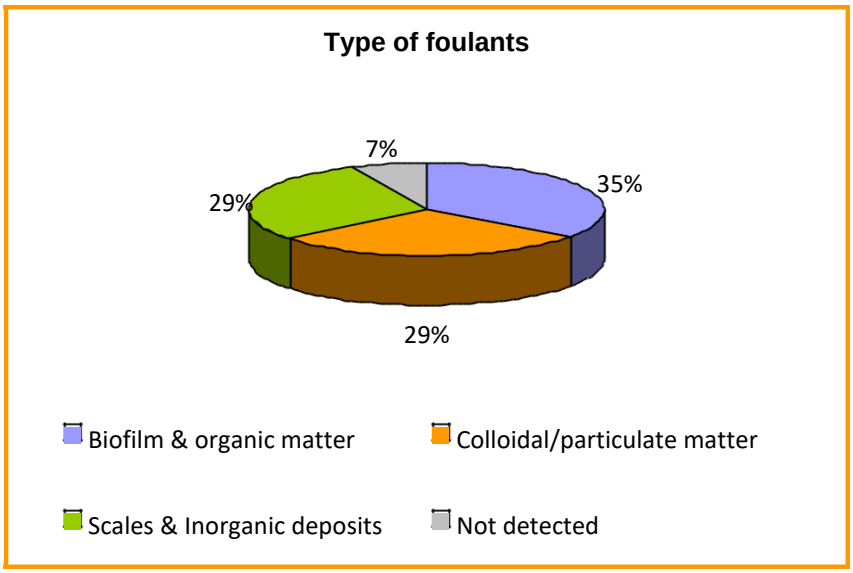
Deposits on the surface of the membranes can cause a loss of flow, an increase in the pressure difference (Delta P), a higher conductivity of the water produced, a consequent increase in the supply pressure, to keep the system production constant, or a combination of these effects.

EFFECTS OF THE MOST COMMON DEPOSITS ON THE PERFORMANCE OF THE SYSTEM

DEPOSIT	REJECTION	PRESSURE DIFF.	PRODUCT FLOW
Calcium and other inorganic deposits	10 – 25% increase	10 – 40% increase	< 10% decrease
Oxides Hydroxies	> 2 x rapid increase	> 2 x rapid increase	20-40% decrease
Colloidi	>2x aumento graduale	>2x aumento graduale	> 50%
Biofilm	Variabile dipendente dalla permeabilità	> 2 x aumento rapido	> 50% diminuzione

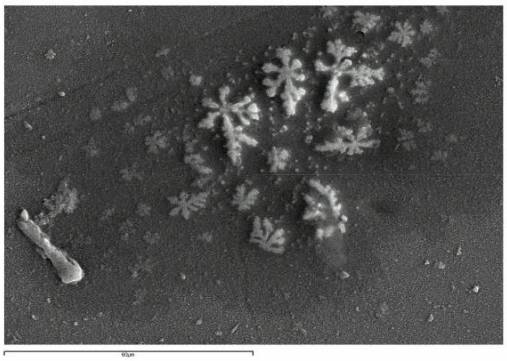
The most common deposits found on membranes used in water treatment are:

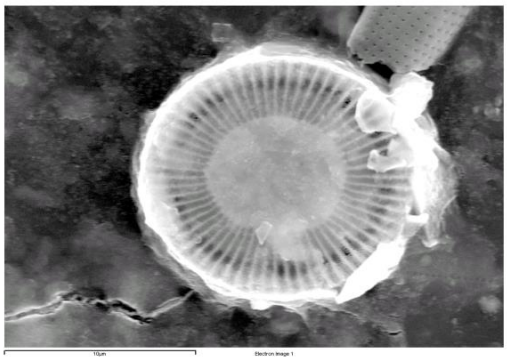
- **calcium carbonate and inorganic deposits**
- **iron oxide and hydroxide**
- **colloidal substances**
- **organic substances and biofilms**



Other precipitants and deposits such as calcium fluoride, barium sulfate, humic acids, and silica are less common but often difficult to remove.

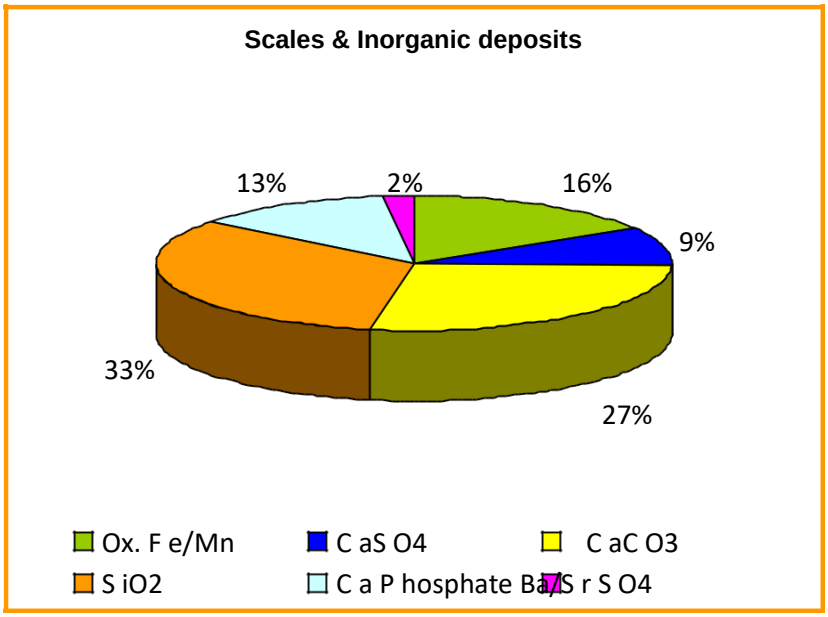
Biofilm is the most common cause of membrane loss of performance.
This deposit is mainly due to the accumulation of extracellular polymeric substances (EPS) secreted by microorganisms (bacteria, fungi, molds) introduced into the membranes from the feed water or developed within the system.
The recommended washing program requires disinfection to be performed usually in three different stages.

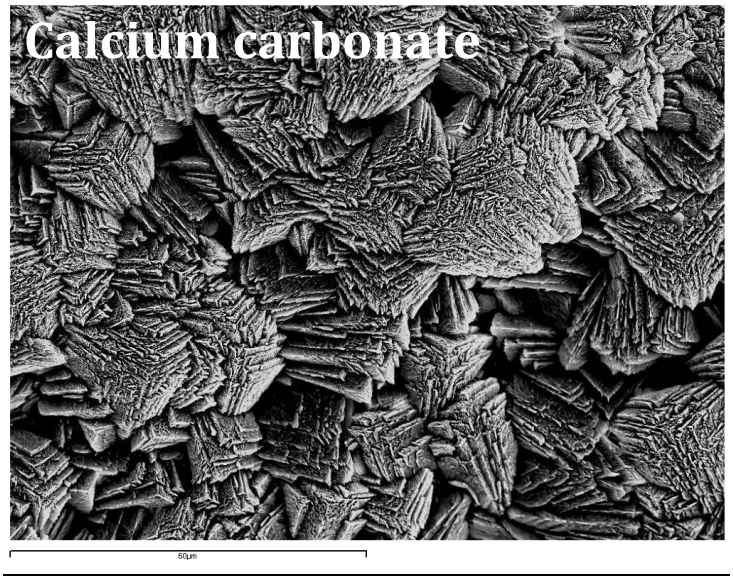


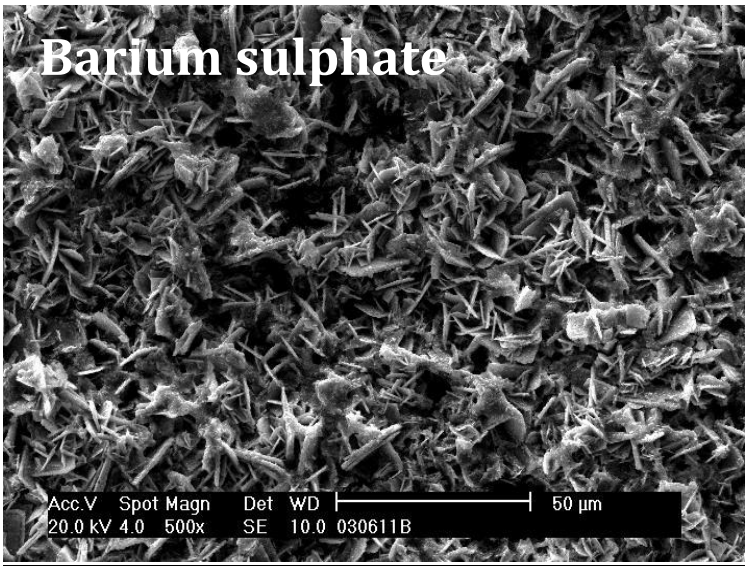


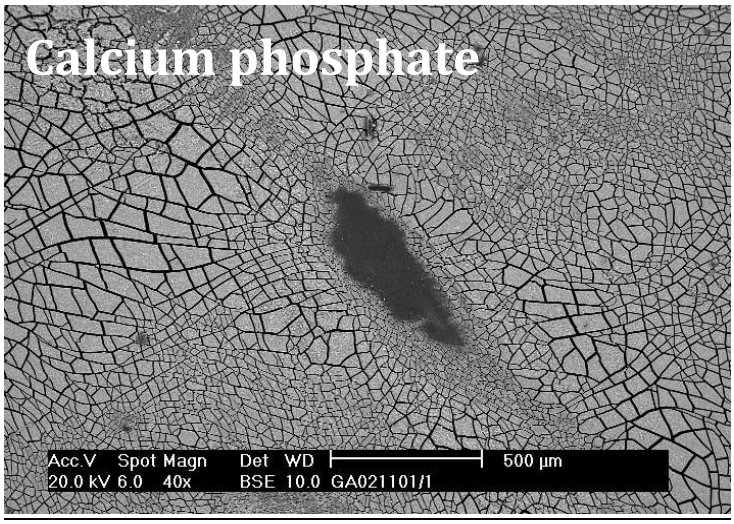
Inorganic precipitants

The increase in salt concentration during the passage of food / concentrate (waste) on the membrane surface, facilitates precipitation especially in the terminal part of the system. The use of an effective anti-precipitant, such as **EVERBLUE 100A** (approved for use in drinking water) or **EVERBLUE 200** (for use in industrial water), prevents this type of deposits. The precipitants, normally found on membranes, include calcium carbonate, calcium and barium sulfate and magnesium silicate.



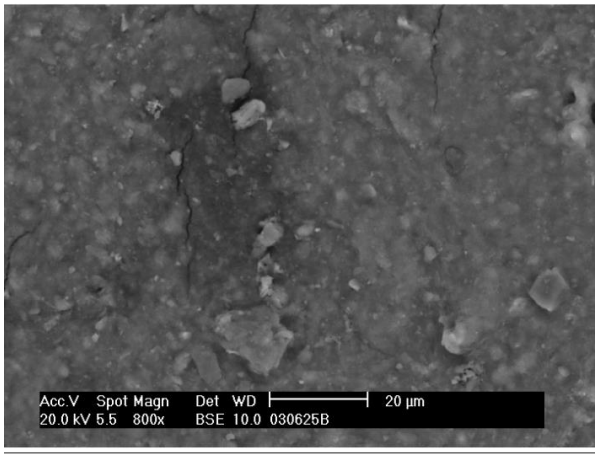

Calcium carbonate

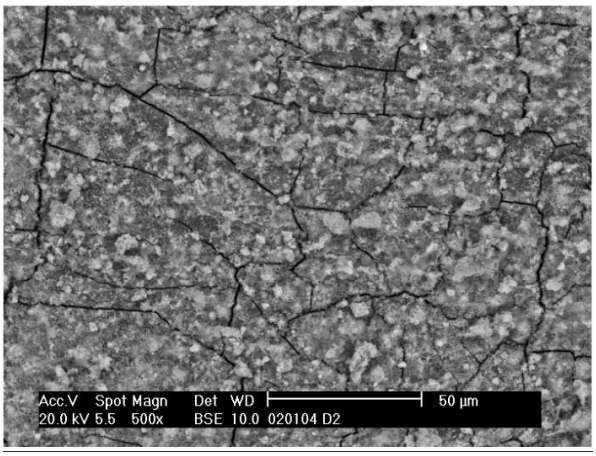

Barium sulphate
Acc.V Spot Magn Det WD 50 µm
20.0 kV 4.0 500x SE 10.0 030611B


Calcium phosphate
Acc.V Spot Magn Det WD 500 µm
20.0 kV 6.0 40x BSE 10.0 GA021101/1

Colloidal substances.

Over 5 years of membrane analysis in our laboratory have shown that one of the most frequent blockages of the modules is caused by colloidal substances (aluminosilicates - clay). The clay is made up of aluminium silicates and is colloidal. It quickly attaches to the surface of the membrane, reducing the permeability of the membrane and consequently the decrease in flow rate and the increase in supply pressure. There are several forms of aluminosilicates which often settle together with iron and biofilm which are very difficult to remove with traditional acidic or alkaline washing products. To solve this problem, Everblue, thanks to its experience, has developed a particularly effective washing procedure (contact our technical department for more information).





EVERBLUE'S RANGE OF PRODUCTS

Everblue's range of products consists of a series of acid and alkaline cleaning products suitable for removing most of the clogging and restoring the performance of all membrane systems. Created and tested in the company's laboratories, they have been applied to plants all over the world.

Extensive practical experience on different product combinations has allowed Everblue to identify a series of washing cards to remove the most common deposits. These procedures include tips for cleaning reverse osmosis membranes, nanofiltration and ultra-filtration in spiral wound, hollow fiber, flat and tubular configurations.

INDEX OF EB-CLEANER PRODUCTS

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

EB-Biocide PLUS

EB-Cleaner B1

EB-Cleaner B2

EB-Cleaner A1

The Everblue product range includes both acidic and alkaline products.

Most of these products are classified as dangerous.
For this reason, as with all other industrial chemical products, the user must know the characteristics of the compounds and make sure that all safety procedures are respected before using any of Everblue's products.

Information about safety and handling is shown on the back of the technical data sheet of each product.

Material Safety Data Sheets (MSDS) are available for each product.

It is always important that before carrying out any cleaning operation, the instructions of the membrane manufacturers are carefully consulted.

EVERBLUE: USER GUIDE

The following products can be used for washing polyamide and polysulfone membranes. You must **always** strictly follow the instructions of the membrane manufacturers. Membrane manufacturer approvals can be provided upon request.

PRODUCT	PRODUCT TYPE	TYPE OF CLOGGING	% TYPICAL CONCENT. Volume/Volume	OPTIMAL CONDITION Temperature-pH
EB-Biocide PLUS	Fast-acting non-oxidizing biocide	Microorganisms Bacteria	0,03% for 60 minutes	pH 6.0 -7.5 25°C
EB-Cleaner B1	Alkaline product High level of active substances	Insoluble sulphates Iron	2.0% - 3.0%	pH 10.0 – 11.0 25 – 30 °C
EB-Cleaner B2	Alkaline product High level 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 level of active substances	Iron oxide CaCO3	1.0% – 2.0%	pH 2.0 – 4.0 25 – 30°C

The following table indicates the correct function of each product:

PRODUCT	TYPE	CaCO3	CaSO4	BaSO4	SiO2	CaPO4	Fe/Mn	Organic	Colloids Clay	Bacteria
EB-Biocide PLUS	Biodica									■
EB-Cleaner B1	Chelation Alkaline		■	■			■	■		
EB-Cleaner B2	Chelation Alkaline							■		
EB-Cleaner A1	Acid	■				■	■			

RECOMMENDATIONS ON WASHING PROCEDURES

The choice of cleaning products depends on the type of blockage present on the membranes.
It is often advisable to use a combination of several **EB-Cleaner** products divided into one or more washing phases.
In many cases, the order of use of the products is very important.
Laboratory studies have shown that under certain conditions the application of an acid wash before using an alkaline detergent can cause an irreversible loss of production.
Thus, as a precaution, if the type of blockage has not been identified, it is best to start the washing procedure with an alkaline detergent.

WASHING PROCEDURES TABLE

CLEANING PROCEDURES

Programme	Deposit type	Phase 1	Phase 2	Phase 3	Phase 4
1	General 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 sulfate	EB-Cleaner B1	EB-Cleaner B2		
5	Silica	EB-Cleaner B2 + EB-Cleaner B1			
6	Organic deposits	EB-Cleaner B2	EB-Cleaner A1		
7	Medium 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	Clogging of UF membranes	EB-Cleaner B2	EB-Cleaner A1		

“EVERBLUE DEVELOPMENT PRODUCTS”

Many other products called **“Everblue Development Products”,** such as enzyme-based compounds, are available for special applications in the food, dairy and wastewater treatment industries.

Cleaning products for cellulose acetate membranes are also available.
For more information regarding these compounds and others not listed in the e, contact Everblue.

GUIDE TO WASHING PROCEDURES

Everblue recommends carrying out regular washing procedures to keep the membranes always in perfect efficiency.
The frequency of washing can be monthly or yearly depending on the characteristics of the system and the frequency of blockages.

It is essential to wash the membranes in the initial stage of clogging.
Washing is recommended when one or more of the following parameters changes by 10-15%:

- increase in the conductivity of the permeate
- increase in pressure difference
- increase in feed pressure
- decrease in production

If the performance deteriorates by more than 30% it is often impossible, with normal procedures, to bring the system back to optimal conditions or even, in some situations, irreversible damage to the membranes can occur during washing operations.

OPTIMIZATION OF WASHING

The washing instructions of the membrane manufacturers must be followed respecting the values of pH, temperature, flow and differential pressure.
The membranes must always be flushed abundantly between one phase and another with good quality chlorine-free water.

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

Temperature Chemical reactions are facilitated by raising the temperatures 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 membrane manufacturers must always be respected.

Hydraulic Characteristics Many washing programs require a high flow to facilitate the removal of deposits from the membrane surface, which means that a minimum flow rate must always be maintained.
It is absolutely necessary to avoid the use of excessive pressures that can cause telescoping of the membrane and can introduce particles into the porosity of its surface.

THE 10 FUNDAMENTAL RULES FOR AN EFFECTIVE CLEANING PROCEDURE

1 Wash the membranes regularly or when the differential pressure, product flow rate or conductivity vary by 10 - 15% with respect to design conditions.

2 A) Organic deposits. Wash with an alkaline **EB-Cleaner** to remove organic deposits and biofilm. This step can possibly be followed by an acid wash.
B) Inorganic precipitation. To remove inorganic precipitations, an acidic **EB-Cleaner** product must be used.

3 The flow during washing procedures must not exceed the limits indicated by the membrane manufacturers.
The operating limits to be respected during the washing operations are those indicated in the table below.

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

4 The washing solution must cross the membranes at a maximum pressure not exceeding 4 bar.

5 The recommended volume of solution for an 8 ”x 40” membrane is 40 liters (excluding the volume of the pipes).
The minimum recommended volume is 25 - 30 liters.

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

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

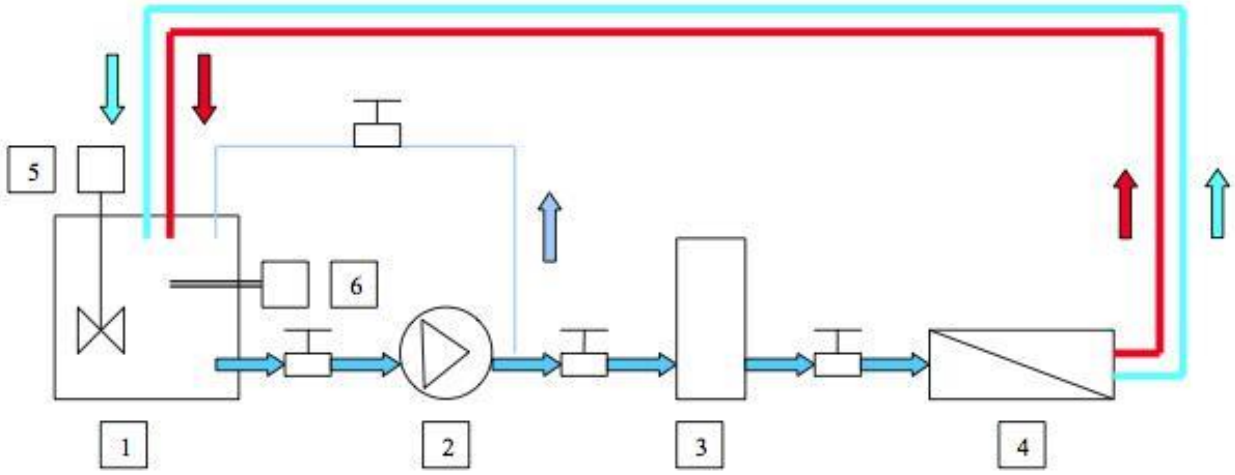
8 Flush (rinse) abundantly, with good quality chlorine-free water, the membranes, pipes, and the container of the washing solution, between one washing phase and the next and before restarting the system.

9 When it is necessary to wash a system consisting of several stages, it is advisable to wash each stage individually.

10 Do not be alarmed if, when the system is restarted, the performance has remained unchanged or even worse than those found before carrying out the washing procedure.

Many washing products cause temporary effects on membranes or polysulfone supports and therefore a continuous work service of 4 - 24 hours may be necessary to stabilize the operating conditions of the membranes.

SCHEMA DEL SISTEMA DI LAVAGGIO



1 – SERBATOIO DI LAVAGGIO
2 – POMPA DI ALIMENTO
3 – FILTRO A CARTUCCE 10 MICRON
4 – SISTEMA AD OSMOSI INVERSA
5 – AGITATORE
6 – SISTEMA DI RISCALDAMENTO SOLUZIONE DI LAVAGGIO

Warning

All the information contained in this documentation is based on laboratory data and direct experience in the field and therefore must be considered true and accurate.
Since the conditions under which these products are used are beyond Everblue's control, the results obtained cannot be guaranteed.

Via Alberto Zanrè, 16 – Loc. Gotra - 43051 Albareto (PR)

Contatti: +39 0525 1920100 – info@everblue.it – www.everblue.it