

- Cleaning Treatment

Complete Cleaning program composed of 2 steps has been designed:

- a.- Alkaline Cleaning with Osmotech® 2691
- b.- Acidic Cleaning with Osmotech® 2575

Osmotech products are designed to be used at both, ambient temperature and with pre-heated CIP solution.

Osmotech® 2691 is based on a synergic mixture of complexing agents, alkalizing compounds and anionic detergents. Osmotech® 2691 is able to remove oil, grease, ester and inorganic deposits. Osmotech 2691 has been specially designed for cleaning on alkaline resistant membranes.

A dosage of 20.0 kg/m³ (2.0%) of Osmotech® 2691 is recommended to prepare the alkaline cleaning solution.

Osmotech® 2575 is a liquid, acidic membrane cleaner based on inorganic acids. It can be used for the most membrane types on the market. Osmotech® 2575 is especially developed to remove scaling and inorganic deposits from membranes.

A dosage of 10.0 kg/m³ (1.0%) of Osmotech® 2575 is recommended to prepare the acidic cleaning solution.

The above mentioned dosages are designed considering that the CIP solution is maintained at temperature 25°C.

Please respect always the recommended limits given by the membrane manufacturer for cleaning operations.

The recommended limits for the cleaning conditions defined by the membrane manufacturer in its technical documentation are given in Table 1.



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Table 4: Hydranautics pH and Temperature Limits for Cleaning
(See Table 3 for target pH and temperatures)

Membrane	Continuous Operation		Maximum Cleaning Temp			
	<45 C	≤ 36 C	50 C	≤45 C	≤35 C	≤25 C
NANO-SW, NANO-BW	3 to 8.5	3 to 9	Contact Hydranautics Technical Department	Contact Hyd Tech Dept	1 to 10.5	1 to 11.5
ESNA1-LF, ESNA1-LF2, ESNA1-K1	3 to 9.5	2 to 10	Contact Hydranautics Technical Department	2 to 10.5	1 to 11	1 to 12
ESPA1, ESPA3, ESPA4	3 to 9.5	2 to 10	Contact Hydranautics Technical Department	2 to 10.5	1 to 11	1 to 12
ESPA2	3 to 10	2 to 10.6	Contact Hydranautics Technical Department	2 to 10.5	1 to 11	1 to 12
ESPAB	3 to 10.5	2 to 11	Contact Hydranautics Technical Department	2 to 11	1 to 11.5	1 to 12.5
LFC3, LFC3-LD	3 to 9.5	2 to 10	Contact Hydranautics Technical Department	2 to 10.5	1 to 11	1 to 12
CPA3	3 to 10	2 to 10.8	Contact Hydranautics Technical Department	2 to 11	1 to 11.5	1 to 12.5
CPA5-LD, ESPA2-LD	3 to 10.5	2 to 11	Contact Hydranautics Technical Department	2 to 11.5	1 to 12	1 to 13
SWC4+, SWC5, SWC5- LD, SWC6	3 to 10.5	2 to 11	Contact Hydranautics Technical Department	2 to 11	1 to 12	1 to 13

Table 1: Hydranautics pH and Temperature Limits for the Cleaning operations of the different membranes.

- **Disinfection**

Most of the oxidant biocides are not compatible with the RO membranes as they can damage the polyamide layer. Therefore traditionally the disinfection is done in the plant feed water and the disinfectant agent is neutralized previous to the entrance in the RO module.

The goal of the treatment of BKG is to offer a membrane compatible disinfectant, which can with direct contact with the membranes, eliminate efficiently the microorganisms.

Ferrocid® 8580 inhibits the microbiological growth and eliminates the existing micro-organisms which may create biofouling on the membrane surfaces (blocking of modules) at the same time that ensures a better permeate quality. It provides a very fast acting microbicidal effect for bacteria, fungi and algae.

Ferrocid® 8580 is a non-oxidant biocide, compatible with the RO membrane modules, effective over a wide range of pH. Ferrocid 8580 is a liquid product based on organic bromine compounds.



Scientific studies performed by BKG Fig.1 demonstrate that Ferrocid® 8580 affects the proteins located in the cellular membrane of the bacteria at the same time that inhibits the effect of some enzymes linked to the vital functions of the microorganisms. Ferrocid® 8580 is non-persistent in aquatic environment after use.

A dosage of 300 g/m³ of Ferrocid® 8580 is recommended to prepare the CIP solution.

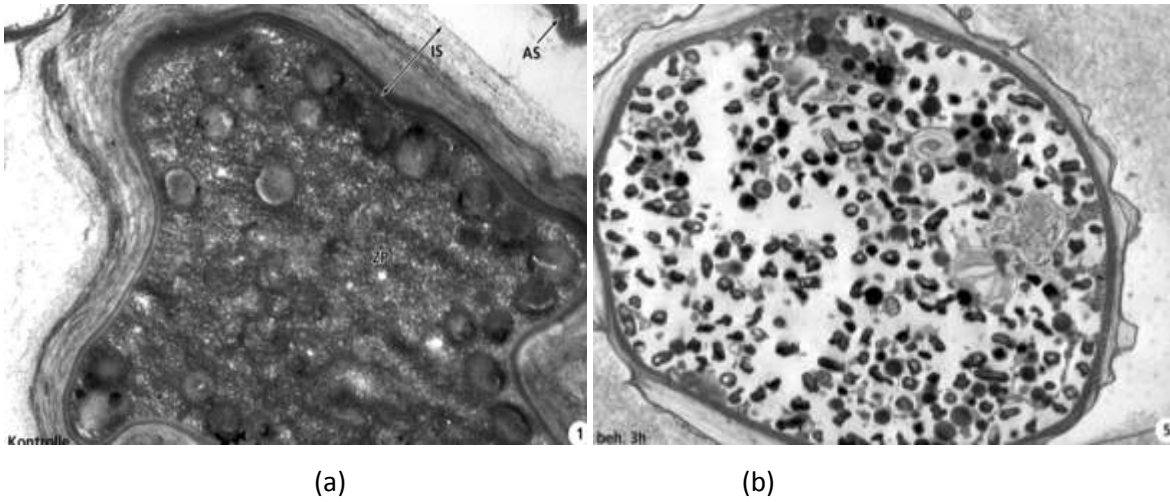


Fig 1: (a) Microorganism previous contact with Ferrocid® 8580. (b) After 60 minutes of contact with Ferrocid® 8580 the nuclear wall and some organs responsible of the vital functions (digestion and breathing) of the microorganism has been attacked.

- Cleaning + Disinfection Protocol

The following protocol has been specially developed for the cleaning operation in your plant.

THE MINIMUM WATER QUALITY THAT HAS TO BE USED IN ORDER TO PERFORM THE CLEANING OPERATIONS IS PERMEATE WATER. DO NOT USE FEED WATER TO CLEAN & DESINFECT.

a. Alkaline Cleaning with Osmotech® 2691

1. Prepare a 2.0% solution of Osmotech® 2691 (Temperature CIP Solution = Ambient) into the cleaning tank. Especially if the membranes are strongly fouled or if it is the first time that Osmotech® products



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are used for cleaning purposes, we recommend that the product is in contact with the membrane during a minimum period of 75 minutes, the cleaning time can be optimized in posterior cleaning operations (approx 45min).

2. During this period recirculation and soaking intervals will be alternated according to the following schema:

15 min. (Recirculation.) 15 min. (Soaking) 15 min. (Recirculation.)

3. The pH of the CIP solution should be measured after 30 minutes. If a pH decrease of 1.5 units is observed from the original value, fresh Osmotech® 2691 has to be added to the CIP preparation till the pH is increased to the initial value.
4. Flush out the cleaner and perform a rinsing operation with permeate water quality until the water pH is neutral.
5. Optionally the exhausted cleaning solution can be collected in a separate tank for posterior neutralization with Osmotech® 2575 previous to discharge.

* Respect the pH and Temperature limits given by the manufacturer during the cleaning operation.

b. Acidic cleaning with Osmotech® 2575:

6. Prepare a 1.0% solution of Osmotech® 2575 (Temperature CIP Solution = Ambient) into the cleaning tank. Especially if the membranes are strongly fouled or if it is the first time that Osmotech® products are used for cleaning purposes, we recommend that the product is in contact with the membrane during a minimum period of 75 minutes, the cleaning time can be optimized in posterior cleaning operations (approx 45min).
7. During this period recirculation and soaking intervals will be alternated according to the following schema:

15 min. (Recirculation.) 15 min. (Soaking) 15 min. (Recirculation.)



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8. The pH of the CIP solution should be measured after 15 minutes. If a pH increase of 1.5 units is observed from the original value, fresh Osmotech® 2575 has to be added to the CIP preparation till the pH is decreased to the initial value.
9. Flush out the cleaner and perform a rinsing operation with permeate water quality until the water pH is neutral or slightly acidic (same pH of the permeate water).
10. Previous to discharge, the exhausted cleaning solutions of Osmotech® 2691 and Osmotech® 2575 can be mixed in a separate tank in order to neutralize the pH.

* Respect the pH and Temperature limits given by the manufacturer during the cleaning operation.

c. Disinfection with Ferrocid® 8580 (optional):

11. Shock dosage of 300 ppm of Ferrocid® 8580 calculated according to the total volume of cleaning solution that will be used. Contact time 1 hours, recirculation and soaking intervals according to the following schema:

30 min. (Recirculation.) 30 min. (Soaking)

12. Flush out the water of the system and proceed to rinse the system with permeate water.



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