



**Finding a balance to
protect the environment from the industry
and at same time
protect the industry from the environment**

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Surface water use by industry

Industries use large volumes of surface water for:

- Cooling purpose of industrial processes:
 - Power plants, O&G, Chemical plants, Heavy industries, etc.
- Source to produce potable water:
 - Desalination industries (sea and Brackish)

Global annual volumes of treated seawater discharged
(Grote *et.al.*, 2022):

- Cooling processes of coastal power stations: $470 - 800 \times 10^9 \text{ m}^3$
- Desalination plants: $46 \times 10^9 \text{ m}^3$
- Ballast water treatment in ships: $3.5 \times 10^9 \text{ m}^3$





Impact industry on the receiving environment

The discharged water can have an impact on the environment:

- Discharge of chemicals (and their byproducts).
- Discharge of brine as waste product of SWRO plants.
- Discharge of heated water (cooling water system in P.Plants).
- Discharge of cooled water (LNG regassification plants).



Environmental impact on industrial water system



- Besides water, also biological organisms enter the intake.
- Intake (Cooling) Water Systems provide an ideal environment for macro-fouling settlement because of:
 - Optimal water velocities for settlement (0,2 – 2 m/s).
 - Water turbulence inside the system that facilitates settlements of larvae.
 - Continuous supply of nutrition and oxygen that stimulates growth.
 - Absence of predators that cannot pass the sieves.



Biofouling species are defined as unwanted accumulation of micro and macro-organisms on substrate which is submerged in water, or frequently submerged

Impact of biofouling on the industry

Known impacts of biofouling:

- Risk on operational reliability
- Head loss due increased wall roughness
- Reduction of thermal efficiency
- Increased demand for chemicals
- Increase ΔP on RO membranes
- Increase CIP frequency
- Leakages due to corrosion, (MIC)
- Unplanned outage
- Risk for human health by pathogens such as *Legionella pneumophila* (cooling towers)
- Biofouling always results in higher O&M costs

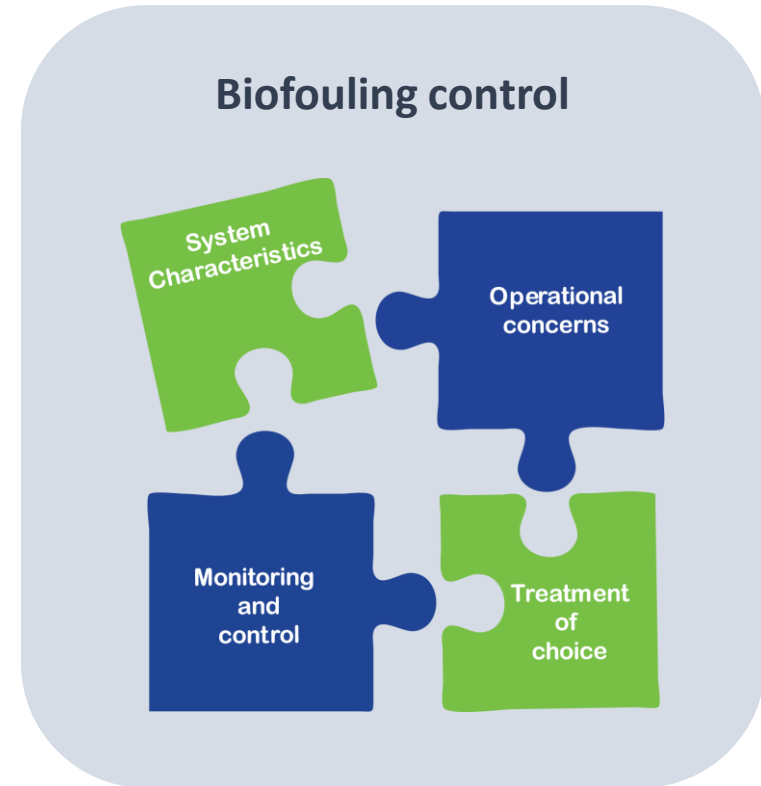


How to prevent Biofouling

Rather than “just” a biocide implementation, Ecodosing™ provides an effective biofouling solution for every type of utility. It takes all conditions and specifications of the water system into account.

is based on:

- Cooling/intake water system design.
- Biofouling species.
- Water quality
- Seasonal effect.
- Restriction related to system specifications and discharge permit allowance.



- *Proven technology for 20+ years (previously called Pulse-Chlorination®).*
- *Technology based on local specific conditions: Type of species, Water quality and seasonal variations, Seawater system specification*
- *Acknowledged as Best Available Technique (BAT) by the EU IPPC Bref and local governments in several countries.*

Case: UNIPER Maasvlakte PP



Case

- North sea coast, seasonal effect and high biofouling potential.
- Once-through cooling water system, several Power Plants and industries, 172.000 m³/hr.



Challenge

- Reduce chlorine use.
- Even during continuous chlorination cleaning outage required every 2 years.



Solution

- Ecodosing: 50% reduction in chlorine dosage
- Permit renewed



Impact

- No cleaning outage required (Saving > 500kEur).
- Improved operational reliability (20 years no problems).
- Large cost savings chlorine use (>500kEur / year).

Polman et.al. 2010

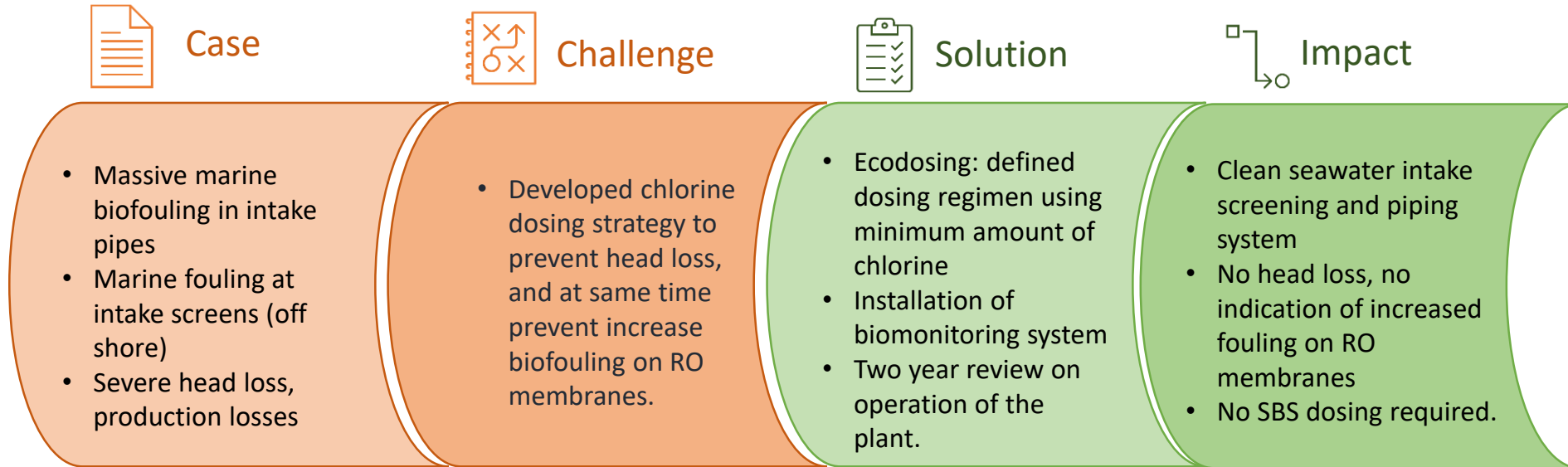


before



after

Case: SWRO Desalination plant Sur Oman



Polman et.al. 2021

Membranes

Opportunities for industries

- Minimize the use of biocides to a minimum, while securing operational reliability and production capacity.
- Promote the ecological habitat function by optimizing design criteria of underwater discharge structures (e.g., coating with eco concrete – structure concrete enhances to the microorganisms to grow) to promote coral growth, nursery ground for fish etc. increasing the surface areas to stimulate marine biofouling to settle (van der Merwe 2020).
- Strive towards more environmentally friendly ways to control biofouling.
- Stimulate same type of regulations between neighboring countries.



THANK YOU

Water without biofouling risk



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