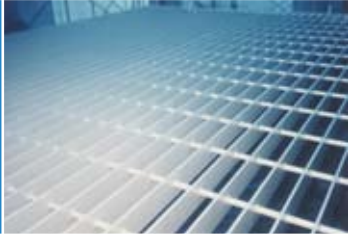


Bioclean ECO

Environmentally - Friendly
Biocide - Free Silicone Foul Release Coating System

Satisfied result on many application



Bar Screen



Filter



Filter



Internal Circle Water Pipe



Rotary Screen



Cooler



Condenser



Internal Condensed Cooling Water Conduit

Bioclean ECO

Environmentally - Friendly
Biocide - Free Silicone Foul Release Coating System

BIOCLEAR ECO system is high performance foul release coating system developed by Chugoku Marine Paints who have more than 25 years experience of biocide free coatings based upon silicone technologies. BIOCLEAR ECO conforms to CHUGOKU's environmentally - friendly policy as it is biocide free and low V.O.C. It is suitable for equipment and facilities such as internal of cooling water intake piping at power stations to prevent marine fouling. The film structure is combined with the silicone bond and methylated groups. At its core, the silicone bond is strong and stable. Surrounding the core are methylated groups, which behave similar to oil hence low surface free energy which results in water repellence. BIOCLEAR ECO system does not pollute the marine environment, hence it offers many benefits. In consequence, it has the leading share in the Industrial market having experience of more than 500,000 sq.m in various applications worldwide.

Features

1 Biocide - Free

The BIOCLEAR ECO film surface specialty delivers anti fouling performance without toxic components or heavy metals. Therefore ensuring our oceans are clean and safe. (Generally Cuprous oxide pigment in the film or infusion of sodium hypochlorite into the seawater are effective for inhibition of marine fouling)

2 Low V.O.C.

BIOCLEAR ECO contains only 51g / Litre V.O.C. (Volatile Organic Compounds). Moreover, BIOCLEAR ECO does not contain the solvents Toluene or Xylene which as well as improving odour during application and results in it meeting the PRTR (Pollutant Release and Transfer Register) control regulation.

3 Higher Foul Release Performance

The foul release mechanism is implemented via the control capability arising from the use of silicone technology where the " Micro phase separated structure " on the surface of BIOCLEAR ECO takes on the polarity of both hydrophobic – Hydrophilic groups hence acting similar to the skin of fish. This structure gives excellent foul release performance.

4 Long Term Durability

The biocide free component and high chemical stability function for the long term and experience minimal environmental degradation, hence prolonging the performance without any harmful elution.

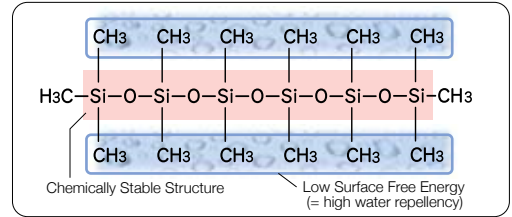
5 Cost Saving

Long servicing life, fewer coats in application and excellent foul release performance ensure low cost maintenance.

Mechanism For Foul - Release

Scientific Characteristics of Silicone

Core = The silicone bond which is strong and stable
Surrounding = The methylated groups which are similar to oil hence resulting in low surface free energy
 The Combination of the Core + Surrounding structure is effective due to **5 main functions** (see Functions for foul release below).

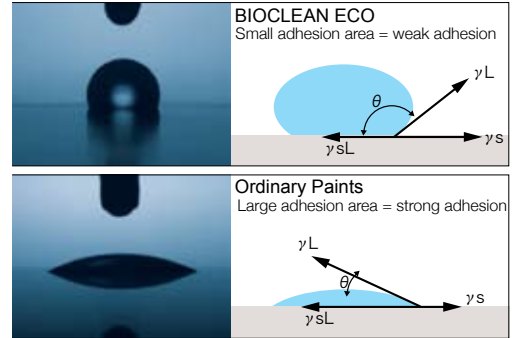


Physical attribute of Foul Release

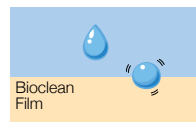
According to YOUNG's and DUPRE's equation. The wider angle (θ) of the liquid droplet on a solid surface indicates that the marine organism is inhibited from adhesion.

$\gamma_s = \gamma_{sL} + \gamma_L \cos\theta$ (YOUNG's equation)
 γ_s : Surface tension of solid surface
 γ_L : Surface tension of liquid droplet
 γ_{sL} : Boundary tension between solid and liquid

$W_a = \gamma_s + \gamma_L - \gamma_{sL}$
 $= \gamma_L (1 + \cos\theta)$ (YOUNG's and DUPRE's equation)
 W_a : Workload (adhesion property) of liquid droplet adhesion on solid surface

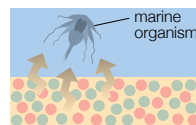


Function For Foul - Release



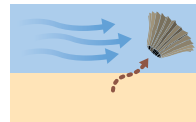
Low Surface Energy

The surface energy of the BIOCLEAN ECO film is engineered to be lower in order to produce the optimum range for inhibition, or reduction of adhesion of both marine organisms and the cements they deposit for adhesion purposes.



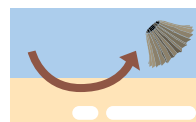
Micro Phase Separated Structure (Please refer to appendix)

The BIOCLEAN ECO film surface has a similar attribute to that of antithrombotic materials. This results in resistance to adhesion of the cements deposited by the marine organisms due to foreign bodies having an adverse reaction to them. Consequently the marine organisms cannot anchor themselves well on the surface of the film.



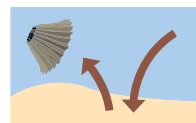
Smooth Surface

The smooth surface of BIOCLEAN ECO film results in easy release of the marine fouling due to it not having a good anchor and despite the marine organism trying to stay in position.



Low Friction

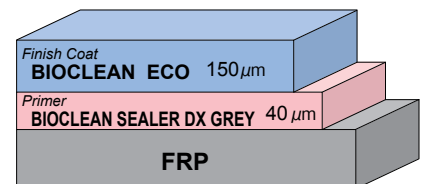
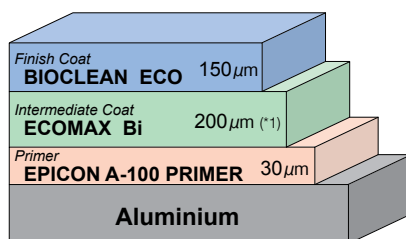
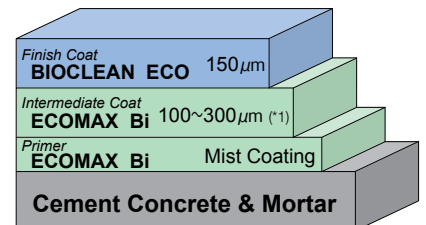
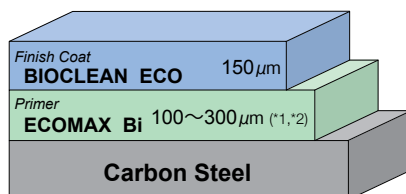
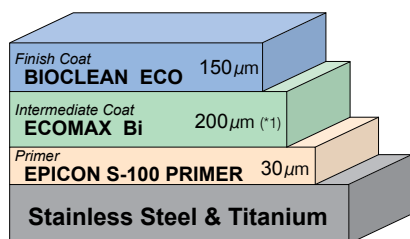
Marine organism cannot remain for long periods on the film surface due to the low friction properties of the BIOCLEAN ECO film surface.



Elasticity

The BIOCLEAN ECO film exhibits moderate elasticity which provides an unstable surface hence making it difficult for a marine organism to anchor itself on the surface.

Standard Coating Specifications



*1 : Dry film thickness (D.F.T.) should be specified according to owner's requirements.
 *2 : Primer and intermediate coats and their film builds (D.F.T.'s). can be replaced with higher grades of anti - corrosives which provide greater durability an example is the use of a zinc primer system for use on steel.
 * : Details such as surface preparation of substrata and overcoating intervals should be adhered to. Please refer the appropriate data sheets for this information.



Analysis test data for dissolution from dry film of BIOCLEAR ECO
(by Hiroshima City institute of Public Health)

Item	Result	Admissibility (Japanese Law)
Cadmium	Undetected	0.1 mg / litre
Compounds Cyanide	Undetected	1.0 mg / litre
Organic Phosphate	Undetected	1.0 mg / litre
Lead	Undetected	0.1 mg / litre
Hexavalent Chromium	Undetected	0.5 mg / litre
Arsenic	Undetected	0.1 mg / litre
Organic Mercury	Undetected	Undetected
pH	6.2	5.0 - 9.0
COD	0.8 mg / litre	160 mg / litre
n - Hexane Abstraction	Undetected	160 mg / litre
Phenol	Undetected	5.0 mg / litre
Copper	Undetected	5.0 mg / litre
Zinc	Undetected	3.0 mg / litre
Soluble Ferrous	Undetected	5.0 mg / litre
Soluble Manganese	Undetected	10 mg / litre
Fluorine Ion	Undetected	15 mg / litre
Tin	Undetected	1.0 mg / litre
Test Condition	<ul style="list-style-type: none"> ■ Substratum ; Acrylic Resin Cylindrical Column ■ Coating System ; Epoxy resin primer + BIOCLEAR ECO ■ Coating Area ; 235.5 cm² / 7.5 litre ion-exchange water ■ Sample rolling speed ; 1m / second ■ Sample rolling period ; 14 continuous days 	