



*Sea*Lion

REPULSE
Nanorepellent Technology™





SeaLion Repulse

Jotun in-house technology

As one of the global leaders in the marine paint market, Jotun takes a major step with their innovation in the Fouling Release Coatings (FRC) market by introducing the SeaLion Repulse.



Jotun is among one of the world leaders in the marine industry, established in 80 countries around the world with a strong reputation in the marine business segment, supplying the worlds' merchant fleet with high quality coating systems and the world's most advanced antifouling technology. With research and development as a core part of the

business, innovation has become a driver for change and new developments, supporting the vision of being perceived as a leading quality supplier of solutions based on customer's needs.

In 2002 Jotun A/S and NKM formalised their co-operation by forming SeaStar Alliance which has more than 22% of the global marine market, providing a presence that ensures that products and services are readily available wherever a ship is being built or drydocked, supported by Coatings Advisors with FROSIO, NACE or similar accreditations.

Sharing of existing and developing technology helps sharpen the competitive edge for the SeaStar Alliance, enabling its partners to maintain their status as leaders in the marine market.

SeaLion Repulse is based on an in-house technology from one of Northern Europe's largest privately owned R&D laboratories. By introducing the Nanorepellent Technology™ with additional features, Jotun is bringing a breakthrough in fouling release coatings technology to the market.



Photo: Courtesy of www.jeffkraus.com



Take fouling control

The non-stick properties of conventional FRC's are based on the properties of silicone, which provides a chemically inert surface. The advancement achieved by introducing Nanorepellent Technology™ is that the film surface has been modified to increase its fouling repellent properties. With the introduction of nanoscaled-springs, the repellent properties are introduced in addition to the release properties. This inhibits adhesion of fouling compared to conventional FRC's on the market.

Nanorepellent Technology™

The Jotun in-house Nanorepellent Technology™ has provided SeaLion Repulse with release and repellent properties. Through nanoscale engineering of the coating's surface a repellent layer is created on the silicone surface. The nano structures extend into the water creating a layer that acts as nanoscaled-springs. When the spring-like structures are compressed, a counter force is developed. The nanoscale-springs thereby provide release and repellent properties to prolong the period before settlement of slime and other fouling. This gives a smoother surface than conventional FRCs with a system life up to 10 years under normal conditions.

Jotun Antifouling laboratory



Scales of fouling

The environmental and economic aim of hull protection is to minimise fuel consumption through a smooth fouling-free surface. This will minimise bunker costs and emission of greenhouse gases to air.

The estimated 4-5000 species of fouling can be classified into three groups based on the fully grown specimen.

ALL FOULING STARTS ON A NANOSCALE LEVEL

The initial stage of fouling on a submerged hull consists of an organic monolayer of glycoproteins and polysaccharides. These nanoscaled substances may be seen indirectly by

advanced scientific instruments, and have no direct influence of the frictional resistance (fuel consumption), but rather acts as a primer for fouling organisms. Through the employment of nanoscaled-springs the repellent properties of the Nanorepellent Technology™ inhibit adhesion of fouling. (Figure 1).

MICROSCALED FOULING

The next successive stage of fouling comprises a complex mixture of groups of bacteria and diatoms in drifting plankton. These microbial organisms may be studied through a microscope. Agglomerates of these microbial organisms may be seen by the naked eye as a slime layer, and have a direct

impact on the frictional resistance and fuel consumption. (Figure 2).

MACROSCALED FOULING

In the final stage of fouling both animals and plants are included. At this stage the impact on frictional resistance is severe and may give a fuel penalty up to 40%. (Figure 3).

Both micro and macro fouling attach by a complex nano-sized glue mixture. Hence all fouling start on a nanoscale level. The Nanorepellent Technology™ inhibits micro and macro fouling.

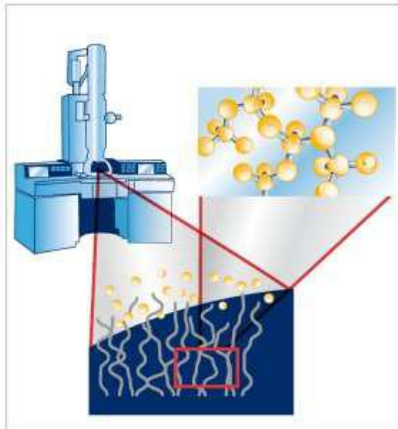


Figure 1

The coating surface has been engineered by introducing spring-like nanoscale structures. One nanometer is one billionth of a meter, and structures of this size can only be evaluated by advanced scientific instruments.

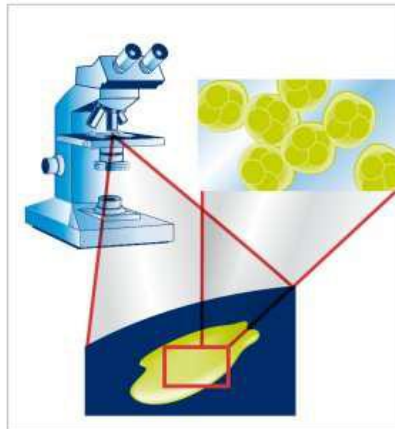


Figure 2

One micrometer is 1,000 nanometers. Micro fouling organisms may be investigated by optical microscopy. Agglomerates of micro fouling organisms are visual to the naked eye.

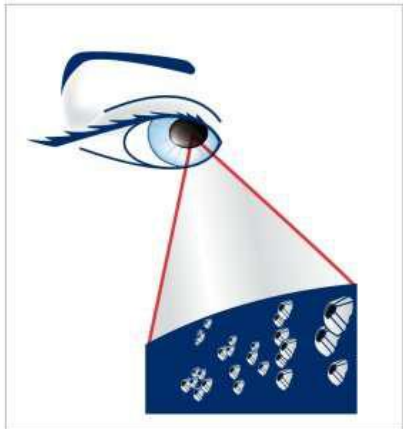


Figure 3

One millimeter is 1,000,000 nanometers. Macro fouling of this size is easily detected by the bare eye.



Repulsion on a nanoscale

Nano technology has received growing attention in the last decade and has almost become a daily expression. One nanometer is one billionth of a meter. Relating this to the scale of chemistry can be illustrated by; atomic and molecular dimensions in the order of 0.1 nanometer and upwards.

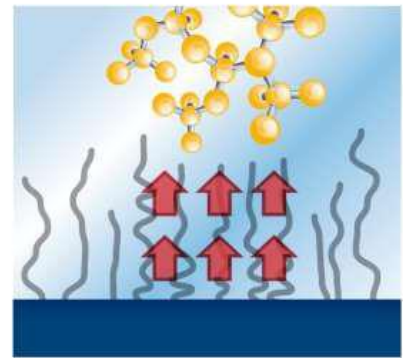
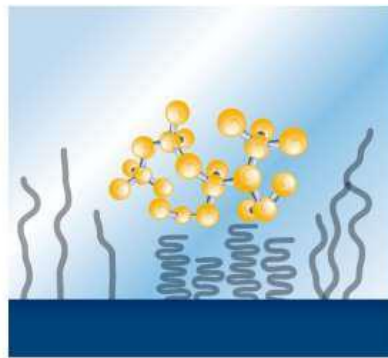
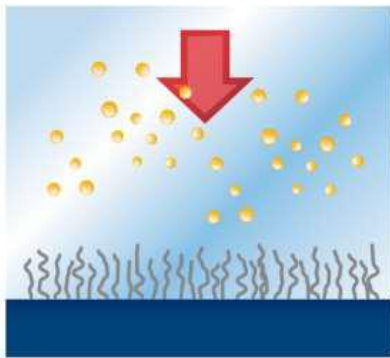
Large molecules organised assemblies of such are in the nanoscale. The concept «nano technology» commonly refers to structures up to 100 nanometers.

Organisms attach themselves to surfaces by exerting biological glues which are molecules that can form chemical bonds

to the surface. These are macromolecules with reactive chemical entities. When these are repelled by the nanoscaled-springs, fouling is inhibited.

1) REPELLENT PROPERTIES

Incoming nano-sized glue from micro or macro fouling is repelled by the nano-springs, and hence fouling is inhibited.



2) RELEASE PROPERTIES

Barnacles can easily be removed from the surface.





COMPARISON OF STATIC PERFORMANCE OF SEALION REPULSE VS PREVIOUS SEALION

SeaLion Repulse



SeaLion



Only some light slime on SeaLion Repulse, whereas SeaLion have barnacle settlements in addition to slime.



Advantages

- Prolongs the time for slime and fouling to settle
- Keeps a smooth surface longer than traditional FRC's
- Less fuel consumption
- Long term investment
- Environmentally sustainable



Areas of use

TYPE OF VESSELS	HULL	PROPELLER	RUDDER
CONTAINER	Yes	Yes	Yes
LNG	Yes	Yes	Yes
VLCC	Yes	Yes	Yes
BULKER	Yes	Yes	Yes
CRUISE	Yes	Yes	Yes
REEFER	Yes	Yes	Yes
CAR CARRIER	Yes	Yes	Yes

Questions and answers



Q What is FRC?

A FRC is short for Fouling Release Coatings and is a low surface energy coating with a smooth, non-stick, water-repellent surface.

Q What is Nanorepellent Technology™?

A A technology based on specifically designed nanoscale-springs, that are motile when linked to the surface of the coating giving a dynamic surface structure. This provides both release and repellent properties towards slime and other fouling.

Q What is the difference between Nanorepellent Technology™ and other FRC-technologies?

A Conventional FRC technology is based on low surface energy and elastic properties of the film. Nanorepellent Technology™ is an advancement where the film surface has been modified to increase its fouling repellent properties. This is accomplished by introducing specifically designed nanoscale structures that obstruct and diminish the attachment of the fouling.

Q Does the nano-springs affect the hull roughness?

A No. The nano-springs are on a scale order of magnitude smaller than hull roughness and do not influence the coating.

Q What are the benefits of SeaLion Repulse?

A Prolongs the time for slime and fouling to settle. Keeps a smooth surface longer than traditional FRC's. Reduced fuel consumption and environmentally sustainable.

Q What are the advantages of SeaLion Repulse compared to standard SeaLion?

A SeaLion Repulse offers better fouling control and protection through the repellent effect which prolongs the time for slime to settle. Keeps the hull smooth for longer, improved static robustness and reduced fuel consumption compared to standard SeaLion.

Q What is the total coating system for using SeaLion Repulse?

A Anticorrosive primer, Safeguard Universal ES, SeaLion Tiecoat and SeaLion Repulse.

Q Is SeaLion Tiecoat an important part of the SeaLion Repulse system?

A Yes, as it provides an excellent adhesion strength and through this a mechanically more robust system.

Q What surface preparation is needed?

A Full blast is our recommendation. If the coating film has minor damages, a touch-up of the topcoat is recommended.

Q Can conventional FRC's be overcoated by SeaLion Repulse?

A Yes. Contact your local Jotun office for advice and recommendation.

Q What is the expected lifetime of the system?

A Up to 10 years lifetime with a touch-up after 5 years.

Q What is minimum speed for SeaLion Repulse?

A As this depends on vessel type, trade and sailing waters may vary. Contact a Jotun representative for correct specification.

Q How smooth is SeaLion Repulse compared to other FRC's in the market?

A SeaLion Repulse is equally smooth compared to other FRC's in the market and offers in addition the nano-spring repellent properties.

Q What is the expected fuel savings with SeaLion Repulse?

A Major fuel savings can be expected depending on vessel type, trade, weather and sailing pattern.

Q Is SeaLion Repulse in compliance with the latest IMO rules?

A Yes, SeaLion Repulse is in compliance with the latest IMO rules. There are no biocides in the product.

Q Is SeaLion Repulse based on a Jotun formulation?

A Yes, SeaLion Repulse is based on an in-house technology as a result of several years' research, in one of Northern Europe's largest privately owned R&D research laboratories.

Q Will slime/algae occur on FRC?

A Yes. Slime and algae will occur on any FRC in the market regardless of technology. SeaLion Repulse with its Nanorepellent Technology™ gives both repellent and release properties that prolong the period up to settlement of slime and fouling.

Q Will mechanical damage occur on SeaLion Repulse?

A Yes, due to the elastic nature of the film, damage might occur when exposed to mechanical impact.

Q Further questions?

A Please contact a Jotun representative for professional advice.



Uniform Standard of Global Service

Global service

- Highest number of technical personnel in the industry
- Same high standard of trained personnel globally
- Easy to exchange trained technical personnel across national borders and multi-national projects

Standardised

- Same tools, reports, procedures and behaviour worldwide
- Same competence in maintaining company standard procedures
- Recognised globally by their yellow and red boiler suits

Coating Advisor Academy

- Compulsory training for all technical personnel worldwide
- Theoretical and practical training testing and examination
- FROSIO and NACE certification
- First Aid and Fire-Fighting



Trained to Deliver the Ultimate Result

Jotun Worldwide · Jotun Coatings and Jotun Paints · Divisions of Jotun A/S

Legal Jotun entities worldwide listed · For details on Branch offices and Jotun representation in countries not listed, please visit www.jotun.com

AUSTRALIA

Jotun Australia Pty. Ltd.
P.O.Box 105, Altona North
9 Cawley Road
BROOKLYN, VIC 3025
Tel: +61 3 9314 0722
Fax: +61 3 9314 0423

BRAZIL

Jotun Brasil Ltda.
Av Santa Luzia, 2084 - Santa Luzia
24.722-315 São Gonçalo
RIO DE JANEIRO
Tel: +55 21 2776 1313
Fax: +55 21 2776 2263

P.R. OF CHINA

Jotun Coatings (Zhangjiagang) Co. Ltd.
Jotun COSCO Marine Coatings Co. Ltd.
Floor 20, Jiu Shi Mansions
No. 28 Zhong Shan Road (South)

SHANGHAI 200010

Tel: +86 21 6333 080 0
Fax: +86 21 6326 968 6
Jotun Coatings (Zhangjiagang) Co. Ltd.
Jotun COSCO Marine Coatings Co. Ltd.
Room 709-12, Goldlion Digital Network
Centre, 138 Tiyu Road East

GUANGZHOU, 510620

Tel: +86 20 38 78 07 49
Fax: +86 20 38 78 19 66
HONG KONG
Jotun COSCO Marine Coatings (H.K.) Ltd.
Room 1208, 12/F, Stanhope House
734 King's Road, Quarry Bay
HONG KONG
Tel: +852 2527 6466
Fax: +852 2861 1307

DENMARK

Jotun Danmark A/S Jotun Coatings
Columbusvej 5, 2860 Søborg
COPENHAGEN
Tel: +45 4492 9400
Fax: +45 4492 9401

EGYPT

El Mohandes Jotun S.A.E.
El Sheikh Aly Gad El Haq Street
Florida Mall, Masaken Sheraton - 4th Floor
CAIRO
Tel: +20 2265 1800
Fax: +20 2265 1801

FINLAND

Nor-Maali OY
Vanhatie 20, 15240 LAHTI
Tel: +358 3 874 650
Fax: +358 3 874 6550

FRANCE

Jotun France S.A.
22/24 Rue du President Wilson, Bat.A
92300 LEVALLOIS PERRET
Tel: +33 1 4519 3882
Fax: +33 1 4519 3894

GERMANY

Jotun (Deutschland) GmbH
Haferweg 38
22769 HAMBURG
Tel: +49 40 851 960
Fax: +49 40 856 234

GREAT BRITAIN

Jotun Paints (Europe) Ltd.
Stather Road, Flixborough
SCUNTHORPE DN15 8RR
Tel: +44 1724 400 000
Fax: +44 1724 400 100

GREECE

Jotun Hellas Ltd.
Skouze 26 Str.
PIREAUS 18536
Tel: +30 210 42 85 980-82
+30 210 42 86 035-37
Fax: +30 210 42 85 983

INDIA

Jotun India Pvt Ltd.
204 & 205 Ascot Centre
Sahar Road, Andheri (East)
MUMBAI 400 099
Tel: +91 22 2822 4600
+91 22 2820 5900 (+fax)
Fax: +91 22 2820 5900

INDONESIA

P.T. Jotun Indonesia
Kawasan Industri MM2100
Blok KK-1, Cikarang Barat
Bekasi 17520
Tel: +62 21 8998 2657
Fax: +62 21 8998 2658

IRELAND

Jotun (Ireland) Ltd.
Unit K7, Marina Commercial Park
Centre Park Road, CORK
Tel: +353 214 965955
Fax: +353 214 965992

ITALY

Jotun Italia S.P.A.
Via Petronio, 8, Zona Ind. Noghère
34147 - MUGGIA (TRIESTE)
Tel: +39 040 23 98204
Fax: +39 040 23 98222

KOREA (SOUTH)

Chokwang-Jotun Ltd.
30th Block Jisa Science Park
1205 Jisa-dong, Gangseo-gu
BUSAN 618-230
Tel: +82 517 976 000
Fax: +82 517 117 735

LIBYA

Jotun Libya J.S.Co
Al Mumtaz Imp. of Paints and Equipm. Co.
P.O.Box 6850
Hail Al Andalous district
TRIPOLI
Tel: +218 214777811
Fax: +218 214780718

MALAYSIA

Jotun (Malaysia) Sdn. Bhd.
Lot 7 Persiaran Perusahaan
Section 23, P.O. Box 7050
40700 SHAH ALAM
Tel: +60 351 235 500
Fax: +60 351 235 632

THE NETHERLANDS

Jotun B.V.
Postbus 208
3200 AE SPIJKENISSE
Visiting address:
Curieweg 11b, 3208 KJ Spijkenisse
ROTTERDAM
Tel: +31 181 678 300
Fax: +31 181 617 899

NORWAY

Jotun A/S
P.O.Box 2021
3248 SANDEFJORD
Visiting address:
Hystadveien 167, 3209 Sandefjord
Tel: +47 33 45 70 00
Fax: +47 33 45 79 00

OMAN

Jotun Paints Co. LLC
Rusayl Ind. Estate, Road No.10
P.O. Box 672 Code 111, MUSCAT
Tel: +968 2444 6100
Fax: +968 2444 6105

PAKISTAN

Jotun Pakistan (Pvt.) Limited
Plot no. 2-H, Sector 5
Korangi Industrial Area, KARACHI
Tel: +92 213 5121 491-2
Fax: +92 213 5121 493

POLAND

Jotun Polska Sp.zo.o.
Ul. 10 Lutego 16, 81-364 GDYNIA
Tel: +48 58 555 1515
Fax: +48 58 781 9692

RUSSIA

Jotun Paints O.O.O.
Stachek Avenue 57, No.31
198096 ST. PETERSBURG
Tel: +7 81 2332 0080 / 2785 0034
Fax: +7 81 2783 0525

SAUDI ARABIA

Jotun Saudia Co. Ltd.
Jeddah Industrial City, Phase 3
P.O.Box 34698, JEDDAH 21478
Tel: +966 2635 0535 / 2636 1271
Fax: +966 2636 2483

SINGAPORE

Jotun (Singapore) Pte. Ltd.
11&15 Sixth Lok Yang Road
Jurong, SINGAPORE 628111
Tel: +65 650 882 88
Fax: +65 6265 7484

SOUTH AFRICA

Jotun Paints South Africa (PTY) Ltd.
Wimbledon Road, P.O.Box 187
BLACKHEATH 7581
Tel: +27 21 905 1070
Fax: +27 21 905 1652

SPAIN

Jotun Iberica S.A.
Poligon Santa Rita
Calle Estatica no. 3
08755 Castellbisbal, BARCELONA
Tel: +34 937 711 800
Fax: +34 937 711 801

SWEDEN

Jotun Sverige AB
P.O. Box 151, Klangfärgsgatan 13
421 22 VÄSTRA FRÖLUNDA
Tel: +46 3169 6300
Fax: +46 3169 6397

THAILAND

Jotun Thailand Ltd.
Amata Nakom Ind. Estate (BIPIL)
700/353 Moo 6 Tumbol
Donhualoh, Amphur Muang
CHONBURI 2000
Tel: +66 38 214 824-6/214 347-51
Fax: +66 38 214 373/375

TURKEY

Jotun Boya San. ve Ticaret. A.S.
Yeni Camlik Caddesi
Ayaz Sok. No. 2/4, 4. Levent
ISTANBUL 34418
Tel: +90 21 2279 7878
Fax: +90 21 2279 2549

U. A. E.

Abu Dhabi
Jotun Abu Dhabi (LLC)
P.O.Box 3714, Mussafah
ABU DHABI
Tel: +971 2551 0300
Fax: +971 2551 0232

DUBAI

Jotun U.A.E. Ltd. (LLC)
P.O.Box 3671
Al Quoz Industrial Area
DUBAI
Tel: +971 4339 5000
Fax: +971 4338 0666

USA

Jotun Paints, Inc.
9203 Highway 23, P.O. Box 159
Belle Chasse, LA 70037
Tel: +1 800 229 3538 /
+1 504 394 3538
Fax: +1 504 394 3726

VIETNAM

Jotun Paints (Vietnam) Co. Ltd.
Song Than Industrial. Zone
No.1 Street 10
Di An District, Binh Duong Province
Tel: +84 65 074 2206-9
Fax: +84 65 074 2205

YEMEN

Jotun Yemen Paints Co. Ltd
P.O. Box 70183, Al Alam
ADEN
Tel: +967 2820 546-9
Fax: +967 2249 362



HEAD OFFICE

Jotun A/S
P.O. Box 2021, 3248 Sandefjord, Norway
Tel: +47 33 45 70 00 Fax: +47 33 45 79 00
www.jotun.com