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»ROBUST« - INTEGRATED COATING AND CLEANING CONCEPT FOR FOULING CONTROL ON OFFSHORE STRUCTURES

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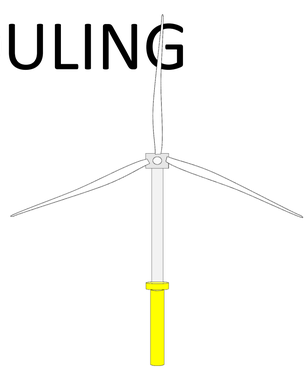


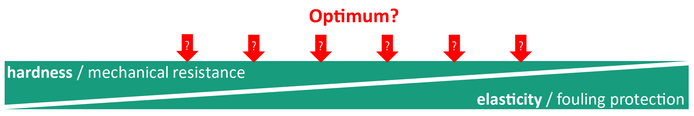
Motivation

- Biofouling is an unsolved problem in offshore industry, it induces a lot of work and therefore high costs
- It causes problems, when the welding seams of offshore-structures have to be controlled by divers regularly
- The industrial standard coatings should be replaced by more efficient non-biocidal systems

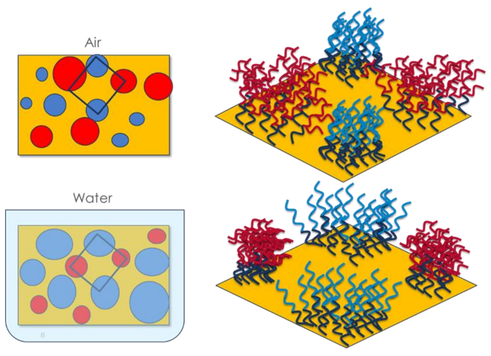
Summarized project goals:
Less fouling, easier cleanings, mechanical stability of the coating, no input of biocides into the environment and lower costs at maintenance

Experimental setup

Technology concept



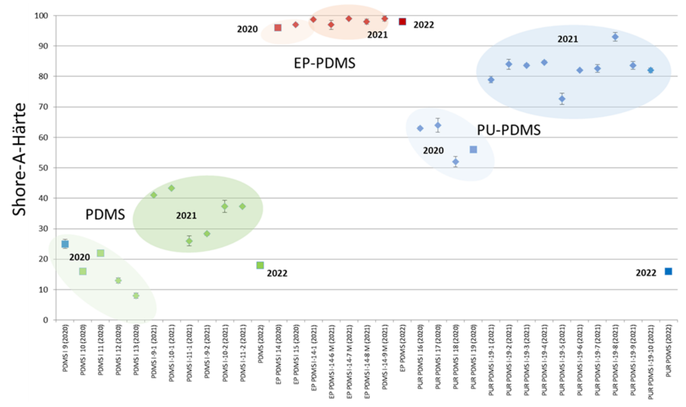
Conversion of the silicone system with low mechanical resistance while retaining the foul-release properties into an abrasion-resistant cleanable coating



Schematic illustration of a surface consisting of hydrophilic and hydrophobic domains of a fouling-release mechanism. © Momentive Performance Materials GmbH

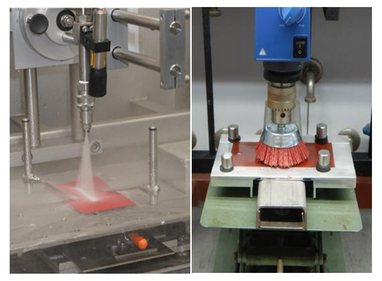
Lab Tests: Shore-A-Hardness

The Shore-A-hardness provides information about the resistance and elasticity of the coating surface to mechanical impacts such as pressure, abrasion and deformation. A higher Shore-A- hardness indicates a harder and less deformable surface that is more resistant to external influences. Lower values, on the other hand, indicate a softer and more elastic surface that yields more easily under load.



Comparison of Shore-A-hardness for PDMS, EP-PDMS and PU-PDMS systems of IFAM from the development years 2020, 2021 in 2022

Simulations of cleaning processes



High-pressure water jet (left) and the in-house development of a brush laboratory test rig (right) for pre-qualification of the developed systems. The pre-selection was necessary in order to make the most effective use of the limited number of test sites in the field.
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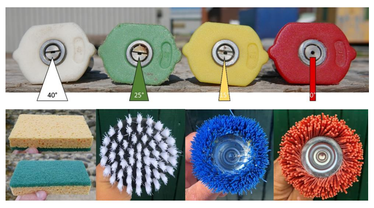
Cleaning methods in the field



Cleaning utensils in the »ROBUST«-project: The top shows the attachments for the high-pressure water jet, which are characterized by a different jet angle.
The lower photo sequence depicts the sponge- and brush-based cleaning instruments, respectively, starting with the sponge (soft and hard side), brush heads soft (white), medium-hard (blue) and hard (red). Brushes are used with a cordless screwdriver.
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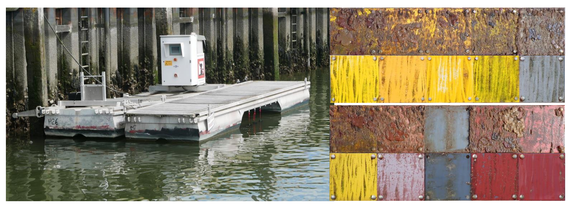
Field tests

Test sites: Norderney harbour



- Brill raft at the North Sea island of Norderney, Germany (53°42'09.9"N 7°09'48.5"E)
- Samples are immersed at a water depth of about 50 cm in the photic zone

Predominantly soft fouling with ascidians and bryozoans in Norderney harbour. Cleaning was possible with only minor damage to the surface.
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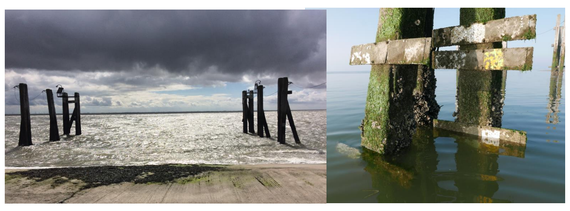
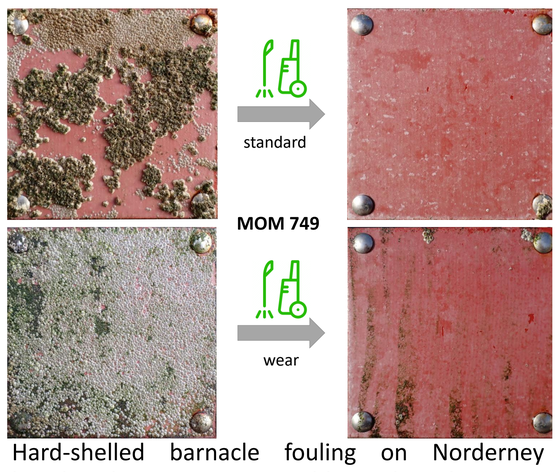
Norderney beachside



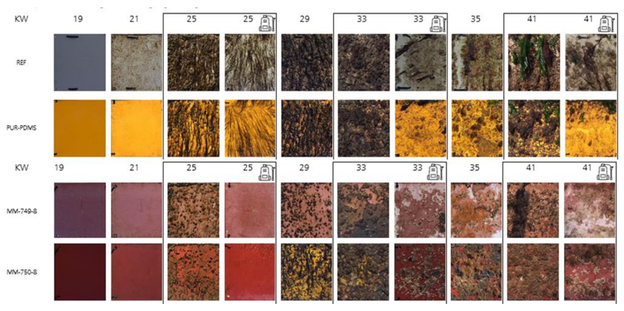
- Brill station at the North Sea island of Norderney, Germany (53°41'47.8"N 7°09'25.5"E)
- Samples are immersed here in the intertidal zone as well as permanently submerged



Hard-shelled barnacle fouling on Norderney beach. Cleaning was possible with only minor damage to the surface even after the third cleaning. © Brill + Partner GmbH

Helgoland harbour

- IFAM raft at the North Sea island of Helgoland, Germany (54°10'14.5"N 7°53'32.0"E)
- Samples are immersed at a water depth of about 1 meter in the photic zone



Fouling scenario for three selected Helgoland wear samples in 2022 as a function of time, masked by calendar weeks. The framed boxes show the sample before and after cleaning with high pressure water jet. The upper row of photos depicts the commercial reference, which accumulates significantly more fouling and has a lower cleaning success.
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Results and Discussion

- Development of simulated and reproducible cleaning methods (high-water pressure and brush-cleaning) under marine conditions as a service for paint companies
- One patent application for newly developed additives
- One patent application for a newly developed UV-curable coating
- Time reduction during cleaning of more than 50% in field tests
- Ability for repeatable cleaning up to 8 times under laboratory conditions without surface damage
- Ability for repeatable cleaning up to 4 times under field conditions without surface damage

Summary

- Several tested coatings show better performance than commercial reference coating
- The mechanical stability is given for at least 4 cleaning operations
- Time reduction of more than 50% in field tests, due to better cleaning properties of the coating

Outlook

- Critical assessment and improvement of technology concept
- Transfer of positive test results to adjacent business areas (anti-graffiti polyurethane applications and dirt-repellent coatings)

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