

# From the lab on to the ship: Environmentally friendly removal of biofouling

*Kiel University and a close spin-off jointly develop coating that prevents the accumulation of organisms*

KIEL UNIVERSITY

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**IMAGE:** LESS BARNACLES AND MUSCLES STUCK TO THE SHIP'S HULL AND THEY CAN BE BRUSHED OFF EASILY FROM THE NEW COATING. THE PAINTWORK IS NOT DAMAGED. [view more](#)

CREDIT: PHOTO/CREDIT: DR MARTINA BAUM

It is one of the shipping industry's major problems: marine organisms like barnacles, algae or muscles quickly cover the hulls of ships and damage their paintwork. The phenomenon of so-called "biofouling" increases the ship's weight and its flow resistance, causing greater fuel consumption and CO<sub>2</sub>

emissions. In order to avoid this growth, protective paints are mainly used around the world which contain and release pollutants.

A research team at Kiel University and the Phi-Stone AG, one of its spin-offs located in Kiel, have closely cooperated to develop an environmentally-friendly coating. This coating makes it harder for marine organisms to grow on the hulls and makes cleaning the ships easier. The new approach has now been awarded an international prize for innovative marine technology and beat competitors from three continents.

"This project from the field of nano-technology is a great example of transferring innovation from Schleswig-Holstein, whereby findings from basic research are brought into industrial application. We, as a university, want to solve existing problems using innovative ideas. In order to do so, this requires a working dialogue between science and companies," stressed Professor Karin Schwarz, Vice President of technology transfer at Kiel University.

### **Around 40 percent higher fuel consumption due to biofouling**

"We estimate that biofouling increases the amount of fuel ships use by up to 40 percent. This costs the world's transport industry over 150 billion US dollars per year and causes unnecessary environmental pollution," added Ingo Paulowicz, Board Member of Phi-Stone, a spin-off from Kiel University. On top of that, cleaning and maintenance increases considerably, in terms of removing the barnacles and other organisms attached to the hulls and repainting. Many of the existing protective paints have already been forbidden due to their massive polluting effects. This includes organotin paints like TBT (tributyltin). Copper-based compounds are expected to be prohibited next year, which will drastically increase the need for environmentally-friendly and long-lasting coatings for ships.

### **Longer-lasting and more environmentally-friendly**

The coating developed in close collaboration by the scientists from Kiel University and Phi-Stone is both environmentally-friendly and long-lasting. The product requires no solvents and does not release any pollutants into the sea - unlike the widespread self-polishing coatings which contain copper. These are gradually removed when the ship moves through the water and continuously release poisonous substances. The smooth surface of the new coating developed in Kiel makes it harder for organisms to attach themselves to the hulls and destroy the paintwork. "This means that the bio-corrosion-resistant paint lasts longer and barnacles or muscles can be brushed off quickly and easily," explains Dr Martina Baum, technical biologist from Professor Rainer Adelung's Functional Nanomaterials working group, which is where the original idea for the coating arose several years ago.

Together with her then-doctoral researcher, materials scientist Iris Hölken, Baum investigated the growth-reduction properties of a polymer composite, which was based on polythiourethane (PTU) and specially-formed ceramic particles. They improve the mechanical properties of the coating and the ability of the paint to adhere to the surface of the ship. Together with Phi-Stone AG, they further developed the material and the coating process. "Every year around the world, 80,000 tonnes of so-called anti-fouling paints are now being used. This costs around 4 billion dollars per annum. Not to mention the cost to the oceans," says Phi-Stone Board Member Paulowicz, to emphasise the scale of environmentally-friendly alternatives.

## **Successful technology transfer through collaboration between Kiel University and Phi-Stone AG**

The research team from Kiel University and Phi-Stone AG tested the new product with companies based in Schleswig-Holstein, initially on ships in the water tanks at the GEOMAR Helmholtz Centre for Ocean Research Kiel. "These tests went very well," said Baum. "We were able to determine significantly less growth after two years on the 'African Forest', which travels from Belgium to Gabon in central Africa. This was then easy to clean off with a plain sponge." Dr Iris Hölken, who has now completed her doctoral studies, is continuing with this topic as the scientific head of the project at Phi-Stone. The company is currently working on developing a spraying technique, with which the coating can be applied easily and over large areas.

### **International award for innovative marine technology from Kiel**

Phi-Stone AG, the spin-off from Kiel University, won the Global Marine Technology Entrepreneurship Competition in November, with its environmentally-friendly coating for ships. A total of 120 teams took part in the qualifying rounds in Paris, London, Shanghai or at the Massachusetts Institute of Technology in Boston. The German qualifying round took place in Kiel at the end of October: Ingo Paulowicz, Board Member of Phi-Stone, and staff member Haoyi Qiu, who is also completing a doctoral degree at Kiel University, successfully presented their environmentally-friendly coating concept at the GEOMAR Helmholtz Centre for Ocean Research Kiel. In the finals in Qingdao, in China, they beat the strong competitors from three continents.

The competition, which is organised by Shandong University and the city of Qingdao, aims to promote innovative marine technology and open up contacts to the Chinese market. The first prize is 70,000 US dollars and includes additional funding measures on site. "We are extremely pleased to have won such a major global competition on maritime innovation," says Paulowicz, who was also a Kiel University graduate. "We definitely want to keep our company in Schleswig-Holstein, but are excited about the extra possibilities that the Chinese market can offer us."

"It's great that this idea was developed in exchange with companies and that we were thus able to transfer it from the lab to the ship," says Professor Rainer Adelung, head of the working group at Kiel University, who is also very pleased about this success. "It is a great achievement for us as a university, but also for the state, if ideas from Schleswig-Holstein are also convincing at the international level in this way."