Keeping ship hulls free of marine organisms

December 6 2012

This photo shows the underside of the boot with the test surfaces. Persons (from left to right): Sebastian Kunsch, MD Barth shipyard; Manfred Füting, Fraunhofer Institute for Mechanics of Materials; Stefan Sandrock, MD Bioplan GmbH, Baltic Sea resort Nienhagen. Credit: Fraunhofer IWMH

Special underwater coatings prevent shells and other organisms from growing on the hull of ships—but biocide paints are ecologically harmful. Together with the industry, researchers have developed more environmentally-friendly alternatives.

If a ship is at anchor for longer periods algae, shells and barnacles will colonize it. Every year, this so-called biofouling causes economic losses of billions of Dollar. Biological growth on the underwater surface promotes corrosion. The deposits increase the roughness of the hull below the waterline which has a braking effect as the ship travels. Depending on the roughness of the basified bio layer, the consumption of fuel can increase by up to 40 percent. In the case of a large container

ship this can result in additional annual costs of several millions.

All the countermeasures used to date have considerable drawbacks: Cleaning the hull by sandblasting in a dry dock removes also the painted coating and can only be used every three to five years. There are effective hull coatings preventing the growing of adhering bio layers, but in most cases by ecotoxic biocides. Both copper ions and synthetic biocides accumulate in the coastal water and in the sediments. For this reason the particularly toxic tributyltin (TBT) is banned since 2008 and the currently preferred and still permitted copper oxide containing coatings are to be replaced by non-toxic alternatives in the foreseeable future.

As part of the BMWi-supported project consortium "Controlled Antifouling System based on Nanocomposits for Shipping" (GANaS) researchers at the Fraunhofer Institute for Mechanics of Materials (IWM) in Halle have developed a more ecologically-friendly alternative. "The electrochemically active coating system produces regularly changing pH values on the surface of the hull. This effectively prevents colonization without having to use any biocides", explains Professor Manfred Füting of the IWM in Halle who is coordinating the project.

Painted coatings as electrodes

Large area electrodes were painted on an isolating primer coating. The electrochemical active layer based on a sol-gel paint of NTC (nano tech coating gmbH), which was modified by electrically conductive particles. To achieve an adequate distribution of the electrolysis current a highly conductive interlayer was applied. In a preprogrammed and optimized electrochemical process the electrolysis current is periodically commutated and interrupted. A current density of lower than 0,2 mAcm-2 generates enough pH stress near the surface of the hull to prevent the growing on of any barnacles, shells and algae The electric

current is supplied by a photovoltaic module or by the land based power grid.

The electrochemical antifouling by alternating pH values was developed and patented by the project partner bioplan GmbH. This principle is working effectively and independently of marine flora and the kind of sea water. "With the coating development in the GANaS project we are on the way to a practical solution", says Füting.

With their development Füting and colleagues are primarily looking at official ships, such as oil spill ships or fireboats: These are in port most of the time, but must be ready for deployment as soon as they are required. "A ship with a heavy amount of growth will no longer be able to attain the speed it requires to quickly reach the location where it is needed", says Füting as food for thought.

Tests with the first prototypes at the Barth shipyard were promising: differently coated and electrochemically active and passive large areas are currently tested to prove their long-term stability against hydrodynamic stress and efficiency to prevent adherence and growth of bio layers. To achieve the real applicability of an economically competitive and ecofriendly antifouling system follow-up projects are planned: "They will mainly involve improving the technical applicability and optimization of our electrochemical antifouling system, which then could be applied on ship hulls for at least 3 to 5 years", states Füting.

Provided by Fraunhofer-Gesellschaft