Exactly how foul is the fouling problem?

MARIN grapples with slime to discover its impact on ship performance

Since the ban on tributyltin (TBT) anti-fouling paints from 2003, the effect of fouling on ship performance has again become an issue. TBT anti-fouling was undoubtedly effective, but at the same time it was not kind to the environment.

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Courtesy TNO

Severe fouling by green algae and barnacles on ship hull and propeller tunnel

High fuel prices and economically challenging times mean that there is an increasing need to reduce fuel consumption and one effective way of reducing consumption is to lessen the impact of fouling. Report investigates MARIN's activities in this field.

Marine growth has many different forms, the most visible being green weeds and barnacles and it is not hard to imagine their detrimental effect on the resistance of a ship. A much less visible fouling is slime produced by bacteria which settle on the hull within hours after exposure to water. It is easily washed off, but strangely enough it can withstand the flow of water along a ship, even if the ship is coated with so-called foul release coating. Slime remains and it can have a large negative effect on resistance. In the past MARIN has found resistance increases up to 8% during tests. Research on fouling is very complex because marine growth depends on a large amount of variables, such as water temperature, sunlight and operational profile. For instance, a ship operating in the Arctic is hardly affected by fouling, while in the tropics fouling on the hull is noticeable within weeks. Ships that spend a lot of time in ports are particularly vulnerable to fouling.
Due to the importance of fouling on fuel consumption and emissions, MARIN has several research projects underway, each with their own focus.

Slime fouling Within the CRS ECONSHIPS work group MARIN and its partners are establishing a ship performance model in which various aspects affecting the economical and environmental impact of a ship are being assessed. One of these aspects is fouling. The objective is to find the relationship between observed slime fouling on the hull and its impact on fuel consumption and consequent impact on exhaust emissions. To obtain a valid relationship it is important to conduct a large amount of tests with various types of slime. Rotating disk experiments are very suitable for these tests because a disk is small enough to grow various types of slime layers under controlled circumstances and it can be rotated fast enough to achieve high Reynolds numbers.

Marine fouling diversity as occurring in the North Sea on a silicone based coating

Courtesy TNO

Courtesy TNO

Adult barnacles of various age at a raft exposure panel at TNO

Dedicated test ship Simultaneously, the Service Performance Analysis Joint Industry Project (SPA-JIP) is initiating a research campaign on board a dedicated test ship to look at the overall effect fouling has on fuel consumption. This ship will also be used to determine the effect of fouling on the boundary layer flow at various locations on the hull in different stages of hull fouling. As well as the hull, the propeller is also vulnerable. The SPA-JIP is also investigating the effect of cleaning the hull and propeller. Fouling can increase the propeller's roughness, which can decrease its efficiency considerably. Dedicated, full-scale tests in the SPA-JIP showed that the cleaning of propellers in a dry dock resulted in an efficiency increase of 13%. If there is only limited time to perform cleaning by divers in the water, it is therefore recommended that the propeller is always cleaned first. Further tests in the SPA-JIP showed that regained performance due to full cleaning could be attributed one-third to cleaning the propellers and two-thirds to hull cleaning. This is backed-up by literature.

New Joint Industry Project These research projects are examples of applied research, leading to tools that can be applied directly by the industry. In addition, it is also recognised that there is a lack of knowledge on the mechanisms that play a role in the effect of slime fouling on the boundary layer. Gaining an insight into this problem is deemed crucial if a solution to the fouling problem is to be found. A new Joint Industry Project on Drag Reduction and Coatings will be set up together with TNO and various industrial partners to investigate optimized drag reduction by smooth hull and coating design. Part of this project will be focussed on how microbial slime layers build up and interfere with friction drag on a ship scale, other aspects will be optimised strategies for coating use and application as well as hull maintenance practices.