

## ***Background***

Back in 1972 Jotun Marine Coatings through its partnership with NOF, Nippon Oil and Fats Co. Ltd launched the first "Self-Polishing TBT-copolymer A/F" Takata LLL. All leading paint manufactures were quickly on the market with similar technologies. The major benefit of these new products was the antifouling predictability and the possibility to prolong the dry-docking intervals from 12-18 months that was the standard at that time, to periods up to 60 months. The market responded and within a short period of time 80% of the world's merchant fleet had converted to the new TBT-copolymer products.

## ***Present situation***

- Following the ban of TBT-containing antifoulings by IMO, all paint suppliers to the marine market are now offering TBT-free products that are claimed to be equal to the TBT-containing products with regards to antifouling performance, self polishing effect and the thickness of the leach layer. The main difference today compared to the situation in the mid 70's, when as all suppliers had the TBT-copolymer technology, is the differentiation in technologies.

The main challenge, as Jotun see it, for the ship owners and management companies is the limited practical experience with the last generation of TBT-free products. Due to this owners and operators must in many cases base their selection of antifoulings on claimed features from the paint suppliers and/or price/per litre.

From Jotun's point of view six parameters are today important when choosing the optimal antifouling solution for a vessel. These product features are:

- Antifouling performance
- Selfpolishing
- Selfsmoothing
- No build-up of leached layer
- Predictability
- Tailor-made solutions

The most obvious feature is still the product's ability to keep the hull free from fouling. Most TBT-free products are today selfsmoothing and can deliver this. However, keeping the hull free from fouling in it self is no guarantee for the best solution. Jotun believes that attention must also be put on the other features, which contribute to overall long term operation and maintenance cost for the owner.

Selfsmoothing is addressed in a separate paper, where the implications on fuel consumption are highlighted. Predictability refers to the degree of linearity in the polishing of the film. The more predictable, the more certain an owner can be of the long-term development of the film and thus the fouling protection of the hull. Tailor made solutions refers to the extent the whole range of antifoulings can match different vessels needs. All of these extra features are covered in Jotun's premium antifoulings as they were in the old TBT-containing antifoulings.

Leached layers will be elaborated on in this paper.

## ***Leached layers***

All antifouling paint develop leached layers, a thin layer is inevitable, and shows that the paint is working as it should, too much leached layer can have huge consequences. The leached layer is proof that the antifouling is self-polishing, but the thickness of the leached layer is of importance.

The TBT-containing products all had more or less the same thickness on the leached layer. Common for them all was that the thickness of the leached layer was not a problem. Not for in-service quality, nor as a possible problem to remove at next docking, with negative outcome if not successfully removed.

## ***Definitions***

**Leached layer** is a layer at the surface of an exposed antifouling where the composition has changed. All the water-soluble components in this layer have been dissolved. The remaining structure is therefore full of voids and the mechanical strength is reduced as a result of this.

**Hydrolysis** is understood as the chemical reaction, transferring the resin, preferably only on the surface layer of the antifouling paint, from being water insoluble to dissolve in sea water

This chemical reaction is the key property with regards to design of a self-polishing, self-smoothing and predictable antifouling product

**Hydration** is understood as antifouling that dissolve into seawater in a more or less controlled fashion. These products are, almost without exception, based on a blend of water-soluble and water sensitive resins. This blend results in dissolution of the paint film when exposed in seawater and serves as a delivery system for the active substances added to the formulation. When the water-soluble resins leave, the water insoluble particles remain this forming a leached layer. Even within this technology we see big variations in the thickness of the leached layer. Jotun Hydrating antifouling is among the best in this category.

## ***Consequences for the owner***

Future failures will in the years to come be a result of two factors: Firstly leached layers as a result of poor surface pre-treatment of low/medium quality TBT-free antifoulings secondly from under-performing products.

## ***There are two possible scenarios related to leached layers***

### ***In-service***

During the sailing period the owners can experience significant variation of the product quality from different suppliers.

The main challenges are:

- Reduced antifouling performance
- Increased roughness

We often see that when the thickness of the leached layer has increased enough the distance from active antifouling to leached layer surface is too big, and the active ingredients in the antifouling will not desolve. As a consequence fouling will start to develop in the leached layer.

The nature of the leached layer is porous and will give increased roughness and increased fuel consumption.

### **Maintenance and repair**

During maintenance and repair Jotun have seen that the possibility for errors is increasing with the new tin-free technologies. Today more focus is required on the quality of the surface pre-treatment and the application of the antifoulings.

The main challenges are:

- Removal of old leached layer
- Cracking and/or detachment of newly applied antifouling
- Popping of newly applied paint
- Increased roughness

Jotun as a paint supplier have seen the need for increased standard of surface pre-treatment before overcoating a product with high leached layer.

The variations in thickness of the leached layer have forced us to demand thorough washing procedures, in worst case sweeping, at a higher cost for the owners.

Experience show that the leached layer can be very hard to remove, and if not successfully removed, the consequences can be significant.

As a result popping; cracking at application which later can lead to detachment can be experienced. We seldom experience detachment during operation, but at next dry-docking after high pressure washing, the result can be detachment.

Applying new paint on top will increase total paint film thickness, and therefore stress, which can lead to further detachment.

Leached layer can be removed by two methods:

- High pressure washing (Min 350 Bar)
- Sweeping

Both methods are cost driving and this additional cost for preparation after the sailing period has to be taken in to consideration when selecting the antifouling in the first place. The extra cost is approximately 3-8 Euro m<sup>2</sup> (Europe)

## Example 1

All antifoulings develop a leached layer to a certain extent. The TBT-containing products all had more or less the same thickness on the leached layer. Common for them all was that the thickness of the leached layer was not regarded as a problem. Hydrolysing antifouling like SeaQuantum, develop a leached layer at a similar thickness as for the TBT technology.

On the picture below taken of a paint flake from Berge Sigvald, SeaQuantum Classic can be seen as the last coat of antifouling.

Starting from the bottom of the picture the old primer system (Black, red), followed by the old antifouling system (Tin containing, note the white leached layer), followed by a sealercoat and new antifouling SeaQuantum Classic.

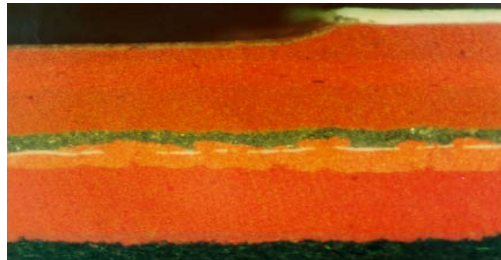
On the right hand side the SeaQuantum Classic is sealed off in order to calculate the polishing effect. However, the most important thing to note is the leached layer on the left side of the picture which shows, the same thickness as for the old TBT bearing AF.

Jotun's experience with all the antifoulings that claim to be hydrolysing shows significant variations in the thickness of the leached layer.

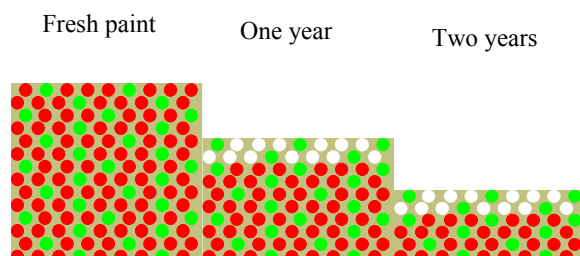
A true hydrolysing antifouling such as SeaQuantum range will not build a leached layer that will influence on performance or overcoating!

*Leached layer SeaQuantum* →

*Leached layer old tin bearing* →

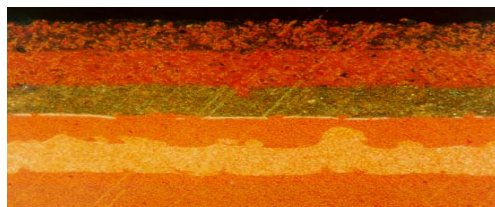


For a hydrolysing antifouling the thickness of the leached layer will remain low and constant throughout the lifetime of the antifouling system.



## Example 2

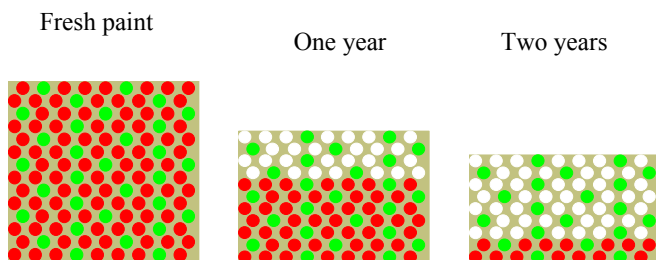
Picture take of the paintfilm from a competitor's vessel in service. Starting from the bottom two primercoats, tin bearing antifouling (notice the thin leached layer), a sealercoat, followed by a competitors antifouling (Note the thickness of the leached layer). The picture clearly shows that the product build leached layer



← Leach layer of competitor's Antifouling

← Leach layer of old tin bearing system

Competitors top of the range self-polishing tin-free antifouling



For a hydrating antifouling the thickness of the leachlayer will constantly increase throughout the lifetime of the antifouling system.

## Conclusion

The TBT-copolymer antifouling served the market for 30 years with excellent predictability and antifouling protection

Today we have a different scenario where the quality of the antifouling available on the market shows big variations in performance.

When focusing on the leached layers problems there are some questions to be raised.

- Are the owners willing to accept the possibility of popping, cracking, and flaking as a possible result of applying the "wrong" antifouling at the present docking?
- Are the owners willing to accept an extra cost for removal of Leached layer at the next docking?
- Even if you have the specified pressure, are you sure that the leached layer is removed?
- At last, are the owners willing to pay for additional bunker due to increased roughness?

## If not

The SeaQuantum range of products is your solution to this challenge!

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