SIGMA COATINGS
A PPG Brand

THE CORRELATION BETWEEN PREMIUM ANTIFOULING AND FUEL CONSUMPTION

TECHNICAL PAPER

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THE CORRELATION BETWEEN PREMIUM ANTIFOULING AND FUEL CONSUMPTION

In the 1980s the coating industry and its raw material suppliers started to develop TBT-free alternatives in preparation for the IMO initiatives for a TBT ban in 2003.

Many new technologies were explored and commercialized into the market. From the current technologies and products available it is difficult and challenging to provide a 'one size fits all' option for all the various vessels and their specific operational requirements. Our solution is to offer a differentiated approach.

For certain vessel types and operating conditions, a robust antifouling product is sufficient to prevent fouling and to keep the underwater hull in good condition. The SIGMA ECOFLEET® and SIGMA ALPHAGEN® product ranges have been proven to give reliable performance over the past 15 years.

However, an increasing number owners and operators are considering the total operating cost of their vessels in great detail. This analysis includes fuel consumption as this is often more than 50% of the operational costs.

Currently, the market is consolidating into two coating technologies for delivering fuel savings:

1. Silicone-based fouling release - biocide-free and non-stick mechanism

2. Silyl Acrylate antifouling - hydrolyzing / self-polishing / self-smoothing

SILYL ACRYLATE ANTIFOULINGS - SIGMA SYLADVANCE™ 800

The key building block of an antifouling is the binder. for over twenty years PPG Protective & Marine Coatings (PPG) has been working on the development of antifoulings, based on silyl acrylate binders in close co-operation with suppliers. As a result of this continuous development, the composition of the product has been optimized and PPG's silyl acrylate antifouling is now considered to be one of the leading premium antifoulings in the market.

The specific nature of the silyl acrylate binder results in a controlled hydrolysis reaction. This controlled reaction provides linear and consistent polishing behavior, which ensures consistent release of active ingredients and also minimizes the leached layer. In addition, the chemical hydrolysis reaction with water results in a continuous self-smoothing effect of the top layer. During service this will result in smoothing the hull, reducing the frictional drag of the vessel and thereby reducing fuel consumption.

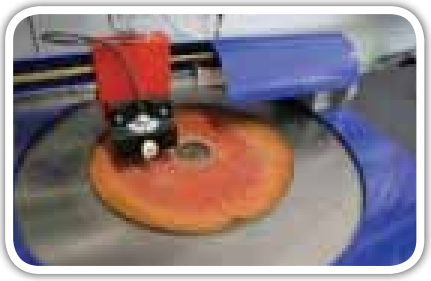
SIGMA SYLADVANCE 800 – SELF-SMOOTHING EFFECT

During antifouling development and quality control, large investments are made to study the polishing behavior of the coating. Within PPG, discs are used to study the polishing behavior over a specified time period. In laboratory conditions, typical measurements are taken for one year, but this process can also go up to five years in order to study a vessel's typical dry-docking cycle. The discs are spun at 1,000 rotations per minute to simulate a vessel speed of up to 19 knots, and at specified times the film thickness of the antifouling is evaluated for the full disc. This enables PPG to determine the polishing speed from its evaluation of the antifouling thickness. Following the antifouling film thickness analysis, the surface profile is then studied in great depth – providing crucial information on the smoothness of the product.

Pictures 1 to 3 show an overview of the polishing test setup, with typical polishing patterns shown in pictures 2 and 3. Due to the faster rotational speed at the outer circle of the disc, the polishing pattern is clearly visible.

Picture 1
Test setup

Picture 2
Disc with redbrown antifouling



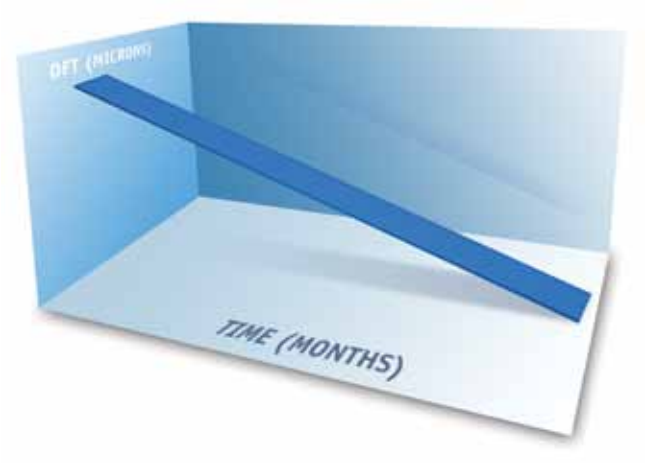
Picture 3
Film thickness analysis

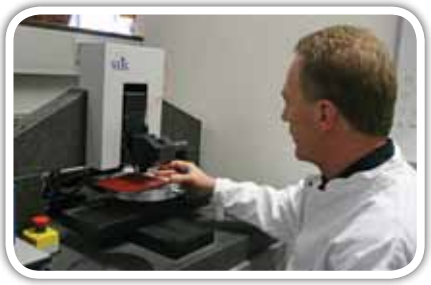
Graph 1 shows an example of the analysis made of film thickness reduction of the *SIGMA SYLADVANCE* 800 system over a period of 5 years. Examination over the full test period demonstrates a constant and linear polishing behavior, which is the basis for the durable performance of the antifouling.

In similar studies the surface profile of the antifouling is studied on discs. For these measurements specialized equipment is available which can screen very precise small parts of a coating surface. The test setup is shown in picture 4. For this particular analysis, a *SIGMA SYLADVANCE* 800 coating surface has been analyzed when freshly applied (picture 5) and after 2.5 years of rotation (picture 6). In this case, an overall hull roughness reduction of around 25 +/- 5 µm was found.

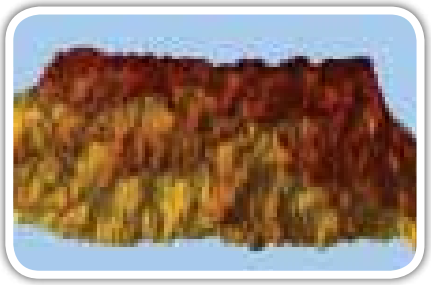
When using analysis, as described in literature a reduction in hull roughness of 10 µm would typically result in an overall fuel reduction of 1%. Taking account of these results, a positive contribution of around 2 to 3% on the fuel consumption of a vessel could theoretically be obtained.

GRAPH 1: EXAMPLE OF POLISHING GRAPH – *SIGMA SYLADVANCE* 800 SYSTEM





Picture 4
Test setup surface profile



Picture 5
Surface profile at t = 0

Picture 6
Surface profile at t = 2,5 year

The evaluation of the performance of antifouling systems is not only carried out in the laboratory but also followed in practice. In picture 7, a vessel coated with *SIGMA SYLADVANCE* 800 system is shown just after application. In picture 8, the same vessel is shown in dry-dock after being in service for 3 years. The picture shows the coating condition just after the dry-dock was emptied and before pressure water cleaning. The underwater hull was free from fouling and a typical polishing pattern showing the first (brown) and second (redbrown) antifouling coat can be observed.

Profile measurements were taken on the underwater hull surface at well-defined locations all around the underwater hull of the vessel. In picture 9, it is shown how these measurements are carried out in practice.

Picture 7
Freshly applied antifouling

Picture 8
Vessel upon indocking

Picture 9
Surface profile measurement

Graph 2 shows the results of the detailed statistical analysis taken from the full set of data for this vessel. based on these results, it was concluded that the average roughness upon in-docking was around 100 µm. For the freshly applied *SIGMA SYLADVANCE* 800 system an average roughnes of around 125 µm was found. These values correlate to an overal reduction of the roughness of 25 µm during service. the measurements on this vessel confirmed the self-smoothing of the antifouling in practice.

Picture 10
SIGMA SYLADVANCE 800 system in service (showing clear polishing pattern)

A significant track record has been built up over the past 10 years with the *SIGMA SYLADVANCE* 800 systems. a container vessel is shown in picture 10 which has been applied with this coating in 2006. The owner has been evaluating the effect of the antifouling system on the underwater hull and made the following statement:

CUSTOMER QUOTE

"Using *SIGMA SYLADVANCE* 800 has had a 2.5% direct cost saving for CSCL QingDao which can be measured due to the sister ship on the same sailing pattern. thanks to the 2.5% fuel saving, this is an antifouling which we will recommend for application on other vessels."

Based on the extensive work done on the antifouling systems and experience obtained over a long period, PPG's *SIGMA SYLADVANCE* 800 system can contribute to reduction of operational costs of vessels.

Some typical examples are described in this document. The actual effect for a specific vessel will, of course, depend on its characteristics and operational profile.

SIGMA SYLADVANCE 800 AT IN-DOCKING

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