

## CLEANING HIGH-SPEED MARINE SEPARATORS WITH AN ENVIRONMENTALLY-FRIENDLY CIP AGENT

Ulf Nylén<sup>1</sup>, Roger Andersson<sup>2</sup> and Peter Forsberg<sup>3</sup>

<sup>1</sup> Materials & Chemistry Centre, Chemistry & Corrosion (MACC-CC), Alfa Laval Tumba AB, Hans Stahles v. 7, SE-147 80 Tumba, Sweden, Tel.: +46 (0)706 60 5024, e-mail: [ulf.nylen@alfalaval.com](mailto:ulf.nylen@alfalaval.com)

<sup>2</sup> MU Marine & Diesel, Parts & Service Equipment, Alfa Laval Tumba AB, Hans Stahles v. 7, SE-147 80 Tumba, Sweden, Tel.: +46 (0)8 530 65210, e-mail: [roger.andersson@alfalaval.com](mailto:roger.andersson@alfalaval.com)

<sup>3</sup> Invekta Green AB, Sågvägen 9, SE-840 50 Gällö, Sweden, Phone +46 (0)693 66 12 10, e-mail: [peter.forsberg@biogenactive.com](mailto:peter.forsberg@biogenactive.com)

### ABSTRACT

The present contribution is devoted to the cleaning of high-speed marine separators employing the environmentally-friendly Cleaning In Place (CIP) agent Alpacon Multi Cip Super. For this particular study an Alfa Laval lube oil separator of type S831 on board the ship MS Isabella was dismantled prior to its first CIP treatment since installation and a few of the sludge-coated insert discs were taken as samples for laboratory experiments. Following assembly, the separator was cleaned according to a standard CIP protocol. Back in the laboratory, experiments mimicking the field CIP conditions verified the excellent cleaning results observed by visual inspection out on the ship after the CIP treatment.

### INTRODUCTION

Cleaning, the removal of deposit layers from equipment surfaces, is an essential operation for many industrial processes subject to fouling (Wilson, 2005). Fouling of separators, however, has not been addressed in the literature though it constitutes a major problem in a wide range of applications implying reduced separation performance. This contribution will focus on separators employed in the marine segment, more precisely lube oil separators where derivatives of heavy oil and particles formed in the engine's combustion process often tend to stick onto the separator discs thereby impairing the performance.

Being one of the world's leading suppliers of high-speed separators, Alfa Laval is constantly trying to optimize the design in order to temper the negative aspects of fouling. Owing to the fact that brass is employed in marine separators, the CIP chemical needs to be relatively lenient. For this reason, Alfa Laval has introduced in its chemical portfolio an environmentally-friendly CIP agent based on fermented whey, fruit acids, water and surfactants. Alpacon Multi Cip Super is a multifunctional CIP agent that embraces degreasing and descaling as well as anti-corrosion properties. Taking into account the growing environmental awareness together with stricter chemical legislation/control

under way, we believe that there is an enormous potential for green cleaning solutions.

### BODY

The Alfa Laval S831 lube oil separator displayed in Fig. 1 (the one under inspection) had been in operation for 1429 hours since time of installation. It serves one of the four main engines and continuously cleans approximately 10 m<sup>3</sup> lube oil at a temperature of 95 °C. It is common practice to clean lube-oil fouled separators by hooking up a CIP unit allowing the hot CIP cleaning solution to circulate for one hour between the CIP unit and the running separator. Subsequently, the dirty cleaning solution is discharged and the procedure is repeated once again. If the result is not satisfactory, it follows that the interval between CIP is too long. The discs should then be cleaned manually and the next CIP treatment should consequently be performed after a shorter period of time. As a CIP bonus the heater may be connected concomitantly between the CIP unit and the separator.



Fig. 1 The S831 lube oil separators on board the ship MS Isabella.

On this special occasion the separator was put off stream, dismantled and a few fouled discs were replaced by new ones in order to have samples for laboratory experiment. The visual appearance of a lube-oil fouled insert disc is presented in Fig. 2. An example of the chemical composition of the lube oil fouling sludge is given in Table 1.



Fig. 2 A typically fouled insert disc obtained from a lube oil separator.

Table 1. Typical chemical composition of the fouling sludge present on a lube oil separator disc.

Chemical specie	Content (wt.%)
Ash <sup>a)</sup>	30
Calcium <sup>b)</sup>	11
Sulfate (SO <sub>4</sub> ) <sup>c)</sup>	12
CaCO <sub>3</sub> <sup>a)</sup>	9
Soot <sup>a)</sup>	9
Asphalthenes <sup>d)</sup>	4.2

<sup>a)</sup> Determined by TGA

<sup>b)</sup> Determined by AAS

<sup>c)</sup> Determined by an in-house developed extraction-precipitation method

<sup>d)</sup> Determined by IP 143-1990

The CIP beaker test was conducted employing a 10 vol.% solution of Alpacon Multi Cip Super (diluted in regular tap water) at 70 °C. Approximately 1 dm<sup>2</sup> of the fouled disc was immersed into the hot cleaning solution and the variation in sample mass was registered as a function of time. A magnetic stirrer operating at about 500 rpm was employed to create a distinct flux around the suspended test plate. The performance of the CIP agent is presented as the cleaning efficiency (1). The total amount of lube-oil sludge

deposit on the sample under investigation was 1.54 g (the mass of the clean plate was equal to 16.49 g).

$$\text{Cleaning efficiency [\%]} = 100 * \left[ \frac{m_{\text{initial}} - m_{\text{arbitrary time}}}{m_{\text{initial}} - m_{\text{clean}}} \right] \quad (1)$$

## RESULTS

The results from the laboratory beaker experiment are presented in Fig. 3. It is clearly seen that Multi Cip Super is highly efficient in removing sludge from the disc of a lube oil separator. After two hours' exposure to the 10 vol.% Alpacon Multi Cip Super cleaning solution kept at 70 °C, 97 % of the deposit has vanished. In accordance with the laboratory findings, a high degree of cleanliness was observed in the interior of the lube oil separator at MS Isabella after full-scale CIP treatment employing similar cleaning conditions.

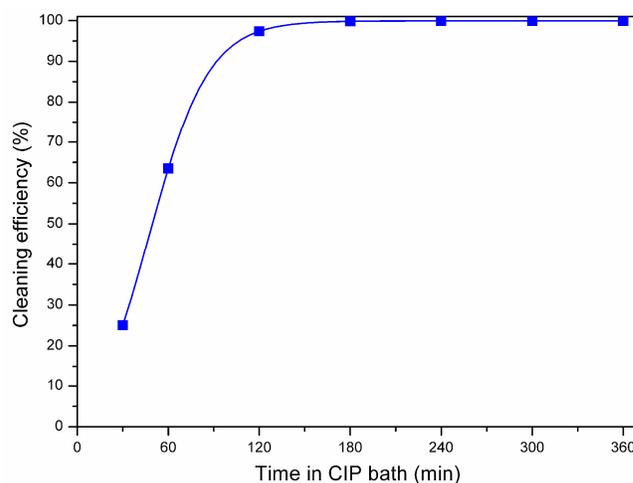


Fig. 3 The results from the laboratory test employing a 10 vol.% solution of Alpacon Multi Cip Super at 70 °C.

## DISCUSSION

Alfa Laval's equipment, systems and services are dedicated to helping customers to optimize the performance of their processes, time and time again. Every day, all over the world, thousands of large passenger- and cargo ships operate the seas. For all of them, the functionality of the engines is of pivotal importance. In this context separators play a crucial role, for example in terms of cleaning lubricating and fuel oils. It is very important to have an effective and reliable CIP reconditioning protocol as it saves money thanks to reduced maintenance work and fewer undesired shutdowns. The present contribution shows the usefulness and effectiveness of the multifunctional, environmentally-friendly CIP agent Alpacon Multi Cip

Super in removing lube-oil sludge from the discs of lube oil separators. Owing to its mild character with constituents including fermented whey, fruit acids, water and surfactants, the materials in the equipment being cleaned will not be damaged. Moreover, health hazards normally associated with the handling of traditional solvents and strong aggressive acids or bases are also avoided. With the growing environmental awareness in mind together with stricter chemical legislation/control under way, green cleaning solutions will be very much in demand.

## CONCLUSIONS

The CIP cleaning agent Alpacon Multi Cip Super presented in this short communication offers several advantageous features and benefits such as:

- Effectively removes oil residues and contamination using heat and circulation.
- Contains no solvents or inorganic acids.
- Is water based and non-flammable.
- Is non-corrosive and non-aggressive to iron, steel, aluminium and brass.
- Significantly reduces transport and storage costs due to ultra-compact packaging.
- Suffers no transport restrictions.
- Can be used for cleaning both lube oil and fuel oil separators.
- Reduces separator maintenance and operating costs.

## NOMENCLATURE

AAS Atomic Absorption Spectroscopy  
rpm revolutions per minute  
TGA Thermogravimetric Analysis

## REFERENCES

D.I. Wilson, 2005, Challenges in cleaning: recent developments and future prospects, Heat Transfer Eng., Vol. 26(1), pp. 51-59.