

# SCRUBBER TECHNOLOGY BENEFICENT FOR ENVIRONMENT AND LUBRICATION OF DIESELS

(Part B')

- PERFECT REMOVAL OF SULPHUR FROM EXHAUST GAS
- PERFECT LUBRICATION OF DIESELS

**IT IS ESSENTIAL TO OBSERVE THE PROCEEDING OF BENEFICENT OXIDATION IN THE CYLINDER LINERS, BEARINGS AND CRANKSHAFT JOURNALS OF DIESELS, BY THE SULPHUR IN THE FUELS IN COMBINATION WITH A CORRECT BASIC NUMBER (BN) OF LUBRICANTS**

By combination of Sulphuric acid from high sulphur fuels, the moisture in the intake air, the thermodynamic condition created inside the cylinder by temperature and compression, a light oxidation is engraved on the surface of cylinder liners. The incoming lubricating oil with its alkaline reaction (usually calcium salts) regulates the oxidation to just a required extent for holding an adequate film of lubricating oil in the walls of cylinder liners. The Basic Number (BN) of a lubricating oil is the degree of its ability to control the acid. The bigger the number, the greater its capability of controlling sulphuric acid.

The Basic Number (BN) of lubricating oil, in addition to lubrication, it is to stipulate the degree of oxidation but not to neutralize it, as the controlled oxidation is very important for maintaining the correct degree of tribology by holding the necessary film of lubricating oil during piston reciprocation. In case the controlling of acid becomes perfect by a lubricating oil of high Basic Number, the surface of cylinder liner becomes polished, it will not hold the necessary lubricating oil film with result the beginning of scuffing and wear which end to the destruction of cylinder liner and not only. The operation of an engine with incompatible lubricating oil and sulphur content in the fuels, it creates risks of either glazing, scuffing and wear or over oxidation on cylinder liners. The advantage of lubrication which is achieved through the tiny pores, created by the light oxidation of sulphur acid it is extended and to the bearings and crankshaft journals.

## RISKS OF TWO-CYCLE-STROKE DIESELS FROM LOW SULPHUR FUELS

The operation of a Diesel with low sulphur fuels is considered problematic due to turning up-side-down of the equation between needed degree of controlled oxidation, prevention of glazing, scuffing and wear, reaction of Basic Number of lubricating oil and eventually lack of direct lubrication by sulphur.

The total alkaline reaction (BN) of lubricating oils must be proportional to sulphur content in the fuels. The minimum feeding rate for an adequate film of lubricating oil BN 70 up to date is about 0.5 gr/BHP/h with fuels of approx. 2.5% sulphur.



The average content of sulphur in the high sulphur fuels worldwide is 3%. In case an engine is burning 1% sulphur fuel with a feeding rate of 0.5 gr/BHP/h lubricating oil, its cylinder liners and not only will become over neutralized from sulphur oxidation and will be subjected to polishing, scuffing and wear. With fuels of low sulphur content, i.e., 0.5%, it will be necessary to perform careful adjustments with low Basic Number lubricating oils BN 40 to 50. This will necessitate frequent careful

inspections of cylinder liners and piston rings before it will be possible to determine a correct dosage of lubricating oil, which however will have to be repeated every time the content of sulphur in the fuels is changed.

The basic safety factor for Diesels however, is to be in a position to evaluate correctly the general condition of the engine after a prolonged use of a low sulphur fuels. As it will be impossible to perform this timely by ships engineers during operation, it should be necessary to open the cylinders 3 or 4 times a year for inspection and/or a regular HONING maintenance of cylinder liners, and a similar care should be taken for the bearings and crankshaft journals. According to our experience, the wear in the cylinders and not only of a two-cycle-stroke Diesel with residual fuels of, i.e. 3% sulphur, will be almost similar either with a reduced feeding of BN70 cylinder oil, i.e., 0.3 gr/bhp/h due to poor lubrication, or with a very high feeding, i.e., 1.5 gr/bhp/h cylinder oil due to high wear from glazing by deposits. In both cases this involves also the piston rings wear, the need for piston crowns and cylinder liners reconditioning, and the necessary time of ship's delay in port for these maintenance works.

## EVALUATION OF RISKS FROM LOW SULPHUR FUELS-REMEDY

In order to be in a position to evaluate correctly the negative results from low sulphur fuels' combustion, we must primarily know always the physical and chemical characteristics of used fuels, starting from ship's trials. The life of a cylinder liner in a two-cycle-stroke Diesel, under regular operation conditions with high Sulphur fuels can well exceed the 45.000 hours. Under a

hypothetical operation with low sulphur fuels, it is evaluated that it will be most difficult in practice to exceed the 35.000 hours of operation for the above mentioned reasons. Basically the condition of cylinder liners and the characteristics of combustion chambers of two-cycle-stroke diesels throughout their life, are prejudiced by the conditions of the initial operation of their pistons, piston rings and cylinder liners from ships trials. Frequent initial inspections and adjustments of cylinder oil feeding rate according to a program, and thereafter frequent periodical checkings and maintenance works ensure a maximum possible operational life. This will be more imperative with low sulphur fuels.

For restoration and regular maintenance of the cylinder liners, a periodical HONING must be made in three consecutive finishing preparations of cylinder surface.

The diagrams show three profile curves of cylinder liner walls during HONING.

Figure 1 shows an almost completely glazed surface prior to honing. Figure 2 shows a rough surface with grooves and peaks after removing ovality, scuffing marks etc. Figure 3 shows the cylinder liner smooth surface after final honing, with the light grooves for holding of the necessary film of lubricating oil.

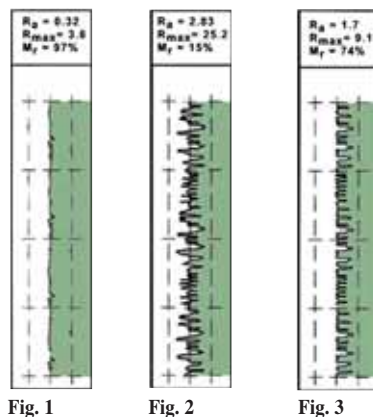


Fig. 1

Fig. 2

Fig. 3

(Source: CHRIS-MARINE)

In two cycle-stroke Diesels using high sulphur fuels, i.e. 3%, this maintenance work may be done optionally at every four year survey. It is not possible to define as yet how often this should be done when they will use low sulphur fuels, but anyway much more frequently for the reasons mentioned above. This concerns also the pistons rings, the bearings and crankshaft journals.

## FOUR-CYCLE-STROKE DIESELS

The four-cycle-stroke engines although not subjected to analogous complicated lubrication adjustments to cylinders, they have the same need of light oxidation from sulphur in the fuels for a proper lubrication and maintenance of their cylinder liners, bearings and crankshaft journals. Whereas accumulations in way of piston rings are avoided by the continuous splashing of lubricant, they must be more frequently inspected for proper lubrication and possible wear in their cylinders, bearings and crankshaft journals when they burn fuels with very low sulphur content, especially to auxiliaries with only superficially hardened crankshafts.

## ANALYSIS OF DISTILLED FUELS - ABRASIVE ELEMENTS

Especially distilled fuel bunkers should be subject to careful purchases and simultaneous analysis according to the internationally approved standard of ISO 8217/2005. (Ask for a copy from [Kaminco@kaminis.com](mailto:Kaminco@kaminis.com).) The analysis must include indications of quality, content of sulphur and particularly of abra-

sive elements which cause wear. The abrasive elements must be under careful attention. They become more destructive in two-cycle-stroke engines when using low sulphur fuels and high basic number (BN) lubricants at a reduce feeding rate, even if this is taking place at short periods.

## “ECOSILENCER” THE CORRECT SOLUTION FOR IMPLEMENTATION TO MARPOL VI REQUIREMENTS

The Canadian MARINE EXHAUST SOLUTIONS made and patented the first system of Abatement Technology “ECOSILENCER”, which ensures the continuation of Diesels operation with the up-to-date used fuels and lubricants. It does not use filters or chemicals. It consumes almost 1% of engine power.

It is evaluated by the sensible environmentalists, technologists, economists and politicians as “apo michanis theos” for the protection of the Environment from the small proportion of Sulphur Oxide pollution of ships. Also the most practical and economical solution for the ship than using distilled fuels, as the Ship Owner pays only once, and its cost is amortized in a short period from the economy in fuels and lubricants, and not only.

It has the capability to reduce sulphur emissions (SO<sub>x</sub>) to near zero and significantly particulate matter after combustion. It delivers the same or better results of the distilled fuels, against a tremendous cost of additional Refinery installations would be necessary for the de-sulphurisation of distilled fuels, which as it is known would overflow the environment with terrible volumes of Carbon Dioxide (CO<sub>2</sub>) emissions and burden more dangerously the catastrophic Greenhouse effects on Earth.

About how sulphur oxide problem in Baltic was erroneously diverted against the ships, we will revert with another Article.

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### NOTE

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George S. Kaminis, a pioneer in the introduction and application of New Marine Technology and Specialized Service, presented the exhaust gas scrubbing system for first time in Greece 1977, with the Inert Gas Systems, analyzing their technology in comprehensive articles, published in the INSTITUTE OF MARINE TECHNOLOGY issue No 5, and NAFTILIAKI NAFTERGATIKI of 26th September 1979. For information [george@kaminis.com](mailto:george@kaminis.com)