CORROSION OF DIESEL ENGINE COOLING WATER SYSTEM

Although VECOM Inhibitors for Cooling Water System if used according the instruction, provide excellent metal protection, other significant problems may affect the Water Cooling System.

OXYGEN CORROSION:
The corrosion process in these systems is normally due to the presence of dissolved oxygen in the water. Air enters these “open” systems and the oxygen dissolves into the water and attacks ferrous and non-ferrous metals. The presence of air should be kept to a minimum to avoid “air locks” which can cause serious local overheating of the engine by interrupting heat transfer. This is normally controlled by the use of air vents fitted to high points on the cylinder covers. These vents and atmospheric seals should be kept in good working order.

ACIDIC CORROSION:
This is normally the result of acidic gases (i.e. combustion gases) entering the system via poor seals, especially around the cylinder head area. These gases lower the pH of the cooling water leading to attack of the metal. Acidity can also be caused by the leakage of sea water into the system, via leaking coolers.

CAVITATION CORROSION / EROSION:
Cavitation is normally caused by vibration and/or turbulent water flow in the system. The damage caused by these phenomena appears like deep pitting corrosion. It is the result of high- and low-pressure waves in the system, creating vapor bubbles on metal surfaces. These bubbles expand and then collapse at a very fast rate with high impact pressure. This action removes the protective layer of oxide and “eats” into the metal. Cavitation Corrosion / Erosion is therefore both mechanical and chemical in nature. The mechanical aspects are design oriented, but it has been found that modern highly effective “filming” corrosion inhibitors greatly reduce the loss of metal.

PRODUCTS OF CORROSION:
The various forms of corrosion described result in soluble and particulate metal oxides in the cooling water. They are mainly iron oxides, but some copper oxide is usually present due to corrosion of heat exchanger tubes. These often form a hard oxide scale, in the areas of greatest heat exchange.

NEW BUILDING PRE-COMMISSION CLEANING:
When an engine system is first built it is inevitable that many of the components become corroded before completion. Many problems later in the life of the system are due to poor or no pre-commission cleaning. It is in the interests of ship owners to specify this when building new vessels or carrying out major overhauls.

HARDNESS SCALE:
The presence of calcium carbonate, sulfate, silicate and a host of other salts in shore water or through seawater contamination, are bound to result in the build up of scale, particularly in areas of high heat exchange. This can be greatly reduced by using distilled water in the system. However, if scale has built up for any reason, it must be removed before overheating occurs and to avoid “under deposit corrosion”.

See next page for recommended cleaning of cooling systems.
WATER TREATMENT

CLEANING OF COOLING SYSTEMS

BLEED OFF OF COOLING WATER SYSTEMS

As in a boiler, solids tend to accumulate in low points of cooling water systems. They must be periodically “Bled-off”. As a practical guideline, it is recommended that the system be bled whenever chlorides exceed 100 parts per million. Consult the engine manufacturer’s instructions for further recommendations according the VECOM Inhibitor used.

OIL

Oil may be present from leaking telescopic tubes of piston cooling water systems or other sources. Also, when converting from a soluble oil type water treatment to a VECOM treatment, oil must be removed to avoid over heating problems. DEGREASER GP or ALKACLEAN are added to the system being cleaned at the rate of 26 liters per ton (2 1/2 per cent by volume) and circulated through the system for 6 to 12 hours. Heat the solution to 60°-73°C. (140°-160°F.) for best results. Dump the solution, then refill and dump again. Flush the system thoroughly, hosing through access covers or other openings, as possible. Any carbonized encrustation, which cannot be emulsified, should be spot cleaned using carbon remover according to instructions on the package. Refill and add the initial dose of the Vecom treatment selected. Consult engine manufacturer’s instructions for specific flushing and cleaning procedures in addition to the above.

SCALE

Scale may vary considerably in its composition. A sample should be presented to VECOM for analysis. In most of the case that may be accomplished by DESCALING LIQUID or SAFE DESCALER POWDER (Consult proper technical brochure for instructions). In both cases, to neutralize any remaining traces of acid and to passivate the circuit, circulate a 1% to 2% of ALKALINITY CONTROL for 2 to 6 Hours.

OPERATIONAL DESCALING WITH SCALE SEQUESTRANT AND NCLT

VECOM offers a unique approach to both clean and protect a cooling water system without downtime. This treatment was designed with the following points in mind:
1. The system should be made clean and scale-free.
2. No dangerous poisonous substances should be used.
3. The procedure should be simple.
4. No damage to packing or metals should occur.

SCALE SEQUESTRANT is used for chelation of metallic ions (calcium, magnesium, etc.). COOLTREAT NCLT is used to inhibit and protect the system against corrosion. Both chemicals are used together for three months. Thereafter, COOLTREAT NCLT is used alone to protect the system.

SCALE SEQUESTRANT PROCEDURE

The system to be cleaned should be flushed to remove as much red-brown sludge as possible. If necessary remove the cooling water inlet line. Note the amount of scale present before treatment begins. Dose SCALE SEQUESTRANT at the initial dosage, rate of 2 liters per ton of cooling water. Thereafter dose daily at the rate of 1 liter per 10 tons cooling water capacity. At the same time, add an initial dose of COOLTREAT NCLT at the rate of 4 to 8 liters per ton cooling water. The system will take some time to build up the recommended concentration of 2300-4500 PPM Sodium Nitrite (Nitrite 1500-2300). Thereafter dose small maintenance amounts of COOLTREAT NCLT to maintain this concentration. The system should be bled off weekly, or more frequently as the color of the cooling water becomes darker as the SCALE SEQUESTRANT removes the deposit from the system.

After three to four months, the system should be Scale-free and the SCALE SEQUESTRANT can be discontinued. Continue with COOLTREAT NCLT to maintain 1500-2000 PPM nitrite, correcting for evaporation, leaks, repairs, etc. by regular testing.

Note: While descaling the system pH should be checked and maintained at 7.5-9.5. If it is necessary to lower the pH, add small amounts of SAFE DESCALER (POWDER). This system of descaling is intentionally a gradual process. Do not overdose to speed up the process.
WATER TREATMENT

REDUCTION OF NITRITE IN COOLING WATER SYSTEMS

BACTERIA
The bacteriological contamination of diesel engine cooling circuits being treated with COOLTREAT NCLT or COLORCOOLING can cause a significant reduction in nitrite concentration. In such cases, one must first make sure that the “disappearance” of the nitrite is not due to a loss of water resulting in intake of fresh water. If there is no water loss and despite the fact the addition of COOLTREAT NCLT or COLORCOOLING, the Nitrite level continue to decrease, it is recommended to add ECOSPERSE to the NCLT treatment. The quantity of ECOSPERSE to be used is one liter per 10 tons of water, on a weekly basic. ECOSPERSE protects the cooling water against growth or a wide spectrum of microorganism. The bacteria, which are monocellular bodies, exempt from chlorophyll can be divided in several groups: STAPHILOCOCCUS, STREPTOCOCCUS, SALMONELLA, PSEUDOMONAS AERUGINOSA, etc. Pseudomonas causes formation of mud and algae and contaminates the cooling circuits resulting in transformation of Nitrite into Nitrates.

IF THERE IS A CONTINUOUS REDUCTION IN NITRITE WITHOUT LOSS OF WATER IN THE CIRCUIT AND IF THE SITUATION IS NOT IMPROVED BY THE ADDITION OF ECOSPERSE, IT IS RECOMMENDED TO DECONTAMINATE THE CIRCUIT WITH THE FOLLOWING SYSTEM:

1. Flush completely the cooling circuit to be decontaminated and re-fill it with fresh water. Add 5 lt. of CHLOR 12 or, better, 2 tablets of CHLORINE TABLETS (20 gr.) for every 5 tons of water. CHLORINE TABLETS dissolve very quickly and have the same effect as CHLOR 12.
2. Circulate the solution in the entire circuit for at least 6 to 12 hours and check that the level of active chlorine is at least 2 to 5 PPM. If it is below that level, add CHLOR 12 or CHLORINE TABLETS until a concentration of 2 to 5 PPM is achieved. That concentration must be maintained during the entire period of decontamination. The solution must be circulated while the engine is at standstill, i.e. the engine is cold because if the temperature of the water goes above 25° to 30°C., the chlorine evaporates rapidly.
3. Check the level of active chlorine every hour to make sure its concentration remains above 2 PPM. If necessary, keep adding CHLOR 12 or CHLORINE TABLETS.
4. After the above-mentioned circulation empty the circuit and flush it with fresh water in order to eliminate all traces of chlorine. Re-fill with fresh water and add IMMEDIATELY the initially recommended dosage of COOLTREAT NCLT or COLORCOOLING, which will protect the metal from the corrosive action of chlorine.

Chlorine is highly corrosive if left in the circuit over a long period of time. One should make sure that the circuit is flushed properly free of all traces of chlorine. Check for residual chlorine with your test kit to make sure that TOTAL ACTIVE CHLORINE = 0. PSEUDOMONAS AERUGINOSA, even in colonies in excess of 50,000 SPP, can be easily eliminated with the decontamination operation described above.

INFLUENCE OF OXYGEN AND TEMPERATURE
Oxygen excess in the water system may be also one of the main reasons of the oxidation of NITRITE converting into NITRATE. The reduction of NITRITE level for causes other than leaks of water in the system will result in a serious loss of protection of the metal, thus starting corrosion and scale. In new building of ships of same class, same type of Engine Manufacturer, same yard construction, same water cooling system (high-low temperature) one can be faced with few cases of unusual NITRITE reduction and suddenly, after a certain period, this phenomenon disappear with no apparent reason. Or in some rare other cases it continues for many years. That fact was brought to the attention of a highly qualified University laboratory that could not come up with a satisfactory answer despite of deep research and studies of this phenomenon. In one or two “chronic” cases VECOM has solved the problem by changing the type of treatment from the NITRITE based to PHOSPHONATE based anticorrosion product. In a few other cases the problem was solved by completely changing the water in the circuit without even decontaminating with Chlorine disinfecting operation as described above. The only common events of this problem were the HIGH-LOW temperature type of cooling systems in new building vessels, which never happens in aged vessels. Temperature variation (high-low temperature system) is also one of the reason of NITRITE reduction problem, but the real influence of all parameter is still uncertain. We suggest therefore to contact your VECOM technical office if any of above problems affect your cooling water system.