C 6091 E

Schiff & Hafen

SEEWIRTSCHAFT · KOMMANDOBRÜCKE
INTERNATIONAL PUBLICATION FOR MARITIME TECHNOLOGY AND ECONOMICS

Sonderdruck
aus Heft 10/2000

Dangerous consequences

"Diesel pest" as a new sickness

Eberhard Runge

"Diesel Pest" is neither a new plague nor a new problem, but a reality with dangerous consequences.
"Diesel pest" is used to describe a phenomenon that is not usually discerned until blocked filters interrupt fuel supply and an engine comes to a halt.
The layman will as a rule attribute slimy, indefinable pollutants to poor fuel or to any other conceivable cause and carry on performing constant changes of filter elements. The engine may thus be able to continue functioning but the cause has not been eliminated and more serious damage is inevitable. So let's approach the subject step by step:

1. What are we describing with the term "diesel pest"?
2. Consequences and damage
3. Constructive solutions – wrong and right

"Diesel Bug"

Every time a tank is refilled, ship's operator can contract the "diesel bug" since each lubricant or propellant (diesel oil, gas oil, heavy oil, but also petrol, kerosene, naphtha or other medium distillate) load can contain the micro-organisms shown in Fig.1 (bacteria, yeasts or moulds).
We can dispense at this point with a scientific treatise on micro-organisms, since "Schiff & Hafen" had already discussed these in its issues 9/1993 and 1/1994.
Although micro-organisms have been known in principle as a disruptive factor for more than 25 years now, the oil industry's service laboratories frequently contain no information whatever about them.
Back in 1971, however, the marine research laboratory in Washington had already recognized micro-organisms as disrupti-

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Fig. 1: Micro-organisms in diesel fuel

Fig. 2: Surface damage to tanks caused by micro-organisms

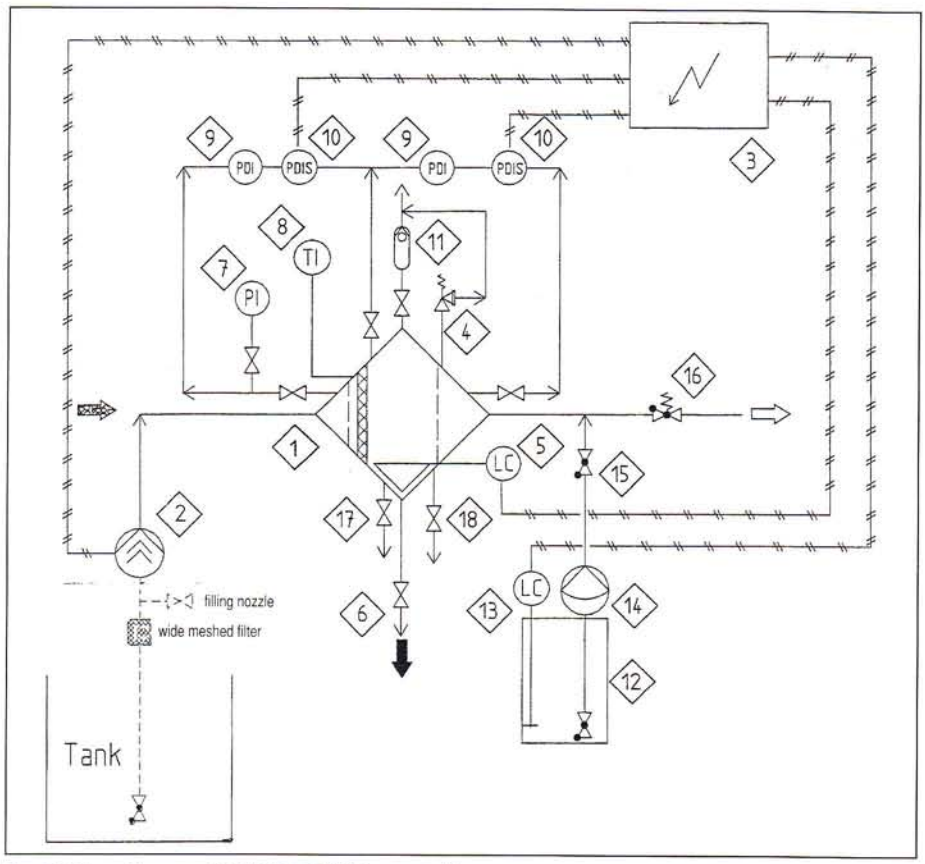

Fig. 3: Flow diagram of PTS 1000-H filter-centrifuge

Illustration

1. Two-stage coalescer/separator
2. Volute pump
3. Switchbox
4. Safety value
5. Water level electrode
6. Water outlet
7. Manometer
8. Thermometer
9. Differential pressure manometer
10. Differential pressure switch
11. Automatic exhaust ventilator
12. Biocide reserve holder
13. Biocide floater switch
14. Dosing pump

15./16. Non-return values

17./18. Drainage

ve factor No.1 in marine fuels. Investigation of diesel fuel samples had been standardized in the IP Code of practice for the examination of light distillated fuels for micro-organisms susceptible of survival (IP 386/88). In that context an Institute of Petroleum working group published a standard working document in the form of "Guidelines for the investigation of microbial content of distillated fuels" (05.01.1994).

The SGS limits might be regarded as the maximum permissible for microbial content. The total number of germs here is limited to < 3x103/l, to a lower figure than for drinking water.

Yet even such minimal rates of contamination in practice lead to grave problems, as confirmed by such experts in this field as Ted Hill or Wolfgang Siegert of Mssrs. S&M, Norderstedt, for example.

Micro-organisms have for a long time been known as a disruptive factor in diesel fuels yet knowledge of them is not generally disseminated. There is suspicion that knowledge on microbial problems is deliberately not passed on so as to avoid claims for damages. Nobody wishes to assume responsibility for supplying microbiologically faultless quality.

Even today microbiological purity is not one of the quality criteria in crude oil norms!

For the future it is essential that knowledge of microbial problems should no longer be concealed but the subject of briefing on a broad basis.

Microbiological investigations must become standard procedure in the event of filter blockages, inexplicable sludge deposits or also signs of wear. The same applies to oil storage tanks irrespective of whether these form links in the trading chain, this should start at refinery tank farms and continue as far as the tanker.

Consequences and damages

Blocked filters may be an irritation and involve labour and costs, yet these represent the least serious harm. Damage caused by microbial corrosion is several times more serious and can seriously endanger ship and crew. Microbial corrosion is not a matter of direct interplay of bacteria on metal but of the effect of products of bacterial metabolism.

A corrosive attack by moulds proceeds on the same principles. Here, similarly, organic and inorganic acids or other products of metabolism are exuded and these trigger secondary corrosion processes.

Fig. 2 shows surface damage to a ship's tank. In this case it was only detected once the tanks had been perforated. A comprehensive study lists the most frequent forms of damage to be:

1. Problems with filtration and separation
2. Engine corrosion
3. Damage in store
4. Injection pumps and nozzles
5. Cracked engine parts
6. Pitted turbine blades
7. General manifestations of corrosion

Correct and erroneous solutions

To indicate which measures are correct and which wrong, we must revert to the micro-organisms and the milieu in which they exist.

The parameter water and substrate are vital for the multiplication of micro-organisms. All fuels and lubricants as organic substances are already substrates for micro-organisms. So only water or the water concentration in a fuel or lubricant is the factor limiting micro-organism growth. Contrary to earlier views that the growth limit lay at around < 100 ppm of free, i.e., active water lay, tests have shown that a water content of < 60 ppm in diesel and other fuels no longer permits multiplication of germs. The residual water in solute form (solubility of 70 ppm) is then present and the a_w (active water content) essential for germ growth has not been reached.

So the correct solution is very simple: less than 60 ppm of free water!

The oil industry's conditions of supply, and also the German Armed Forces technical conditions of supply, still permit in excess of 100 ppm!

Let us list the appliances on offer that do not lead to the desired result, even if some of these are unfortunately well established on the market and especially in shipbuilding.

1. Mechanical separators are not capable of adequately separating off free water, even if their filtration performance may suffice to separate off solids.
2. Similarly, filter systems generally, or if installed for a specific purpose, cannot separate off water.
3. Most of the appliances offered that claim through their nomenclature to act as separators or filters and moreover to separate water 100% tempt shipbuilders to purchase something cheap but unable to function as a water separator. The declaration and assertion of 100% water separation relates to a DIN norm based on the Karl Fischer method and formerly giving 1000% as the residual figure, and nowadays 500%. Micro-organisms are delighted at so much water!
4. Just recently permanent magnets have been offered for countering diesel bug but unfortunately here again the statements are not correct. If such appliances are installed to act before the filter, the operator may well have the impression that micro-organisms can no longer cause him damage. Yet this impression is mistaken, since the micro-organisms streaming through the magnets are torn apart on account of their polar structure, no more, thus at that moment being rendered capable of passing through a standard engine filter. Yet the real problem is not solved.

Let us now turn to the correct solutions that could consist of just a single one, for distillation in practice produces a sterile fuel and now water and exterior air must be kept separate from the product. Since that is unfortunately impossible, it is only at this point that the proposed solutions commence.

In storage tanks and through fresh purchases of spot consignments and also along the entire transport chain, water forms and hence the milieu for micro-organisms. The sequence continues in bunker tanks right into bunker tanks or consumption tanks.

1. Planning principles for the redesign and cleansing of tank installations are essential for avoiding any recontamination. The possibility of convenient, regular and hence automatic dewatering plays a key role here. The NFV company of Hamburg supplies fully automatic tank dewatering systems of this kind that not only expel water from the sedimentary phase in a tank but also from the interim (product/ water) stage.
   Whether for storage, bunker or consumption tanks, tank design must facilitate total dewatering. Drainage connections, which also serve as offtakes for NFV treatment units, must be fitted at the very lowest point of the tank. Figs. 3-5 show the possibilities for installing tank dewatering systems and fuel treatment units.
   With transport through pipelines as well, it is essential to provide dewatering facilities at the deepest points of tanks.
   Retention of the microbiological quality of fuels must be taken into account when designing tank installations and transport systems, so that dewatering systems and NFV water treatment units alike with guaranteed residual water rates of < 20 – 50 ppm are accorded higher priority.
2. A biocide can be used as a preventative measure to avoid microbiological

Fig. 4: 2 x FCS (PTS 1200/21 FC 24)

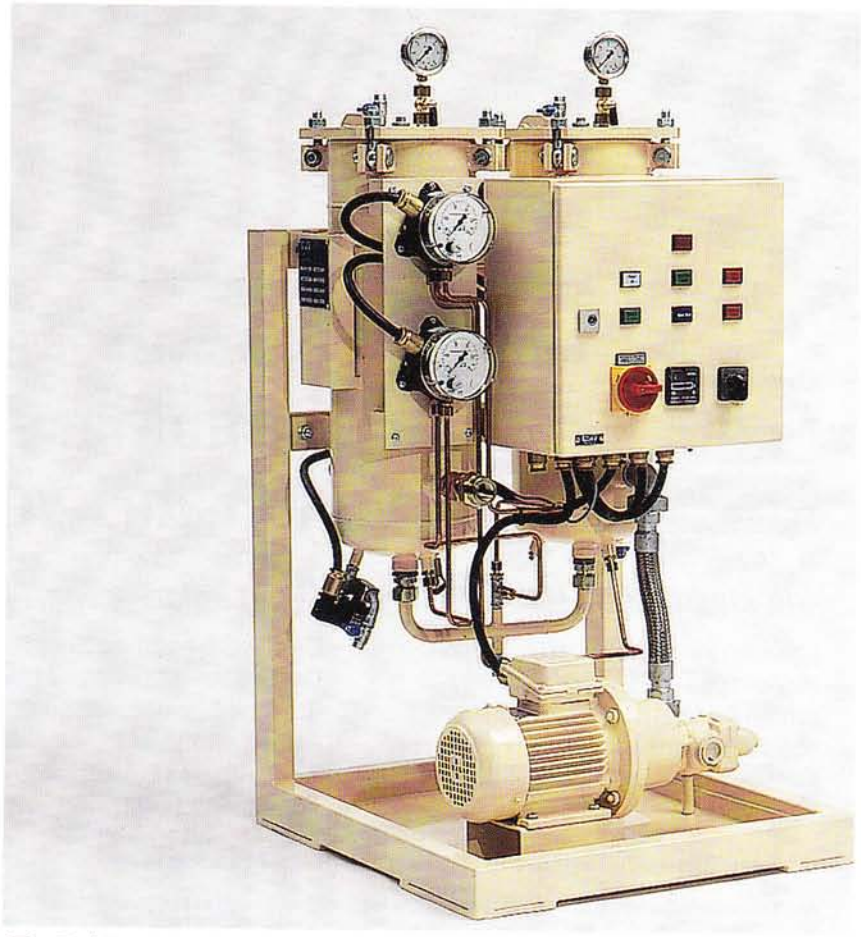

Fig. 5: FTS – Fuel Treatment System

growth in storage tanks, and already contaminated fuels can also be cleansed by this means.

Hamburg-based NFV has cooperated with S&M of nearby Norderstedt in this special field in this special field. S&M manufactures a highly effective biocide on the basis of methylenbisoxazolidin. Known as GrotaMar 71 (formerly MAR 71) this agent acts across a wide spectrum against bacteria (including sulphate-reducing bacteria) and also against yeasts and moulds.

Thanks to its alkaline content, GrotaMar 71 neutralizes acids formed by microbiological growth and thus offers effective, long-term protection against corrosion.

GrotaMar 71 forms no corrosive inflammable by-products (is BIMSCH approved), is also non-sulphurous, free from organic chloride traces, so that no AOX load occurs in waste water.

GrotaMar 71 is halogen-free, and thus conforms to the 19th Federal German law on emissions.

GrotaMar 71 has been tested and approved by such leading engine manufacturers as Mercedes-Benz AG, MAN or MTU, also by the German Armed Forces and NATO.

Fig. 6: NFV biocide dosage unit for adding biocides as fuels are bunkered

As a precautionary measure NFV, Hamburg has developed dosage units that add a precisely measured quantity of GrotaMar 71 to fuel as tanks are being filled.

In observing instructions from one turbine manufacturer on gas oil treatment, one German shipyard has installed mechanical separators (centrifuges) that do not produce the required residual water content. As a preventative measure, as tanks are filled NFV dosage systems are being used to add GrotaMar 71 to the gas oil.

Conclusion

Fuels and other oil products will also be suffering microbial contamination in future.

Regular investigations allow the risk to be recognized and facilitate taking appropriate measures to kill and avoid germs.

Only water separators (phase method) that separate water present in a fuel as far as the limit of solubility (NFV systems) and GrotaMar 71 as an additional preventative measure offer dependable protection against micro-organisms and the consequences.