Thermal Disinfection of Coolant Lubricants

Whoever works with coolant lubricants knows the problem: You enter the production hall in the morning and it stinks to high heaven, because the coolant in one of the tooling machines has turned.

As is well known the cause of this are microorganisms, namely fungi and bacteria which find a perfect breeding ground in the coolant. These microorganisms mainly occur in water-soluble coolants and become more frequent in summer and in southern countries because of higher temperatures. The odour nuisance comes from the excretions of anaerobic bacteria.

Apart from the smell bacteria and fungi also have other unwanted side effects: They reduce the effectiveness of the coolant and so impair its performance. Occasionally pipes and tubes are blocked by fungus threads and/or mucus bacteria, exceptionally even fungus growths the size of a cabbage occur.

Therefore, a targeted maintenance of the coolant clearly makes sense to maintain the performance for longer, i.e. to prolong the life span of the coolant. This reduces the cost for purchasing new coolant, the – frequently underestimated – cost for disposal of used coolant, and the cost for machine stand still times during the change of the coolant.

Coolant after three days: No thermal disinfection
bacteria 10^4 cfu/ml fungi 10^4 cfu/ml
(cfu = colony-forming units)

Maintenance of the coolant in most cases includes filtering the coolant with the aid of specific coolant filters as well as collecting surface oils with the help of skimmers and oil separators. Such mechanical methods, however, are powerless against existing microorganisms. Even monitoring the coolant with respect to nitrite, nitrate and the pH-value only allows to determine that resp. when new measure have to be taken.

For fighting bacteria and fungi in the coolant only very few methods are available. Widespread is exposure to ultraviolet light. This works relatively well with transparent fluids but with coolant the UV rays can only disinfect at the surface because of the milky quality and impurities. As a result the coolant has to be reduced to a very thin layer so that UV rays can still penetrate the coolant. In practice this is a significant challenge and results are often rather modest: Often only 60-80%, and sometimes less than 50% of the existing bacteria and fungi can be eliminated.

Certainly most frequently applied are biocides, i.e. bactericides and fungicides. Without a doubt these have the advantage of being highly cost effective and normally also of being very efficient. On the other hand, biocides are hazardous substances under the CLP ordinance of the EU, which require a professional (and expensive) disposal.

So, in many respects one evil is replaced with another because biocides can result in considerable health complaints. These span from easy infection of everyday wounds to eczema and allergies all the way to irritations of the skin, the eyes, and mucous membranes. Concentrates in particular must not touch the skin as even smallest droplets can lead to significant health problems.

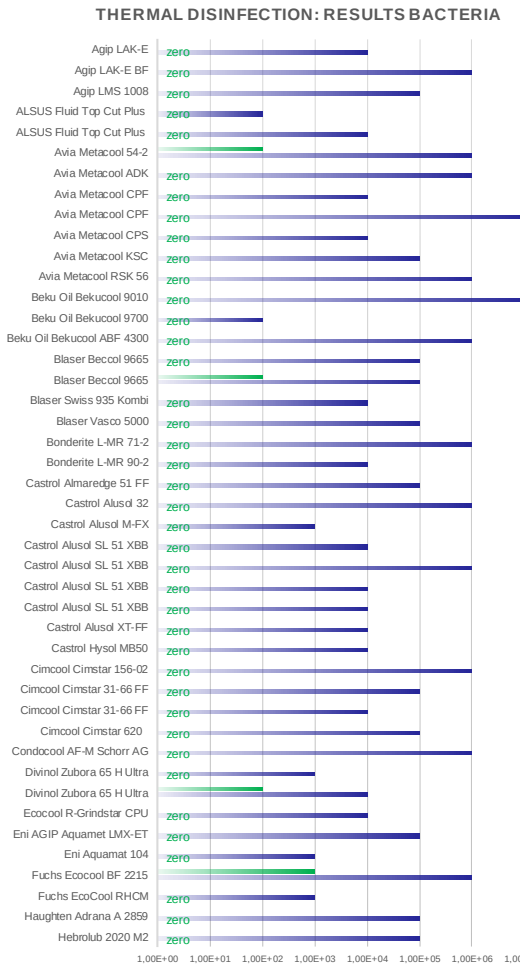
Avoiding biocides would therefore reduce the health risks for the employees and contribute to reducing sick days.

Coolant three days after thermal disinfection
bacteria 10^0 cfu/ml fungi 10^0 cfu/ml
(cfu = colony-forming units)

Little known but all the more effective is the thermal disinfection, known as pasteurisation in hospitals and in the food industry. For this purpose the coolant is heated up to 65°C. As proteins and therefore bacteria and fungi are destroyed at ca. 62-63°C this method is close to 100% effective.

In a test series conducted by ph-cleantec in Fellbach thermal disinfection was analysed at 107 customers with 75 different coolants. 88 customers showed bacteria, at 29 of the 107 also fungi were found in the coolant.

Graphic 1a – Bacteria page 1



Test results of ph-cleantec GmbH with diverse customers from October 2017 to today – page 1
Bacteria: blue bars prior to disinfection;
green bars post disinfection

Note: The quantity of fungi and bacteria prior to a thermal disinfection of a coolant only shows that at a specific customer at a specific point in time a specific amount of germs was found in the respective coolant. This may be a function of the temperature, the specific application, or the age of the coolant, and does not say anything about the quality of the respective coolant or whether a particular coolant is particularly prone to developing germs.

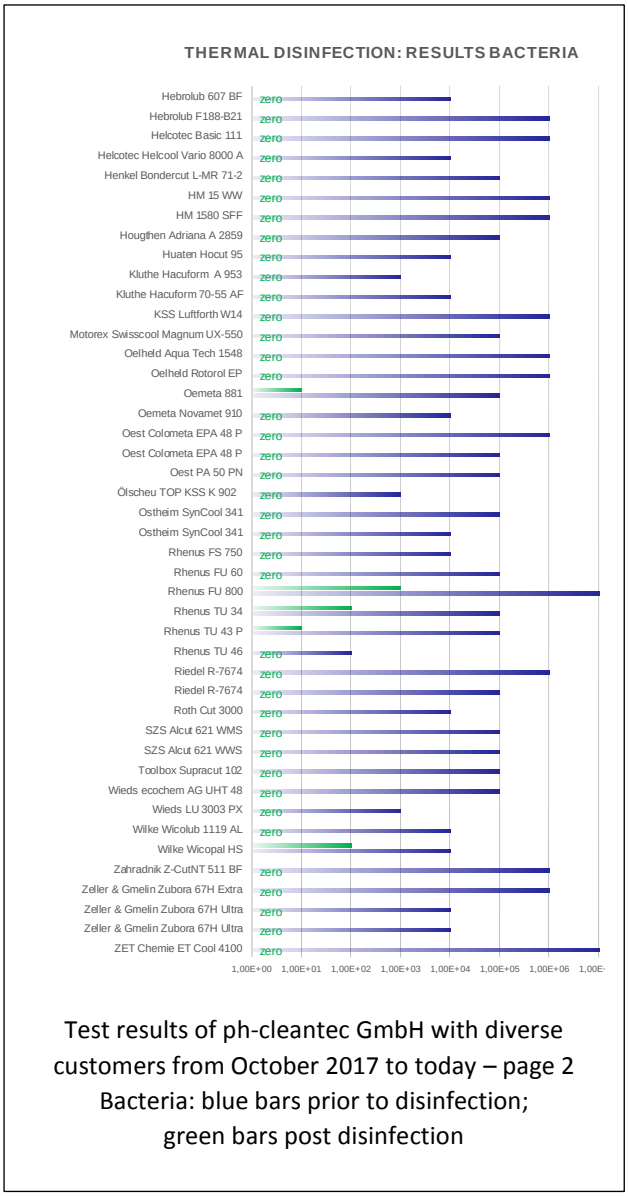
Graphs 1a, 1b, and 2 show the results of the thermal disinfection for several coolants in practice. The graphs are on a logarithmic scale, so 10^3 means 10 x 10 x 10 = 1000. Measured were colony-forming units per milliliter (cfu/ml).

In 90% of cases – 79 out of 88 customers – bacteria were reduced to zero (graphs 1a and 1b). Only in 9 cases bacteria remained at all, but could be reduced by a factor 10^3 on average. Even in cases of severe infestation – 10^6 or 10^7 bacterial germs per milliliter – after the disinfection no bacteria were found in the coolant in 23 out of 26 cases, and in the remaining cases bacteria were reduced by a factor 1.000 or 10.000.

Even more successful was the thermal disinfection of fungi (graph 2): In all 29 cases these were reduced to zero.

From the users' perspective particularly relevant is that the thermal disinfection works in real life and in the long run. Companies using the system were able to completely avoid biocides and to prolongate the life span of their coolants significantly once they started to disinfect their coolant regularly. This is also acknowledged by coolant producers.

Graph 1b - Bacteria page 2



Test results of ph-cleantec GmbH with diverse customers from October 2017 to today – page 2
Bacteria: blue bars prior to disinfection;
green bars post disinfection

As a result thermal disinfection is certainly one of the most efficient methods to disinfect coolants. It is, as no chemicals and no biocides are needed, also health and environmentally friendly. Finally, the thermal disinfection is particularly cost efficient as a relatively low investment for purchasing a machine for thermal disinfection – e.g. the ThermoDes or the 1000 SR with an upgrade for thermal disinfection from ph-cleantec in Fellbach – as wells as minimal operating costs, namely for electricity, are required. In any event, the disinfection should be run during full production so that the content of tubes and pipes can be disinfected also. As a result there are also no stand still costs during disinfection.

This can be illustrated with a simple example: At a company with ten tooling machines (TM) of 500 liters each where the coolant is changed twice a year the annual consumption amounts to 10,000 liters of coolant. At costs of €5/l of coolant concentrate and a concentration of 6%-that costs 10,000 l x 6% x €5 = €3.000. Say the disposal costs another €0.12/l, that is 10,000 l x €0.12 = €1,200. Add the cost of stand still times: Assuming the TM stands still for eight hours to change the coolant, and an hour of stand still time costs €100, then this costs 10 TM x 2 changes per year x 8 hours x €100 = €16,000. Total costs therefore amount to €20,200.

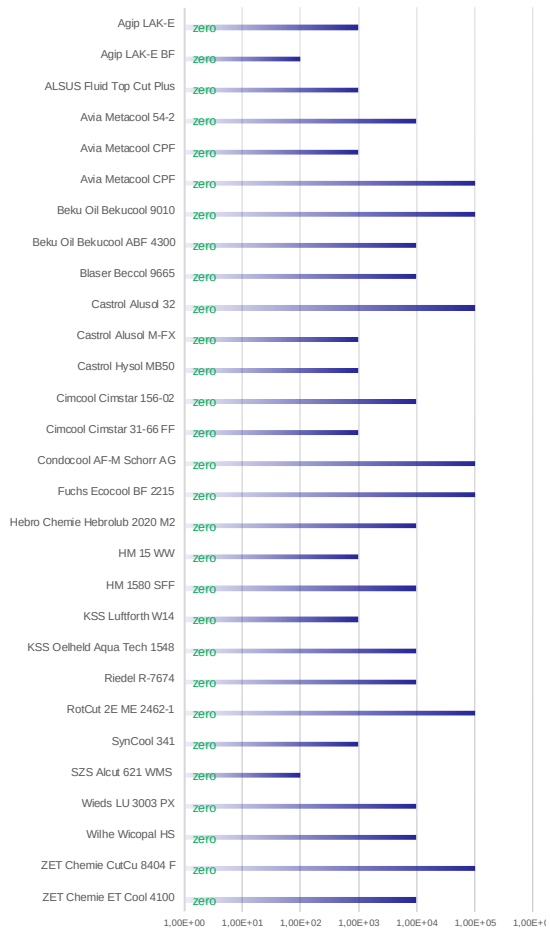
If the life span of the coolant can be prolongated by 50% due to thermal disinfection the company saves €6,733 p.a., and if the life span of the coolant can be doubled the company even saves €10,100 per year. On top the costs for bactericides und fungicides can be saved. Last not least some benefits which cannot easily be quantified in terms of money need to be cited: No unpleasant smells, a clean production environment, and, importantly, less health problems.

In practice the machines used for thermal disinfection are mobile and can easily be driven to the respective tooling machine. The coolant is sucked into the disinfection device from the tank of the tooling machine, disinfected, and then re-injected into the tank of the tooling machine. With a disinfection capacity of 5-6 liters per minute a tank of for example 500 liters can be disinfected once in less than two hours. Also an incorporation into a central cooling system is feasible.

Ideally the disinfected coolant should be fed into a separate and disinfected recipient, and the tooling machine be cleaned and disinfected top to bottom before the coolant is re-injected into the tooling machine. However, this is – incidentally with all methods – not feasible in practice. Rather the disinfected coolant is re-injected directly in the tank, where is mixes with the un-disinfected

coolant. As a consequence, some residues of non-disinfected coolant regularly remain in the tank of the tooling machine, in particular the biofilm at the bottom and on the walls of the tooling machine.

Graph 2



Test results of ph-cleantec GmbH with diverse customers from October 2017 to today
Fungi: blue bars prior to disinfection;
green bars post disinfection

In practice it is therefore advisable to disinfect the coolant two times in a row, and to mix it up a bit, so that a maximum of infected volumes from the corners, the tubes and from the bottom is whirled up and disinfected. Even so it will be impossible to reach the biofilm as such and the biofilm will re-contaminate the dis-infected coolant. Nonetheless, after a thermal disinfection it will take weeks if not months until the coolant as again so severely infested that a new disinfection becomes necessary. As a result the thermal disinfection should definitely be repeated on a regular basis, for example once a month.

To conclude, a significant prolongation of the life span of the coolant is possible – with corres-ponding savings potential for purchasing and disposing of the coolant, as well as reduced health complaints by employees and therefore potentially lower sick times.

"Since the middle of February 2018 we use a 1000 SR by ph-cleantec with the Option Thermal Disinfection. On top of machine cleaning with the low pressure hot cleaner we use this option as a prophylactic measure to disinfect the content of the tanks of our tooling machines. Both the cleaning and the concurrent disinfection are conducted according to a specific plan that we developed in-house.

Particularly with the very hot temperatures of the last months we could reduce the usage of biocides significantly, resp. avoid them altogether, because the thermal disinfection reduces the infestation of bacteria and fungi so dramatically!

As a result of this environmentally friendly procedure our personnel and our environment are burdened less."

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