

microbiological control

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Growth of Microbiological Organisms in Cooling Water System

Conditions in a typical industrial or electric power plant cooling water systems are close to ideal medium for biological and marine growth like living organism referred to as Biofouling. This cooling water system provides an ideal medium (32-38 °C in the water temperature and 8-9 in pH) for the biological growth because it provides air, heat and light. The water source contains all the naturally occurring organisms and nutrients that are required for biological growth. Also inorganic and organic phosphates are often used for corrosion control, thus adding additional nutrients. This requires, above all, a clean heat exchanger and heat transfer and cooling efficiency.

There is no need to emphasize the fact that algae proliferate in the cooling towers and basins open to the air, particularly in summer. In a recirculating system, the water in the tower is cooled by evaporation and thereby becomes more concentrated with dissolved solids, since biofouling often serves as the "glue" that binds other deposits to the heat transfer surfaces. If the main purpose of a cooling tower is to cool the discharge water,



concentration cycles will be low. If the purpose is to conserve water and reduce discharge water volume, the water will be held in the system much longer and become more concentrated with dissolved solids, thus increasing the fouling potential.

For biofouling control, to kill the algae and slime type growths, to keep the plant cooling water pipework clear of growths to attain maximum heat transfer

efficiency, the chlorine gas is generally added at the circulating pump suctions or water intake screens of a recirculating cooling tower system. Also the object of chlorinating cooling water is to kill the water borne organisms before they have a chance to attach themselves to the internals of the cooling system and block the water flow, reducing the cooling efficiency.

Once the growth is established to a degree that it reduces the cooling efficiency, chlorination will not remove the growth; the only solution is to mechanically clean the system then chlorination will keep it clean by killing the organisms before they attach themselves to the internal of the cooling system.

The classes of microbiological organisms that proliferate in open recirculating cooling systems are Algae, Fungi and Bacteria.

Algae

Algae require sunlight and use chlorophyll to convert carbon dioxide into biomass. While different types of algae flourish under different optimum conditions, those which are most predominant in recirculating cooling systems are found on the wet, exposed, aerated surface such as the open distribution decks of the cooling tower. Algae biomass are found attached to the tower structural members and in the plenum and drift eliminator. Algae attach themselves to structural surfaces in the area where they grow. Consequently, algae normally have little direct effect on heat exchanger surface. If dislodged, algae may interfere with proper water distribution on the tower deck and/or they may be transported to heat exchangers where they may cause plugging.

Algae biomass can provide a nutrient source for bacteria, thereby enhancing bacterial growth. If attached to, and/or deposited on metal surface, algae can contribute to localized corrosion processes, especially microbiologically induced corrosion (MIC.)



Fungi

Fungi are simple organisms containing no chlorophyll. They can be unicellular or filamentous. They usually require less moisture and can survive at lower pH levels than algae or bacteria. Fungi can reproduce both sexually or asexually (sporulation).

Two commonly known classifications of fungi are yeasts and molds.

The yeast type of fungi do not cause wood rot, but instead can proliferate to high numbers and foul heat exchangers surfaces.

The most serious damage caused by molds is destruction of cooling tower wood. Fungi obtain their food from plant and animal matter by secreting enzymes into their surrounding.

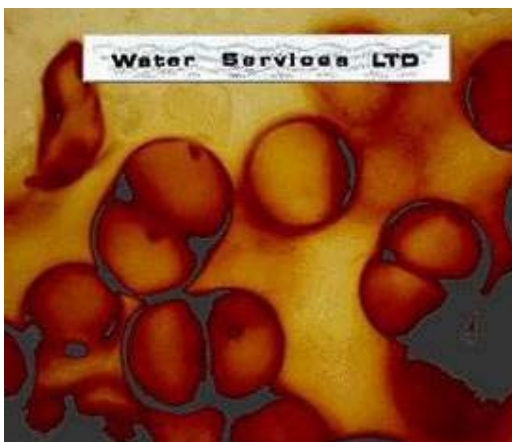
Cellulytic fungi use cellulose as a source of carbon, and in doing so, they destroy the wood. The most generally accepted classifications of fungi wood destruction are soft rot (sometimes called surface rot), brown rot and white rot (sometimes called pocked rot or deep rot).

Soft rot occurs primarily on wood surfaces which are heavily wetted, such as the tower fill. The cellulose (the material giving the rigidity to wood) is destroyed, which the lignin (the cell cementing material in wood) is not significantly attached. Wood which has suffered soft rot, upon drying, will reveal cracks perpendicular to the grain, giving a cross-checked appearance to the wood. Also, the wood becomes very brittle; if broken across the grain, the wood will not splinter, but will break evenly in a straight line along the edge.

Brown rot is similar to soft rot, but it occurs inside the wood. Again, the cellulose is metabolized, leaving the lignin little affected. A brown color occurs as a result of the lignin residue remaining. Brown rot occurs in wood that is not fully saturated with water, allowing diffusion of air into the wood. Areas of the towers, such as the plenum, that are only contacted with water mist, are more likely to incur brown rot.

Wood may suffer brown rot and lose most of its structural strength, yet it may appear, externally, to be sound.

White rot also occurs inside wood not completely saturated with water. While rot organisms digest both the cellulose and the lignin, leaving hollow pockets in the wood. Wood which has suffered white rot may also appear sound when viewed externally.



Bacteria

Bacteria are single cell, microscopic organisms that usually reproduce by binary fission. Bacteria can be described as aerobic, anaerobic, or facultative, depending on whether they flourish in an oxygenated environment, and environment void of oxygen, or in both types of environments, respectively.

One of the more predominant types of bacteria occurring in open recirculating cooling water systems are slime-forming bacteria. These bacteria are aerobes and are naturally present in the soil. Consequently, they continuously infect open recirculating cooling systems. These bacteria may flourish throughout the cooling system, including the heat exchanger surfaces and the cooling tower.

These are typically encapsulated bacteria which produce slime layers outside the cell walls. These slime-encased cells attach to the available surfaces. Then they reproduce, form additional slime and develop into boideposits or "biofilms".

The biofilm layer is composed mostly of water, hence it presents a significant barrier to heat exchange. The biofilm mass, which also frequently contains filamentous bacteria, can serve as the nuclear for agglomeration and deposition of water borne suspended solid. These combined biological-mineral deposits dramatically reduce heat exchanger efficiency and also create differential aeration cells which can result in high localized corrosion rates.

Corrosion of metal surface is also caused by several types of anaerobic bacteria. These bacteria flourish beneath biofilm and other deposit layers where oxygen is not present or readily replenished. The most notable of the anaerobic corrosive bacteria are the sulfate reducing bacteria (SRB).

These bacteria reduce sulfate to corrosive hydrogen sulfide. They also are thought to cause cathodic depolarization by removal of hydrogen from the cathodic portion of corrosion cells.

Acid producing bacteria (APB) produce organic acids. These metabolic processes cause localized corrosion of deposit laden distribution piping and also provide the potential for severe pitting corrosion of heat exchanger



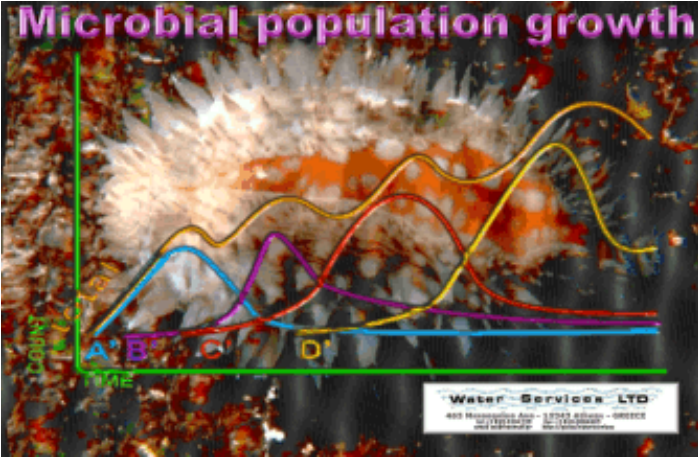
surfaces. This entire process is called microbiologically induced corrosion, or MIC.

Legionella bacteria, which can pose potential health hazards, can also proliferate in cooling towers and condensers. Legionella bacteria are normally found in low numbers in water containing systems and can be isolated from most natural aquatic and soil environments. Cooling towers are therefore easily contaminated with these bacteria. When Legionella are expelled from towers as an aerosol in the drift, there is the potential that people may contract a certain type of pneumonia called Legionnaires' Disease or Legionellosis.

Although people inhaling these bacteria-containing aerosols may get severe pneumonia and require antibiotic therapy in a hospital, the conditions necessary to produce the disease from cooling tower aerosols are certainly not well established. A less serious form of the disease is called Pontiac Fever.

Legionella bacteria are not slime-forming and do not appear to cause fouling or corrosion in the cooling towers.

Microbial population growth



Let examine how the microbial population is increased into our system.

We are considering a very limited starting population, introducing nutrients that will improve growth.

Under such conditions, a certain category of microorganisms, start to multiply. As it is shown in the video to the left, the

population of this category (A') is increased, increasing also the figure of the total population.

The increase in A's population is leading to the increase of its physical enemies (Category B') which are being fed by them.

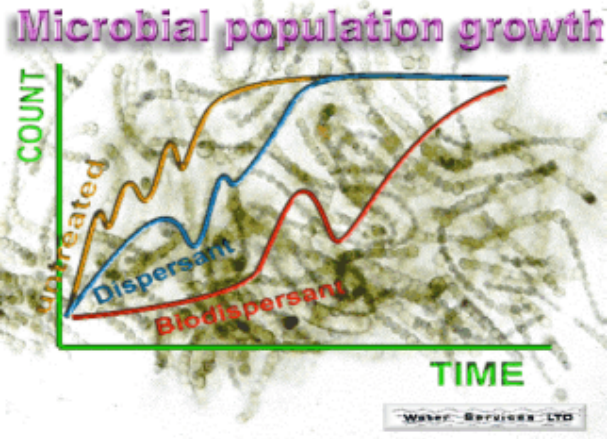
The population of A' rises to a maximum and starts to decrease, due to the lack of additional nutrients, plus the increase of the Category B'.

But the population of the category C' starts to increase, being the physical enemies of category B', and the cycle is continuing till a final equilibrium, related to the system's characteristics and the nutrients available.

Normally this equilibrium status is well outside the operational limits of our system.

If we try to control the population by adding a dispersant toxicant (biocide), the total population growth will present the graphs of the video on the left.

The total population level will decrease for a small time period, but then it will expand to the untreated level, because organisms find the way to overpass the toxicity, creating mutagenic, more resistant species.



Those pore resistant species, can also be dangerous to human.

In open recirculating cooling water systems, the existing blow down is removing the toxicants from the system, resetting the initial living conditions.

This cannot be done automatically in closed systems, so if the system has not significant leaks, it is mandatory either to replace the entire water volume every three months, either to use a self-detoxified biodispersant, like [BDS® 6950](#)

PROBLEMS CAUSED BY MICROBIAL ACTIVITY

Continued accumulation and growth of microorganisms in a industrial water system cause a number of problems. Good corrosion and deposit control programs are incumbent upon a successful microbial control program. A plant unable to control microbial growth can — and very often will — experience increased difficulty controlling corrosion and deposition.

Another problem associated with microbial infestation is the deterioration of industrial tower lumber. This not only reduces efficiency of industrial tower operation, but adds substantially to the operating cost of the plant. Microbiological growths also directly cause other problems by their presence, among them odors and environmental pollution.

- [Corrosion due to Microorganisms](#)
- [Deposit Problems](#)
- [Wood Deterioration](#)
- [Microbial population growth in closed systems](#)

Our New Technnology Advanced Solutions

When a material contains is its formulation non ionic dispersant, to improve biocidal action, is characterized as "biodispersant".

Water Services Ltd offers all up to date available biodispersants, oxidizing and non oxidizing and suplies it under the general trade name BDS[®] 6XXX.

Microbiocides, according to their microorganisms killing effect, are characterized as :

- Oxidizing, subdivided to :
 - Chlorine releasers,
 - Bromine releasers
 - Other oxidizing microbiocides
- and Non-oxidizing.

In our product range is also included the new generation biodispersant BDS[®] THP .

Selections

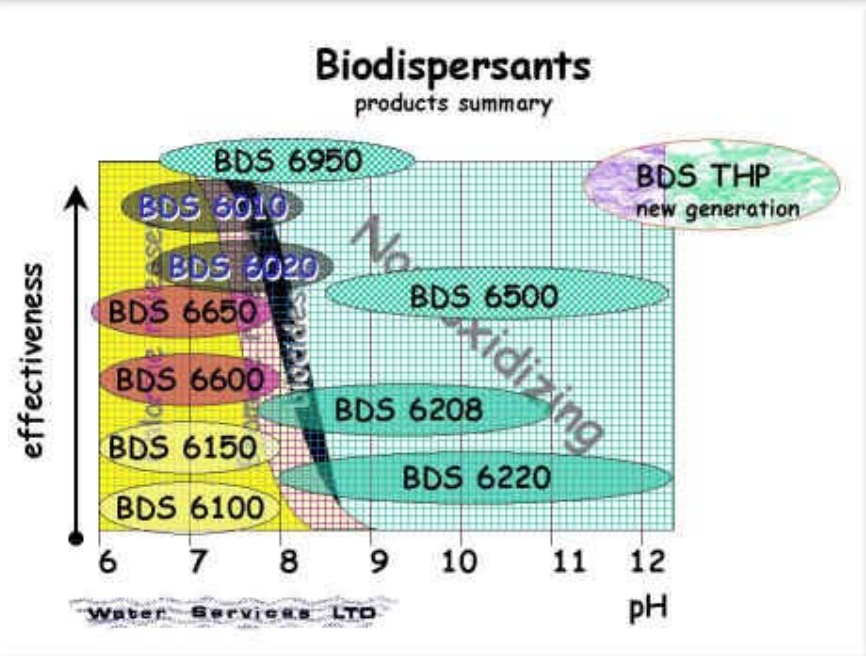
The proper use of industrial microbiocides in industrial water treatment applications requires a thorough knowledge of the system to be treated before the best course of action can be chosen. There are a number of oxidizing and nonoxidizing approaches which can be effective in controlling the growth of microorganisms, but each has its own specific area of application strength, use-cost characteristics and system compatibility constraints.

When the parameters of the given system are examined and goals for the treatment program established, an effective technology or combination of technologies is available to satisfy those treatment goals.

As with all effective industrial water treatment, microbiocide programs require the proper dosage, control and monitoring techniques to insure success. When these parameters are met, the myriad of operating problems caused by the uncontrolled growth of microorganisms in industrial water systems can be effectively eliminated.

Our technical representatives will support you in the selection of the appropriate combinations, frequencies and monitoring.

Product summary

<u>Oxidizing biodispersants</u>			Non oxidizing
<u>Chlorine releasers</u>	<u>Bromine releasers</u>	<u>Biocides</u>	
BDS 6100 fast releaser	BDS® 6600 fast release BDS® 6610 slow release	BDS 6010 form plus dispers.	BDS 6208 quats mixture
BDS 6150 slow releaser	BDS® 6650 BNPA technology	BDS BIOBROM Q BDS® 6020 form plus quats.	BDS® 6220 quats mixture
			BDS® 6500 glutaraldehyde
			BDS® 6950 isothiazoline
			To BDS® THP belongs to non oxidizing

DECHLORINATOR-ES

Our representatives:

Country	Company
 Malta	 <p>Triforce Ltd., 42, Lord Byron Str., Naxxos NGR08 MALTA</p>
 India	 <p>Aqua Tilsep Water Treatment Pvt. Ltd.</p>
 Iran	<p>رَبَدَت ؛ قَسَدَنَه</p> <p>RAHESH ENH & CONSUL. CO. ADD. NO. 242 1ST FLOOR, KARDMEHANZAD AVE. TEHRAN</p>
 Egypt	 <p>Egyptian Oil & Gas Services</p>
 Jordan	 <p>TRADING & CONTRACTING CO. LTD.</p>
 Qatar	 <p>مارس MARS التجارة والتوريد TRADING & CONTRACTING</p>
 Saudi Arabia	 <p>SAUDI ARABIA CHAMBER OF COMMERCE AND INDUSTRY RABEEL AL KHAYYAT RABEEL AL KHAYYAT</p>

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