One AquaSource

# BLUE NOTE # 07-004

## *The 'Dual Biocide' Myth*

Even in industry, myths develop and persist despite that they are not validated by hard science. In the water treatment industry those myths exist, and one of those is that '*by frequent alternation of 2 nonoxidizing biocides to a cooling water system, microorganisms will not develop resistance to either, and bacterial control will be better.*' Not only is this not true, but is actually opposite of the biological reality.

In the 60's a few general purpose, broad spectrum nonoxidizing biocides were used to kill and control microorganisms in cooling water systems. These materials, like chlorophenols, acrolein, etc. were very powerful agents against all organisms. There were hazardous to handle, very toxic to fish and persisted in the environment. Both USEPA and OSHA regulations in the early 70's moved to remove these biocides from the market. Since chlorination of tower systems was not well understood (and difficult to control) and bromine did not exist, water treaters were forced to use a variety of organism specific, nonoxidizing biocides. To control bacteria, algae and fungus, multiple biocides were used and alternated to prevent molecular interaction and system foaming.

In the late 70's new general purpose, broad spectrum biocides were introduced that were reasonable to handle and environmentally friendly. However, by this time, the alternating of target specific biocides was already ingrained and continued. The new justification for the practice was that organisms can develop resistance to toxins, so by continuing to alternate, resistance would be avoided.

Unfortunately, this was opposite of real biology. If a large bacterial population is exposed to a specific Toxin A, some of the population will have, by accidental mutation, a higher resistance to the toxin. If then in a short time (days or weeks) the progeny of these resistant organisms are exposed to a Toxin B, the surviving organisms will now be resistant to both toxins.

This phenomena is well understood in the medical community. A physician would never prescribe a low dose, alternating antibiotic regimen to control a human bacterial disease.

Finally, the myth has also been expanded to include oxidizing biocides, like chlorine, bromine and chlorine dioxide. It is also a well known fact in the microbiological community that organisms CAN NOT develop resistance to oxidizers, regardless of the level and frequency of exposure. Nonoxidizing biocides kill by either coating (and starving) cells, interrupting protein production, interfering with reproduction or interfering with metabolism. It is possible for mutations to occur that can provide improved resistance to all of these kill mechanisms. However, oxidizers kill by breaking the C-N bond in all proteins and nucleic acids – a chemical reaction with the basic backbone of life itself. Therefore, biological resistance development is not possible.

It remains true, that the best control technique in all cooling tower systems remains continuous, low level application of an oxidizing biocide supplemented with a biofilm dispersant to improve penetration of the oxidizer. No resistance can, or ever will, develop.