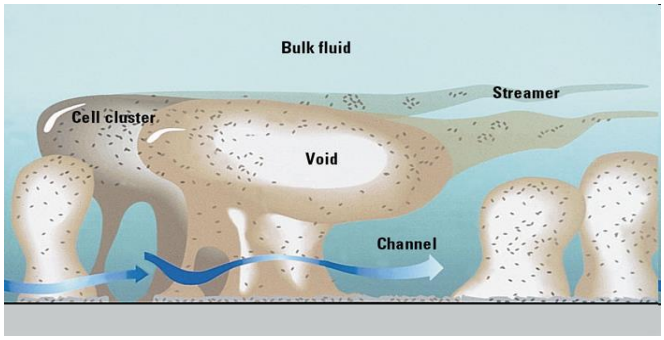
LaMotte Water Management **Technical Data Sheet**

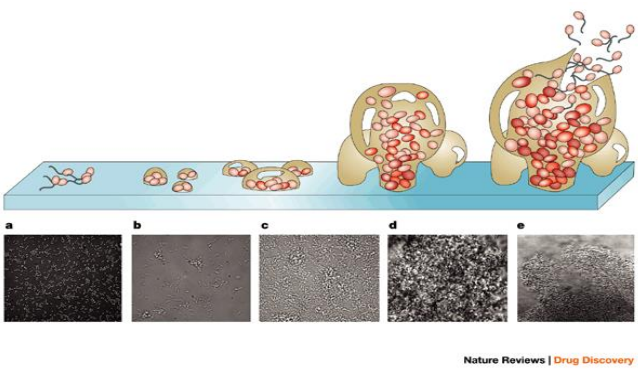
BIOFILM AND REDUCED ENERGY EFFICIENCY

Biofilm: a gelatinous mass that forms in cooling water systems, which consists of microbial cells, the polysaccharide biopolymer they produce, and debris extracted from the cooling water.

Biofilm is made up of multiple species of bacteria, including amoeba and protozoa. This film contains sugars and proteins adding to the bulk and insulating properties of this colony layer and can range in consistency from slimy to very hard.



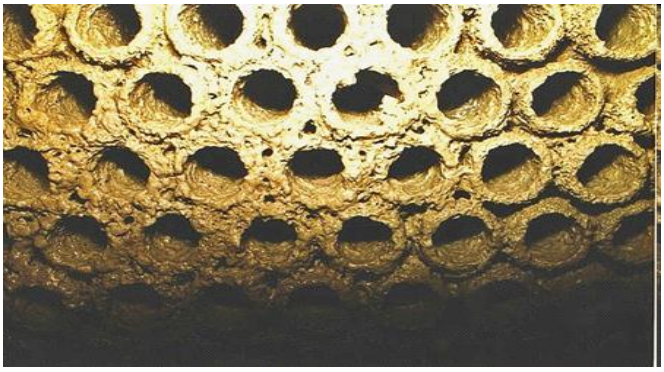
The mass is "cemented" by the produced biopolymer, which often exceeds the volume of living microorganisms by a factor of 100, or more. While biofilm can be responsible for many different problems in cooling water systems; such as plugging of cooling water passages/pipes due to physical blockage and accelerated corrosion under the biofilm itself; the two major problems are reduction in heat exchanger efficiency and increased risk of exposure to Legionnaires' Disease and other infectious diseases. This biopolymer also acts as the glue that helps deposits like Calcium Carbonate scale adhere to heat transfer surfaces.



Biofilm and Energy Use

While mineral scale formation is commonly believed to be the major cause of increased energy usage in heat exchanger operation, biofilm actually has a lower thermal conductivity (a lower number indicates a greater resistance to heat transfer) than common mineral based scales. The following table illustrates this unappreciated fact:

Scale	Thermal Conductivity
Calcium Carbonate	2.6
Calcium Phosphate	2.6
Calcium Sulfate	2.3
Iron Oxide	2.9
Biofilm	0.6



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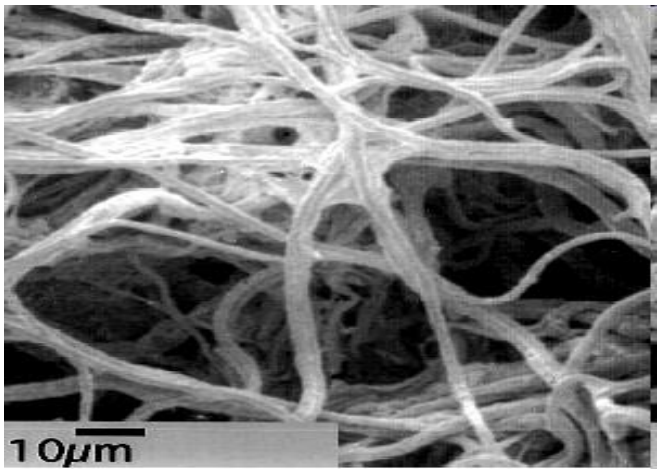
Thus biofilm is over four (4) times as resistant to heat transfer as common calcium carbonate scale! Calculations show that a biofilm only 0.045 inches in thickness on the condenser tubes of a centrifugal chiller results in a 35% increase in chiller electrical power consumption.

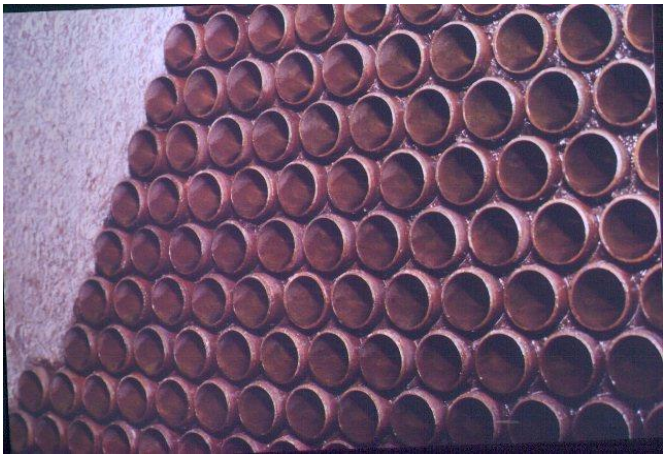
The economics of biofilm are astounding! As an example, consider a 200 ton chiller installation operating at a 50% annual average load with power at $0.05/kwh; the electrical power cost would be $26,280/yr. A biofilm thickness of 0.045 inch on the condenser of this unit would increase the annual power cost by $9,198.00. Annually, biofilm has been estimated to increase power costs to commercial and industrial operations in the United States by several billion dollars.



Biofilm Control

Traditional biofilm control technology uses various chemicals that are costly, dangerous to handle, and toxic. Chemicals such as chlorine, chlorine dioxide, dithiocarbamate, hydantoin, isothiazolin, and glutaraldehyde; commonly referred to as "biocides". These hazardous chemicals are used to treat cooling systems scattered throughout our towns and industrial complexes. The resulting use of these toxic chemicals represents severe safety and environmental risks due to accidental spills as well as the resultant toxicity of treated cooling tower blowdown.

A better choice is the use of Ozone to treat the system. As an oxidizer, Ozone is five times more effective that chlorine and is not effected by system pH. Ozone is produced on site so there is no chemical handling required. Further, Ozone does not create detrimental by-products during its' use and any ozone that has not reacted with contaminants in the system reverts back to Oxygen, meaning that there are no chemicals left in the tower bulk water when it is discharged.



This form of treatment leaves the cooling system significantly cleaner and more energy efficient.

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