Cooling Tower and RO filter water Microbiological Analyses

Cooling towers and RO filters can be a critical process in many industrial production facilities.

An industrial cooling tower can be the perfect media for biological growth if not properly treated. Typical pH is 7-9 and temperatures may have a wide range.

In a cooling tower, the water trickles down a large surface area in order to air-cool the water. The natural evaporation provides the cooling necessary to reuse the water.

As water evaporates, minerals and contaminants in the water concentrate. These minerals and contaminants will eventually reach a concentration where they will cause problems and interfere with the performance of both the tower and the cooling system, itself. Fouling and corrosion of the cooling tower can impact treatment, and impact heat transfer losses causing decrease in efficiency and increased power consumption.

Biofouling can also destroy cooling towers if they are made of lumber. Corrosion can occur on metal parts.

More seriously, such contaminants can be harmful to humans who come in contact with them, like operational and maintenance personnel. The most notable example has been the outbreaks of Legionnaires' disease, affecting people in hotels, hospitals, office buildings, and other locations, who have come into contact with cooled air from an air conditioning system contaminated from cooling tower water of the air conditioning plant.

What are the typical biological species found that could cause corrosion and Biofouling?

Fungi

Mold

Yeast

Algae

Aerobic and anaerobic bacteria

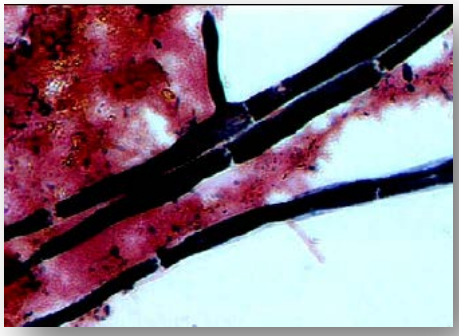
MIC bacteria (sulfate-reducing, acid producing, nitrate reducing,

Iron/sulfur oxidizing)

œ Slime-forming bacteria

Iron/manganese depositing bacteria

œ *Thiobacillus spp., Gallionella spp., Sphaerotilus spp.*



Yeast and Fungi

The presence of large amounts of yeast or fungi can indicate a low pH, or existence of fermentative conditions. There are more than 75,000 species of yeast and fungi, which include mold, smut, rust and mildew. They may be colorless or cover the entire color spectrum. Most grow best in warm, dark, moist places. Most are aerobic with low oxygen demand. A few, including yeast, are anaerobic. Fungi can grow on almost any surface and are considered an attributing factor to wood deterioration. Both yeast and fungi are commonly transported by air currents. They are relatively large and can easily be identified with microscopic analyses.

Fungi

Two forms of fungi commonly encountered are molds (filamentous forms) and yeast (unicellular forms). Molds can be quite troublesome, causing white rot or brown rot of the cooling tower wood, depending on whether they are cellulolytic (attack cellulose) or lignin degrading. Yeast are also cellulolytic. They can produce slime in abundant amounts and preferentially colonize wood surfaces.

Identification:

Fungi are extremely large, non-motile filaments (300-1000 µm). They can be straight, irregularly curved or bent filaments with true branching. Cells

are very rectangular (3-8 x 5-15 µm) with very large trichomes and contain organelles and large intracellular granules and structures. A heavy cell wall is usually present.

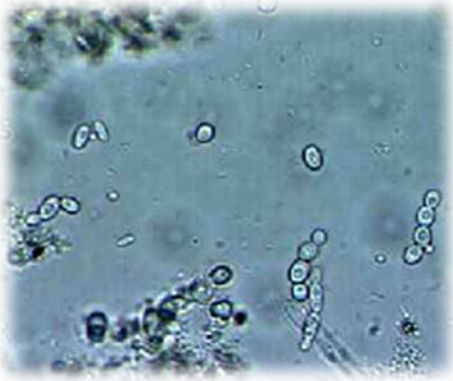
Environment:

Fungi and yeast are usually found in environments where there is a low pH. They are usually common in a biotower or a trickling filter. They can cause "plugging or ponding".

Control:

Low pH is usually the cause of fungi and yeast. pH can be increased on the influent or in the MLSS to above pH 6 and usually with a little bit of time they disappear.

Yeast



Identification: Yeast are a group of unicellular fungi a few species of which are commonly used to leaven bread and ferment alcoholic beverages. Most yeast belong to the division Ascomycota.

Similar Organisms:

Yeast can be similar to Tetrads

The presence of large amounts of yeast in the wastewater can indicate a low pH, the existence of fermentative conditions, or a severe phosphorous deficiency. Raising the pH above 7 will usually make the yeast disappear.

Algae

Algae primarily occur in the tower deck area because most species require sunlight for photosynthesis and growth.

Algae slimes can plug distribution nozzles and troughs in the cooling tower deck, causing poor water distribution across the tower and hence reduce cooling efficiency. Water intake screens may also become plugged by algae slimes that can slough off from the tower. The growth of algae may provide a food source that encourages the growth of other organisms, such as bacteria and fungi.

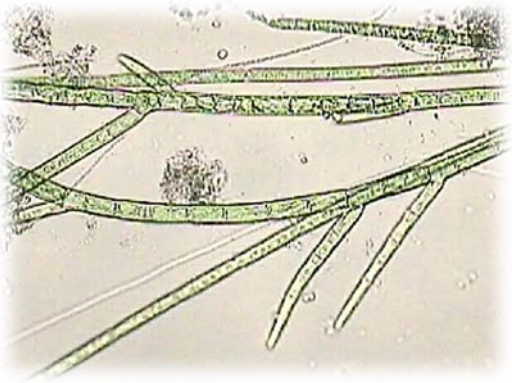
Algae require control because the biomass can also break loose and cause exchanger fouling. When this happens, slimy, rubbery masses form, which cause plugging and decrease the tower efficiency. Various types of algae can be responsible for green growths, which block screens and distribution decks. Severe algae fouling can ultimately lead to unbalanced water flow and reduced cooling tower efficiency.

Algae can be single celled and free floating, filamentous and cause mattes or can be slime forming.

Algae are typically photosynthetic organisms. Green and blue-green algae are very common in cooling systems. Blue-green algae are now classified with the bacteria and are called cyanobacteria.

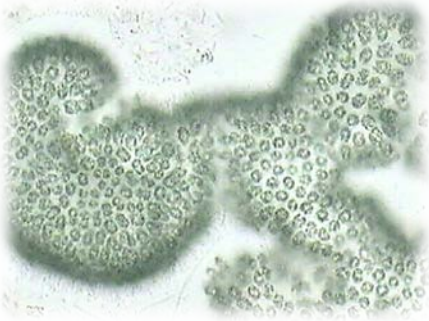
What type of Algae are you growing in your cooling tower?

Algae can be branched or straight

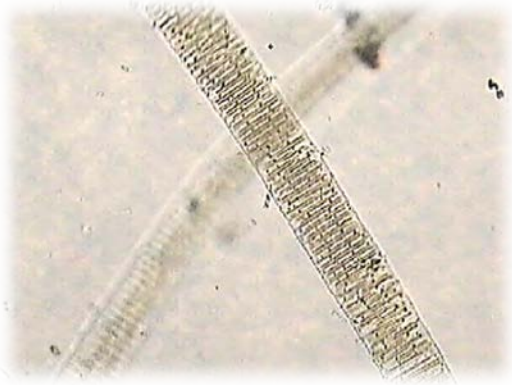


Algae can be curled or in small free floating clusters with a slime coating

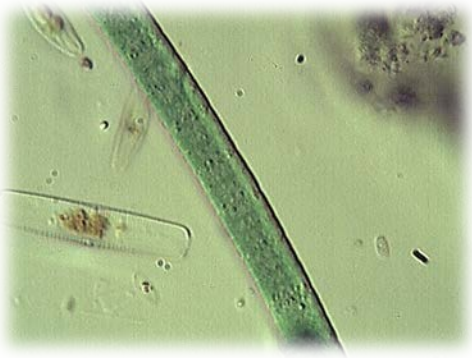
Anabaena



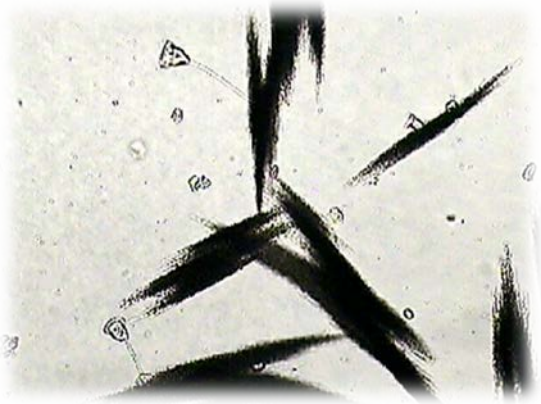
Woronichinia naegeliana



Achnantes taeniata is a brown algae



Filamentous Blue Green algae or cyanobacteria and Beggiatoa



Aphanizomenon flos-aquae

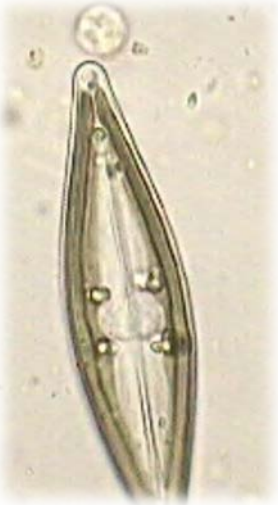
Scenedesmus and Flagellate

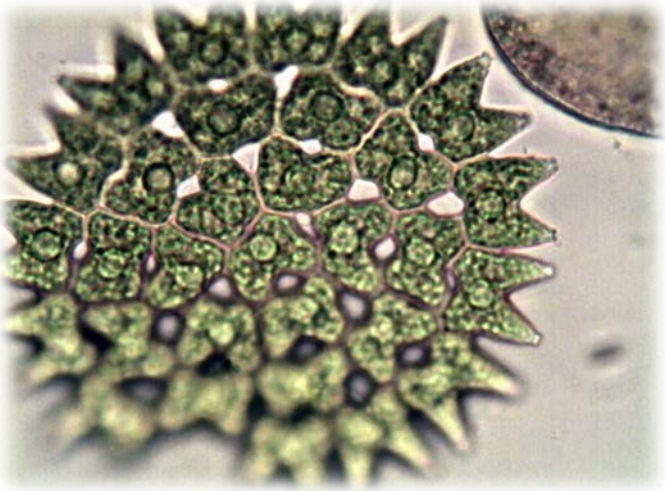
Branched algae and filaments

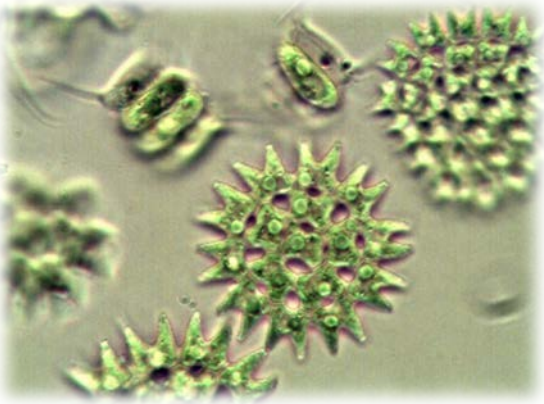
Algae slime on cement and metal

Diatoms

Diatoms are algae enclosed by a silicaceous cell wall and may also be present in cooling towers but generally do not play a significant role in cooling system problems.







Microbiological Influenced Corrosion or MIC

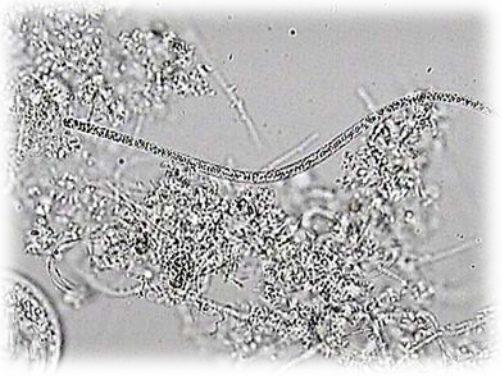
is corrosion or deterioration of material, which is initiated and/or accelerated by the activities of micro-organisms. These materials are mainly metal, but also can be concrete or plastics.

1/5 of all corrosion is typically caused by microorganisms and biofouling.

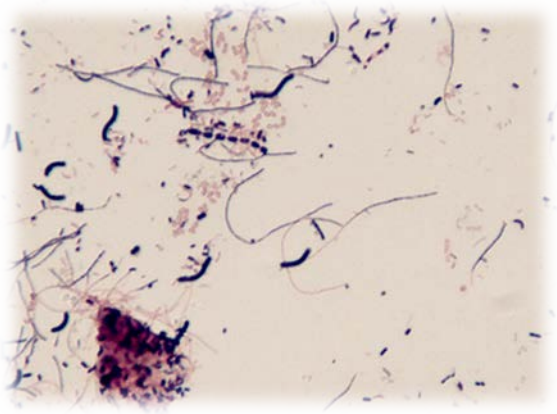
The most common MICs can be categorized into sulphate reducing bacteria (SRB), iron oxidizing bacteria and acid producing bacteria (APB).

Sulfate Reducing Bacteria can include Desulfovibrio, Purple sulfur bacteria, Beggiatoa, Thiobacillus, Spaeratolis Natans

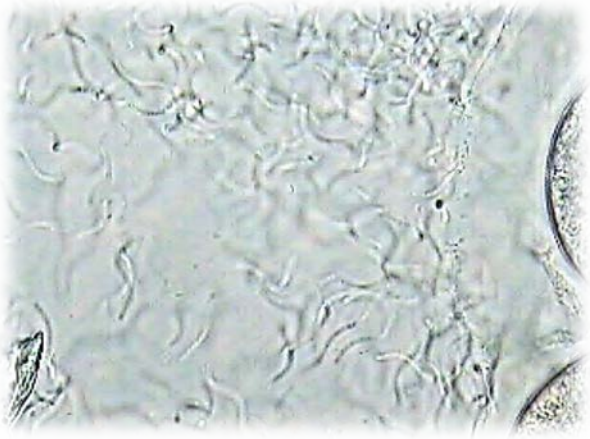
SRBs are characterized by hydrogen sulfide odor and blackened water or black colored deposits. Iron oxidizing bacteria generally form in filamentous clumps and can be detected under microscope by their distinct appearance due the excreted products that grow. This corrosion by iron bacteria often forms tubercles.



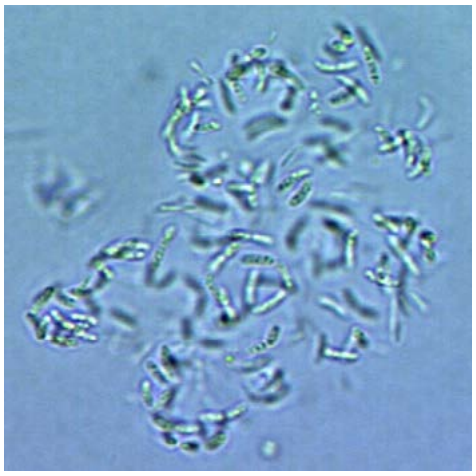
Beggiatoa is a motile sulfur reducing filamentous Bacteria found in many biofilms

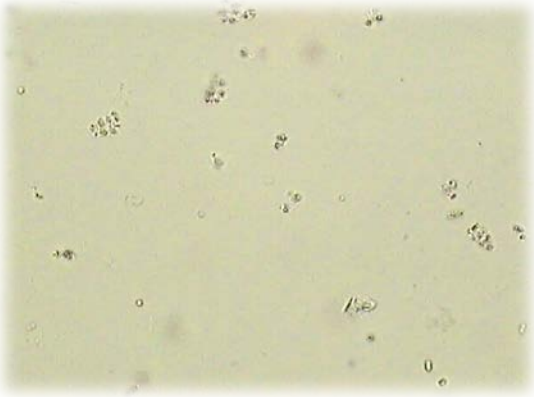


DesulfoVibrio



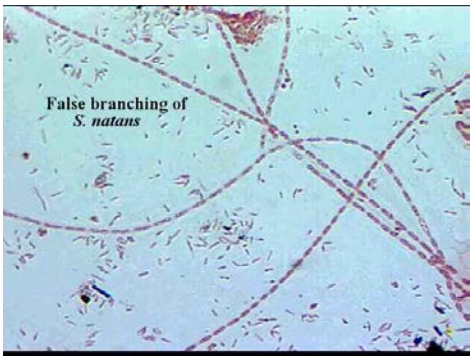
Spirillum

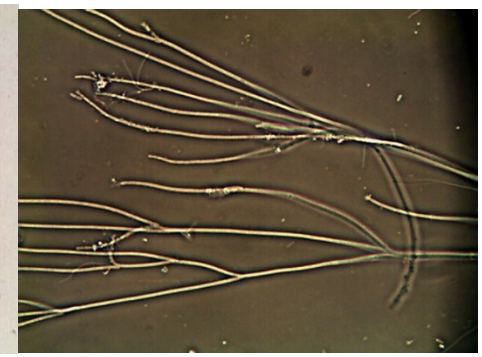




Purple sulfur bacteria

Spirillum with sulfur granules

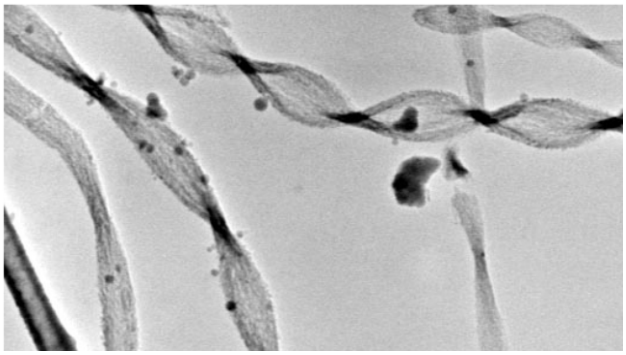




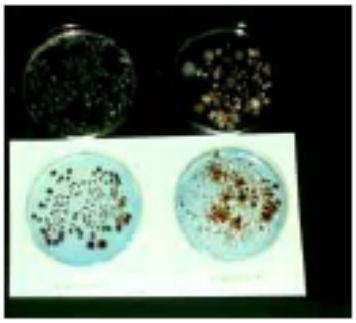
Sphaerotilus **natans or** S. natans

Iron-depositing bacteria grow best in low oxygen environments but are common in open-circulation systems. Gallionella and Sphaerotilus use soluble, or ferrous, iron as an energy source, and convert it to an insoluble oxide or hydroxide form. These deposits create fouling and set up concentration corrosion cells and conditions under which anaerobic bacteria flourish. Gallionella frequently leave spiderweb-like deposits on metal surfaces. The deposit looks like black iron. Severe corrosion is usually evident under the deposit.

Gallionella spp.,



Other bacteria that may be present in cooling water include Pseudomonas, Klebsiella, Eneterobacter, Acinetobacter, Bacillus, Aeromonas, and Legionella

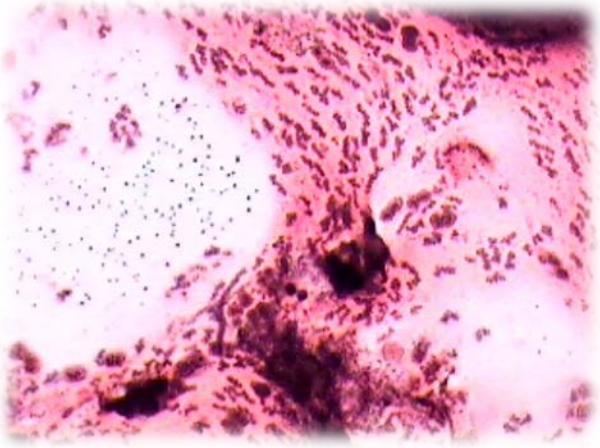


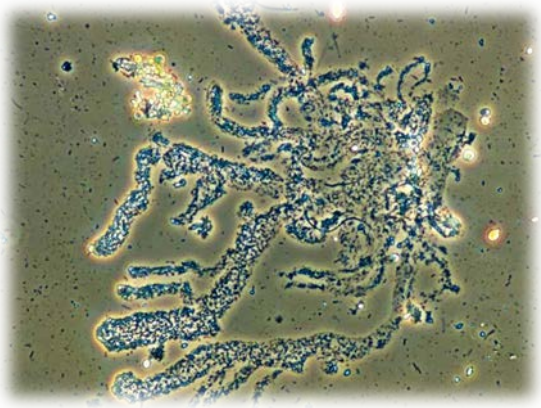
Spore forming bacteria

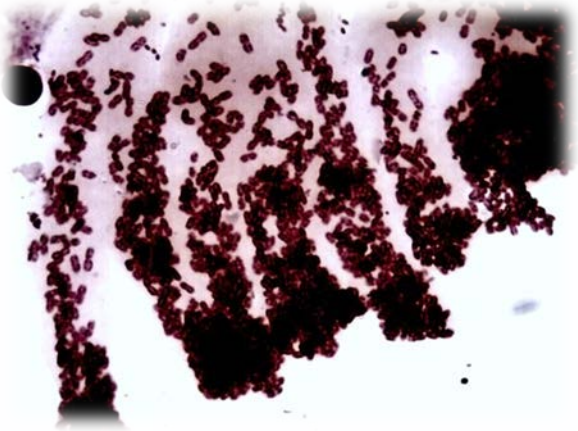
Denitrifying bacteria, or pseudomonas, can cause the loss of nitrite inhibitor in closed-water systems.

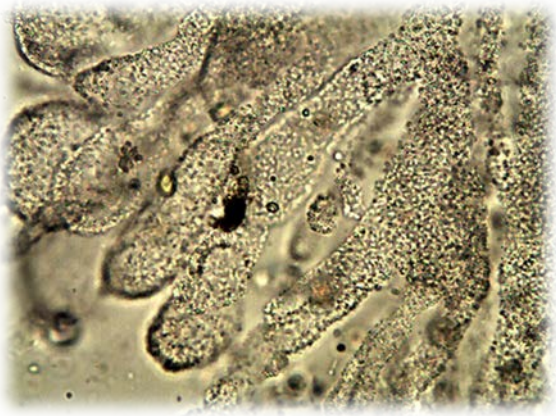
Usually plate counts with differential media are used to determine the exact count of these types of bacteria

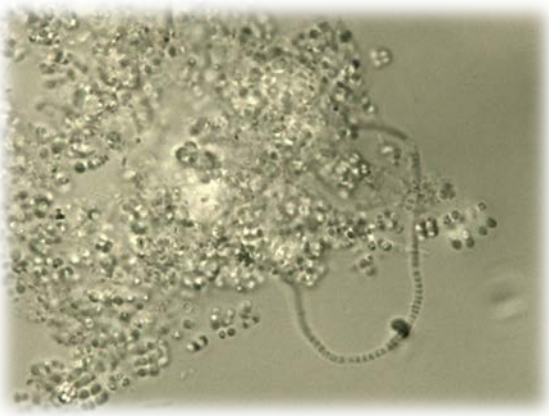
Biofouling Slime or Slime forming Bacteria











As you can see, there are quite a few different things that can be determined under the microscope from Cooling tower water samples.

Many things can be determined that can save time, money and reduce multiple traditional tests.

Call our lab to find out how to schedule a microscopic analyses of your cooling tower water or slime that has built up.

Start your way now to a cleaner, brighter effluent with fewer hassles in your cooling tower.

Ok, you convinced me. How do I go about sending in a sample?

Contact Jennifer, Laurie or Dan at Environmental Leverage- 1-630-906-9791 to set up sampling.

Call for shipping address as we rotate three different locations.

What will I need to send in?

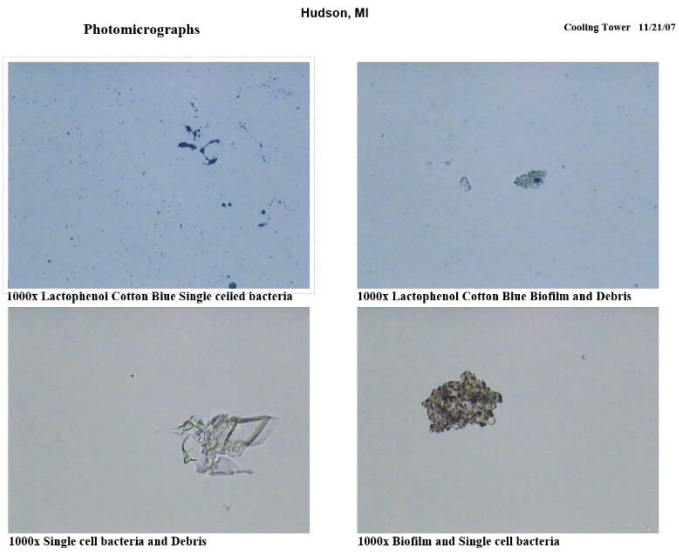
Send in 150 mls of cooling tower in a small, plastic bottle with at least 1-2 inches of headspace in the bottle. Seal the bottle carefully. Send overnight by UPS, Fed ex- etc. If possible, pack with blue ice to keep refrigerated.

If you have a slime section that you want examined, send that in a plastic bottle.

Sample costs- $200.00 unless filaments are present and you need a Filamentous Identification performed. Sample turnaround for results- same day if received before noon in the lab.

What will the analyses contain:

The Standard biomass Analyses will contain a cover letter with comments, recommendations and troubleshooting tips, A photo sheet with major components found in the sample as well as digital copies of the photos taken. An excel based worksheet detailing the analyses results will be included. Additional training materials may be included if applicable



Please let us know if you have any questions. 630-906-9791

More information can be found on our website

EnvironmentalLeverage.com

And a Chain of custody form can be downloaded as well.