June '07 Volume 4.6

The Wastewater Insight

Environmental Leverage INC.

HIGH BOD VS TOXICITY

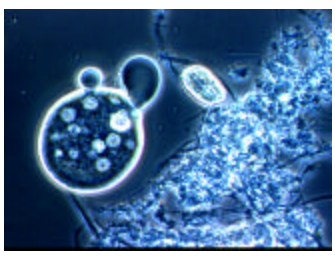
Oh no all my bugs are dead! Something toxic must have come through the system!

This is a common thing we hear quite often at wastewater treatment plants. Are your bugs really dead? What exactly are you looking at to determine that your system is dead? Is there a ton of white crisp foam? If you look under the microscope are all the higher life forms dead? Is the floc blown apart and clear, diffuse and weak structures? What is the DO in y our system?

Crisp, white, fluffy or billowing foam

In actuality, you may not have a dead system, but you might just have gotten hit with a very high BOD loading and your system is in a young, high growth phase. 98% of the biological degradation in your system is done by the bacteria, not the higher life forms. This is a common misconception in waste treatment plants. The higher life forms, or the little critters that are moving around that you see under the microscope are, in reality, just "indicators" of how well your system is and what conditions are going on in your system.

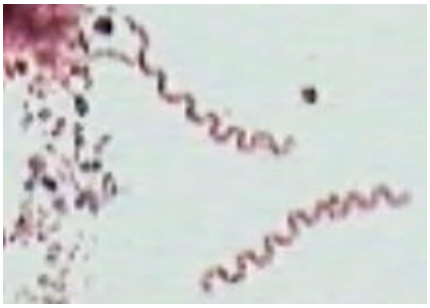
Higher Life Forms as "Indicator Organisms" -- The higher life forms are often called collectively indicator organisms. This is because they can serve as indicators and



MYSTERY BUG OF THE MONTH

We started this month out with a new

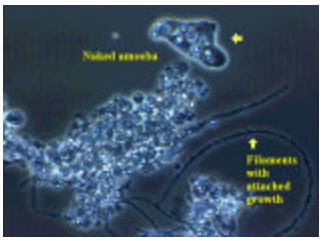
Mystery Bug of the month!



Check out our website for more photos of our new mystery bug!!!! WWW.EnvironmentalLeverage.com

early warning of undesirable conditions that have not yet impacted the bacterial population. Bacteria are extremely hardy and resilient creatures. They can survive and even thrive at a variety of temperatures, pH's and dissolved oxygen conditions. They are also fairly resistant to toxic compounds in that they may be inhibited, but still "alive" and capable of quick recovery. The indicator organisms are the last to show up and the first to leave. The type and abundance of protozoa are certainly an indicator of general health and stability of the system.

How often do you use the microscope?



Microscopic analyses of any biological system should be a critical component of any ongoing daily monitor and control programs. Lab sheets to correlate health of the system, any changes in floc structures, higher life forms, filamentous identification, polysaccharide coating of the bacteria and suspended solids can be determined by using a microscope and examining the biomass. This

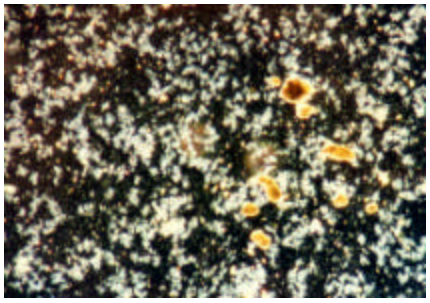
INSIDE

is a tool that can help not only show exactly what the health of the system is at a given time, but can also help predict which direction the plant is headed if used daily. It is a tool that can also help prevent critical upsets, or be used as an early warning. In the cases of filamentous problems, staining and identification of the filamentous can help with troubleshooting and help avoid costly chemical consumption.

By looking under the microscope, you can tell the types of higher life forms, how well your floc structure is, the presence of filaments, single celled bacteria, etc. All of these will indicate not only how well you will meet BOD and TSS, but how much you may end up spending on solids handling.

However, higher life form "counts" alone may not be indicative of the bacterial population performance in terms of BOD degradation. For example, a slug of high pH may wipe out the higher life forms for a couple of days, but barely impact the bacteria at all. Also, most protozoa are strict aerobes and will not thrive if the dissolved oxygen levels are depressed. That being said, a significant shift in the protozoan population or the loss of higher life forms for an extended period of time should be considered cause for concern and be investigated.

The situation listed above could be an example of one of two situations, either a high BOD loading, or a large hit of surfactants. A quick and dirty test to determine which of the two it is would be to take a small sample of the water. Place it in a small jar. Shake it up. If it foams like dishwater does in your sink, you probably just got hit with a high load of surfactants and that is what is causing the foaming on your aeration basin. If it does not, another way to verify what is going on is to perform a DO uptake test. This will show if your bugs are in a high growth phase just due to a large amount of food or BOD loading



Weak dispersed floc that can cause high TSS problems

DOUR Test Procedure

Catch fresh sample in a 500ml or 1 liter bottle. In the lab, shake sample vigorously to saturate sample with oxygen.

Fill BOD bottle with the aerated sample. Put DO probe in bottle making sure to eliminate any air bubbles.

Start the magnetic stirrer.
Allow the DO readings to stabilize and record the initial reading as DO_i. Take the DO reading every minute for ten minutes. The final reading will be DO_f.

Calculate DOUR using the formula: DOUR= (DOi - DOf)/ (Tf - Ti) x 60 Units will be mg/l O_2/hr

High DOUR readings mean there is an abundance of food and the bugs are in a high growth phase
Low DOUR means there is a lower biological activity

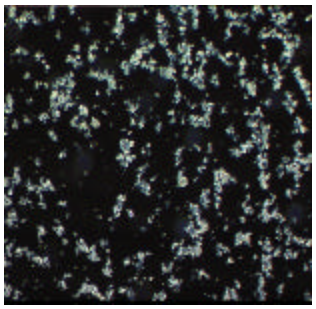
Signs of a High BOD loading

DO is zero or very low
High TSS, weak or clear floc, single celled bacteria
Shift in higher life forms to younger or loss of higher life forms if high enough loading
Nutrient deficiency- High India Ink possible
Very white crisp foam

When a high loading comes through the system, the bugs can be like kids in a candy store and in a high growth phase. They will consume all the oxygen, floc will be small, weak, clear or diffuse if high enough loading. There can be high levels of single celled bacteria. Loss of higher life forms or a shift from Rotifers to amoebae and flagellates. DO will be virtually consumed by the bacteria, so when testing it, there will be no or little residuals.

Signs of Toxicity

High TSS in effluent
Dispersed floc
Loss of higher life forms
High DO- none is being used by the bacteria
NO foam
Scum on clarifier surfaces



The opposite occurs with a toxic shock. All the higher life forms will be gone due to toxicity, the floc can be blown away. There will be sky high DO because none of the bacteria are using any, and there should be no foam. Major visible changes in toxicity vs. just an overload of food.

What does your India Ink stain look like?

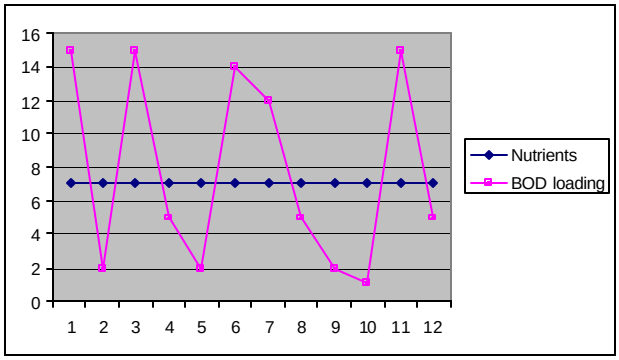
Another thing you might see with a high overload of BOD is Zooglea.
Zooglea can come from high BOD loading, simple sugars or high grease, low pH or low nutrient levels.

Polysaccharide coating can be high due to zooglea that can be present, from nutrient deficiency or even be due to septicity.

India Ink tests should be performed. This is an excellent quick and dirty test that can be used daily. One drop of India ink is added to one drop of the biomass. Everything

will be dark except for the polymer generated by the biomass. A normal biomass will have some bright areas relative to the size of the floc structures. Extremely bright or excessive areas will indicate one of two things. A toxic shock to the system or nutrient deficiency. If there are higher life forms present, then a shock can instantly be ruled out and nutrient deficiency can be verified. If this plant has wide fluctuations on the influent loading, nutrient control should closely resemble the loading on the system. Nutrients levels and BOD loading needs to be closely monitored in the future to optimize and control this system. Nutrient deficiency can also cause excessive growth of filaments. It also can cause development of poor floc structures that either generate high levels of slime that are hard to dewater and increase polymer consumption but also can cause small, poor floc development and increase the level of TSS. Information on India Ink staining procedures can be found on our website or email us for the files.

A typical loading of nutrients is 100-5-1 of Carbon, to nitrogen to phosphorus in order for optimal bacterial growth. During wide swing loads, nutrients should be increased. Nutrient deficiency can cause serious problems. It is already harder for the floc forming bacteria to work when organic acids are present, but add the stress of nutrient deficiency and septicity increases the problems. This creates a climate that is difficult for the



floc forming biomass to grow in, but enables filamentous bacteria to take over.
Even though final measurements on the effluents may indicate sufficient nutrients are eventually present, the way the nutrients are added as well as the significant slugs of BOD from the food plants that are sent to the biomass may be causing the bacteria to be deficient when they really need the nutrients. Night shifts with high clean out may cause slugs of high BOD to the plant, and cause nutrient deficiency during their immediate loading to the plant. Adjust nutrients to the swings in the plant.

Correlation of Nutrient loading to BOD loading to help create an idea that even though nutrients may be measured at the final effluent by a residual, they are not present in sufficient amounts when the bacteria need them based upon loading. TOC should be measured so correlations could be made in order to optimize nutrient addition. A recommendation of TOC using Hach Test N Tube reagents on the influent daily to get immediate approximations of loading is recommended to develop a pattern and curve to help run the process more efficiently in the primary and secondary systems. Standard test procedures and equipment can be used. A nutrient dosing chart that we created is available by request that can be used to help regulate addition of nutrients. It might be necessary to overdose a bit closer upstream, at food plant sites or industrial facilities or to pH adjust or add bioaugmentation upstream, in order to help even out the significant BOD swings. Any time a change is made at a plant of more than 10%, it is significant to the bacteria.

Ok so now that I know I just got hit with a high BOD loading instead of a Toxic shock, what is this going to do to my plant?

There are a number of things that can happen. Usually there will be an increase in TSS or BOD in the final effluent if your system holding time is too short and unable to handle the surge. It depends upon your system and the flexibility you have to make process changes.

What can I do about it? If you have activated sludge, you can play with the WAS rates or RAS rates. Your plant will recover eventually in time. The key question is, do you have enough time? Remember that it is always a time and numbers game in wastewater. Given enough time or with enough numbers, the bacteria will consume the entire BOD. Your job is to control the numbers, since the time is limited by the pieces of equipment.

One quick way to help you out of an upset if you do not have time or flexibility is bioaugmentation. Bioaugmentation for upset control is an excellent way to help your system recover quicker, better and less costly that having to add a ton of polymers to the clarifiers as a Band-Aid or trucking in sludge from another plant that might have filamentous bacteria and cause additional problems down the line. The addition of cultured biological products allows the plant to maintain or quickly regain acceptable performance to avoid permit violations.

If you have a high loading or toxicity to your nitrifiers, they will take even longer to recover from an upset.

Biological Product Description
Environmental Leverage products are biological products specifically formulated to be effective in enhancing wastewater biology during upset conditions.

Through extensive research activities, the products have been developed to involve numerous strains of bacteria, which have been selected for their ability to perform under both aerobic and anaerobic conditions, and to biodegrade organic material comprised of proteins, fats, carbohydrates and select hydrocarbons.

To assure rapid establishment in the biomass, the products are produced and blended with select biological nutrients and stimulants.

Effect
Environmental Leverage products, with their aerobic and facultative anaerobic microorganisms-establishes and maintains a biomass which by providing greater resistance to the effects of organic inhibitors present in wastewaters, are able to perform more effectively than the

naturally occurring biomass.

Environmental Leverage products ensure that the natural mechanism for the selection of the biomass population is presented with a range of selected microorganisms. These aerobic and facultative anaerobic bacteria have been taken from their natural environment and then adapted to give optimum performance.

Misc. websites

http://www.doe.gov/environment/cleanairesoil.htm

http://www1.eere.energy.gov/industry/

U.S. Department of Energy
Energy Efficiency and Renewable Energy

Industrial Pages

The 21st Century is already being called the "biological century"—
http://www.science.doe.gov

http://water.me.vccs.edu/subject.htm
Wastewater distance learning
Free training online

Environmental Leverage Inc. offers consulting services, beneficial reuse, training and bioaugmentation programs that can help reduce your surcharges.

We have given quite a few training classes already this year, but we have had dozens of requests for classes. If you are interested in hosting a class at your plant, please call us.

CEU's are available for classes.

We would like to thank Sasol for hosting two classes, May 8-9th and May 23 and 24th.

We had a great time at the class.

Contact our office today to find out how your can start saving money and become more efficient at your plant!!!
Many times we have suggested articles for the next months issues. Sometimes we change what we will be featuring based upon critical issues that surface during our contacts with our customers. We hope this does not inconvenience you. If you have a specific topic you are interested and do not want to wait to see if it shows up in our newsletters, call us direct. We do have over 20

gigabytes of information on file on every subject around on water and waste issues.

COMING IN THE NEXT MONTHS . . . . .

Sand Filters
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