Environmental Leverage INC.

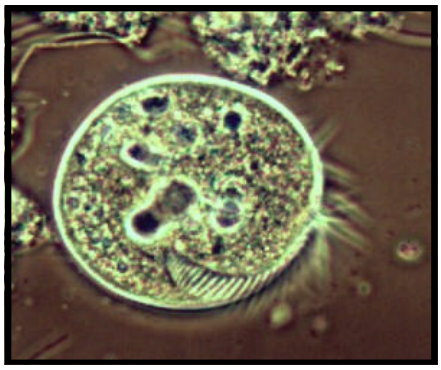
Turning Liabilities into Leverage

February 2009

The Wastewater Insight

The wastewater insight

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

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Wastewater treatment plant lab testing and troubleshooting

We have performed many wastewater

treatment plant audits in the last few months. What we keep coming across tends to be a common theme. Many plants run a battery of tests, but the data and correlations do not seem to match with the plant operations. Troubleshooting the plant for the operators has been difficult. As we thoroughly examined data, sample collection points, methods of testing, and correlation of data with interpretation we found that things were not as they appeared.

- COD vs. BOD or TOC
- BOD testing
- Nutrient calculations
- Dewatering and digestor supernatant
- Sludge age
- Antifoams
- Microscopic analyses
- Filaments vs. floc
- Sampling- where, when and how you test

We always use the microscope first. The bacteria are the most powerful tool you have at your plant. The microscope, settleometer and sludge judge will tell you more than many of the tests combined. Start getting used to performing a daily analysis. It should take 10 minutes to perform a simple quick look at the floc, filaments and higher life forms. What we found was that under the microscope, the bacteria were young in many cases in spite of MLSS and F/M calculations of older sludge. Operations were running based on these two mathematical calculations. Technically they are quantitative measurements, not qualitative measurements. They can easily be miscalculated. Let's walk through a few scenarios that will show you how easy it is to make the numbers wrong, and make you scratch your head while trying to troubleshoot.

First case- COD numbers are often used for influent readings since they can be easily performed and give you real time data as opposed to BOD and 5 days to get the results. BOD to COD ratios were used at this plant instead of TOC numbers. Remember, COD is anything that can be oxidized, organics as well as inorganics. Bacteria are really only going to use the organics as their food source.

Some of the inorganics such as N compounds that might be oxidized may be present in the COD portion and get consumed, but many times in chemical or refinery plants, where sulfur or other inorganics are present, COD- BOD ratios may be only 60-80%. In many food plants, where there are only organic compounds, it usually tends to run 85-95% of your COD is BOD. Make sure you are using real numbers, not incorrect approximations for your I nfluent number calculations. If you are using a wrong ratio, then your F/M, nutrient addition, sludge age, all your calculations are completely off. At this plant, a wrong approximation of Cod-BOD ratios led to miscalculations on everything, so it was making it hard to operate the plant. Low nutrient conditions were noticeably present, as shown under the microscope. Young sludge age was present in spite of the miscalculations that the sludge should be old. If you think you have less loading, then it would be easy to miscalculate nutrient loading, sludge age, etc. Make sure your influent data is correct.

COD vs. BOD vs. TOC- Here is another problem that many plants have. Which test to use?
COD can give you instant numbers. It is a 2 hour test, relatively cheap and easy to get real numbers. But are they real numbers. Usually they are slightly higher than the organic loading to the plant in many cases. Recently TOC has been easier to use. In the past TOC was expensive, huge furnaces were required to test TOC and it was not a very good test. Lately, Hach and a few other companies have made TOC as easy to run as COD. If you have a plant that has any inorganic in the influent, septicity anywhere, acids, caustics, etc, any compounds that can be oxidized, then TOC is a much more realistic number to use when calculating your F/M, nutrient requirements, etc. See 11-06 BOD newsletter, or what COD, vs. TOC vs. BOD handout is.

BOD is the most impractical test we have ever seen for numerous reasons. BOD is a very old, out dated test. It does not even give real numbers that are meaningful or useful. It should be banned from wastewater.
Here is the history on the BOD test- The Royal Commission on River Pollution was established in 1865 and the formation of the Royal Commission on Sewage Disposal in 1898 led to the selection in 1908 of BOD5 as the definitive test for organic pollution of rivers. Five days was chosen as an appropriate test period because this is supposedly the longest time that river water takes to travel from source to estuary in the U.K. Pollution in the river was causing problems and it took 5 days to travel down the river. In 1912, the commission also set a standard of 20 ppm BOD5 as the maximum concentration permitted in sewage works discharging to rivers, provided that there was at least an 8:1 dilution available at dry weather flow. This was contained in the famous 20:30 (BOD:Suspended Solids) + full nitrification standard which was used as a yardstick in the U.K. up to the 1970s for sewage works effluent quality.
In the mid-1700s Benjamin Franklin and others petitioned the Pennsylvania Assembly to stop dumping waste and attempted to regulate waste disposal and water pollution. European countries were correlating sickness with lead and mercury in the late 1700s. In 1855, Chicago became the first U.S. city with a comprehensive sewer plan, and all U.S. towns with populations over 4,000 had city sewers by 1905.
We have seen more plants make numerous errors solely based upon BOD numbers.
Think about this test- for 5 days we are going to see how much bacteria can consume organics in a test and measure that only by the oxygen uptake- so many things can make that data irrelevant.

What type of biomass are you using? What if you have filaments vs. floc formers in your seed sample? Some plants use their own mlss, some use commercial seed, sometimes we found they did not use any seed. This is the first inconsistency in the test. The amount of the bacteria used, as well as the quality of the bacteria used. What if you are a refinery, municipal seed will not grow very fast at first in the different influent, so the BOD will show a lower value since it takes time to acclimate to different chemistries.

Second thing, what if you have more food than the bacteria can possibly eat in 5 days- where does that get accounted for? It doesn't !! Wastewater is always a time and numbers game, for each lb of food, x amount of bacteria are required. Also all food is not alike, so different bacteria are required to break down different chemistries. That is like saying a lb of broccoli is the same as a lb of ice cream. Which is going to be broken down faster? BOD does not take into chemistry variations. It also stops at 5 days or only shows what can be digested in a specific test for 5 days. Leftovers are not accounted for.

What about pH, and nutrients? If you have an influent that has hard to degrade compounds as well as low nutrients, won't your bacteria grow slower in this BOD test, vs. a plant like a food or candy plant with high nutrients and high sugars? pH can drop over 5 days, nutrients can be depleted in 5 days or less, depending upon the initial loading. How does the BOD test account for that?
What if you have high ammonia, enough alkalinity and some nitrifiers present in the mlss you use on your BOD test? Higher levels of oxygen will be consumed, and your test may show a higher BOD level. This does not mean you have high organic compounds, just that a high level of oxygen was used on both nitrification as well as carbonaceous degradation. Have you differentiated on your test for that?
What if you have no ammonia? Bacteria require N and P, so for 5 days, you are expecting them to consume

organics without the proper nutrients?
We have seen some plants run influent data, with no seed used. Very low BOD results were given. Of course, no nutrients, low pH and no bacteria were present. What was going to generate any need for oxygen?
Can you start to see that this test can easily give you meaningless data? What is your sample like? What type of bacteria are you using, are you sure it does not take 30-40 days like most chemical plants with carbon ring compounds? Is there sufficient nutrients and pH in the sample? The critical 5 are always a factor anywhere, this test is no different. Garbage data is meaningless. Not only that, it takes you 5 days to get the results. If your plant only has a 24-48 hours holding time, who cares what it says by the time you get the data, it is too late to make any changes if you had an upset. No wonder this is a useless test.
Point blank, switch to TOC if you can. You will get real time data that you can really use as a process control tool. Then correct influent loading can be calculated, as well as nutrient requirements. Hach now makes Test N tube

reagents that are just like running COD. There are other companies now that also make TOC easy to use and more reliable, and you get the numbers immediately, they are based upon chemistry not variables of biology.

Nutrient calculations: How do you measure the daily requirement for nutrients for the bacteria? It should be based upon flow times loading. Correct flow measurements of all streams must be accounted for. Many times, some streams are overlooked. Some food plants have constant changes in loading or huge spikes that are unaccounted for. Changes in loading every 2-4 hours make it hard to track influent and correlate loading to requirements. If you have spills of loading, "spill" extra nutrients so the bacteria can handle the extra loading. If you have differences in night loading vs. day loading, make adjustments to that loading. Do not slug load your nutrients. Most of the carbonaceous bacteria have a life span of 2-4 hours. I use this analogy often. What if I gave you 6 hamburgers for breakfast and nothing the rest of the day? You might be pretty hungry by dinner time. Since bacteria have a shorter life span, the guys at night never saw what you dumped in the morning. Make your nutrients be there when the load is there.

It does not matter what an influent number or final effluent number reads, if during an extremely high loading you are short. You can still have nutrient deficiency as far as the bacteria are concerned. See 1-06 Nutrient deficiency newsletter, October 5 Nutrients 2

Another thing we noticed at quite a few plants, is that the supernatant from the dewatering or digestors was not measured or calculated into any factors. Belt press or any type of dewatering device that has a supernatant usually has some COD, nutrient values and even TSS present. Usually these streams are returned to somewhere in the plant, whether back to the EQ tank, primary or the basins or clarifiers. This can oftentimes add up to quite a bit of flow as well as loading on a plant. Here are a few variations of how it can impact a plant. One plant was using too much polymer, and he pulled samples off the belt press. It turns out the high polymer and the amount of water returned to the front of the plant put an additional 1000 ppm of loading on the influent. That can easily make all calculations of F/M, sludge age, nutrient requirements, etc completely off base. Another plant had a digestor, so quite a bit of the sludge had aged during the time in the digestor. High levels of N and P were present in the supernatant. When adding nutrients to a plant, these can easily be calculated and save money on costs of nutrients. Some plants instead have nutrient effluent limits. High N and P off the supernatant can cause the plant to have too much nutrients and then not enough time in the aeration basin to react with the excess nutrients.

Where are you putting your supernatant? Do you measure the TSS, N, P and TOC loading that comes off these streams? They can easily impact your entire "math" balance on everything from sludge age to nutrient requirements.
We created a nutrient dosing wizard if you need a copy, let us know. You plug in flow times loading on the

influent and correct dosages of nutrients can easily be determined. If you use ferric or alum anywhere near the wastewater plant, these can pull out your phosphorus and cause nutrient deficiency.

Sludge age is the most often under or over calculated item we see along with F/M at 80% of the plants we audit. It is a calculation based upon mass and incoming food. How much food do you have vs. how much time do you have to degrade it vs. how many bacteria are there to degrade it. All those variables make a difference. Unfortunately sludge age and F/M are basically quantitative measurements that are easily skewed. What is the quality of the sludge? Is it filamentous vs. floc formers? Floc formers take up significantly less space, so technically more bacteria can fit into the same mass. Do your mathematical calculations take this into account? No, you must use the microscope to determine this.
The microscope and the bacteria do not lie. Use your higher life forms as an indication of sludge age.

They always correlate. You cannot have an "old" sludge yet be loaded with amoeba and flagellates.
Using the microscope will tell you if you have a slug of high loading that was missed under your grab sample testing or even composite sampling. Unless you have an online TOC analyzer, and even those test only every 15 minutes, you may miss slugs of loading depending upon the type of plant you have. See 1-08 Sludge age newsletter or 8-06 Operations newsletter

F/M loading is another part of this. We found quite a few plants that were making the incorrect calculations. Food plants are a perfect example. 85-95 %of your influent loading typically is BOD-COD. Most of your incoming chemistry is sugar or grease. If you are a food plant with grease, your BOD will never show up completely in a test. Same at a municipal. We had numerous plants run a COD on .1 gram of grease- guess what the measurement was? Anywhere from 1-4 million ppm. There is no way a BOD test will degrade that all in 5 days. Much of this loading is often overlooked, under calculated in F/M, sludge age as well as nutrient addition calculations. Think about what types of chemistries you have, do you have mostly simple organics, hard to degrade chemistries that take time, grease or oils, lots of inorganics that can add to COD, biocides or cleaning compounds. All these chemistries make up your loading.

We just did an entire newsletter on **Antifoams,** but I am going to remind you again, since this is often overlooked in the F/M calculations or sludge age calculations. We just had two food plants that could not understand why we kept telling them under the microscope they were young, nutrient deficient and had large amounts of Zooglea. Turns out they were adding antifoams. At one plant the antifoam had a BOD of 100,000 ppm and the other had a COD of 300,000 ppm. Both plants were significantly making all their calculations wrong based upon this missed loading. Technically, short term antifoams reduce the foam, long term, the bacteria break down the chemistries found in antifoams and have additional loading that is usually not accounted for. See 11-08 Antifoam newsletter

Using the Microscope to evaluate your System

A wastewater treatment plant is a biological "bug" factory. You need to grow bacteria to successfully meet final effluent permits. There are no replacements for the biological activity. You can build more equipment, you can use all the chemicals you want, but basically, it comes down to how well you can grow bacteria! So if you are running a "bug" factory, it would be a pretty good idea to check the status on your product – the bugs.
In order to view the bacteria present in the wastewater system for monitor and control purposes, samples must be collected. Where, how and when you sample the MLSS or bacteria can make a total difference in how accurate the analyses.

Always make sure to take the sample at the back of the aeration basin, lagoon, or whatever piece of equipment you are using for the biological portion near the outfall, below the surface of the water. Do not collect the sample in dead corners where scum has built up.
Use your microscope. Since you cannot jump in, see under the water, and really know what is going on in the bottom, pull samples instead and use the microscope to tell you what is going on. Then with a little detective work, you can really pull together what each piece of equipment in your system is doing. This shows how each piece of equipment ties all together and little things here and there can make a big impact.
Periodically, take samples from many parts of your plant, collections systems, primary, clarifier even digestor, you might be surprised at what you find.
See June-08 Using the microscope to evaluate your system newsletter

There are obviously quite a few areas to look at in a plant and numerous variables that make even the normal standard testing hard to correlate to what really is going on in your plant. The three best tools that can help in troubleshooting are the sludge judge, settleometer and microscope.

MISC. WEBSITES:

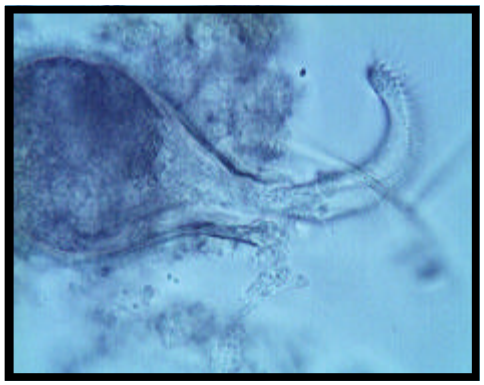
http://www.climatevision.gov/sectors/index.html
Industry initiatives, goals, vision plans, troubleshooting and Case histories
http://www.subscribeforfree.com/
Free subscriptions to trade magazines- great source for your specific area and you can get these online as opposed to mailed to you if you want.
http://www.dec.ny.gov/chemical/8464.html
Technical data for Wastewater Facility Operators
Each state has some type of free technical training for industries, municipalities, air, water and waste. Here is one we picked this month that has quite a bit of technical information free.
http://starcentral.mbl.edu
Microscopy images- great site
http://www.webdirectory.com/
The Environment Directory

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

Contact our office today to find out how you 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 in 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.

BUG OF MONTH:



Last Month's Bug:

This is probably Chaetospira muelleri. It is unlike any other loricate ciliate. This is one of the few loricate ciliates with cirri (hypotrich) found in sewage-treatment plants. It can get quite large attaining a length of 200- 300 µm.

COMING IN THE NEXT MONTHS……..

How to help solve Winter problems

MISCELLANEOUS:

We are in the planning stages for this year's class schedule. If you are interested in setting up a class and audit at your plant or would like to host a class, please contact us.

For any suggestions for topics that we may have missed that you would like to see covered in our newsletter, please drop us a line. Thanks Tracy

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