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Turning Liabilities into Leverage
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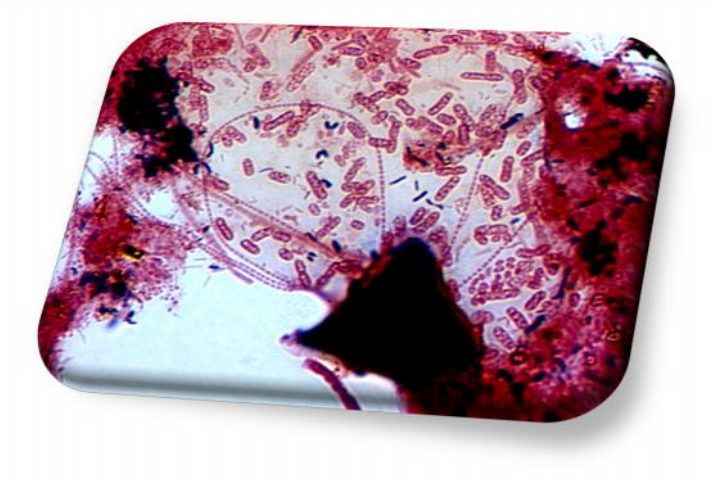
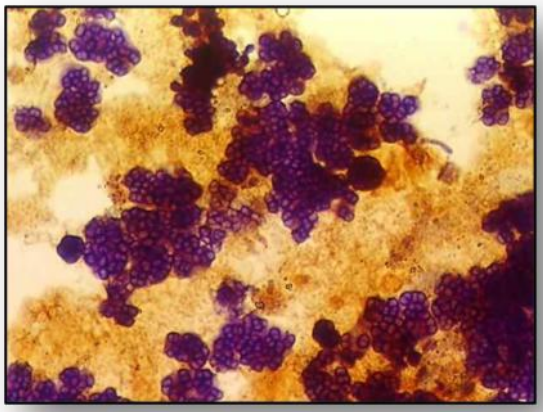
Are You Under Dosing Nutrients At Your Plant?



Here is a scenario we come across occasionally in industrial facilities and at municipalities where they have industrial pre-treatment. Many industrial plants have to add N and P for the carbonaceous bacteria to consume as a nutrient source because there are insufficient levels in the process water.

Some times plants underdose the nitrogen feed. They see residuals in the final effluent, so they decrease the ammonia levels. The plant then gets a wide swing in loading and of course it becomes nutrient deficient. Underdoses are often common in this scenario.

Typical dosing of nitrogen, many times for a rule of thumb, has been suggested that dosing of nutrients should be controlled so that there is a residual of 1-2 ppm in the final effluent. Part of the reason this rule of thumb guide is used is because final effluent residuals almost always have to be tested for permit levels. This saves on additional testing of influent parameters and the numbers are easily available.



The problem with this scenario is that sometimes, plants are short on nutrients and create many problems in the system.

Another thing we see quite often at paper mills or chemical plants that indicates this type of condition exists is the presence of tetrads. These little clusters of gram negative and neisser positive cells almost always indicate nutrient deficient. They can cause serious TSS problems. If you see these, it means again, you are usually underdosing nitrogen. Increase your nitrogen dosing.

How do you figure out if you are dosing correctly? One simple test to run is N and P on the influent and effluent. If you do not have ammonia, or amines in the incoming process water, you should have to add sufficient nutrients so that you have a residual in the effluent levels.

Is there a quick way to test for this and make calculations- Actually it is quite easy. You need to start feeding based upon front loading of carbon. There is now a quick easy way to test TOC (total organic carbons) onsite in two hours. If you have testing equipment for COD, you can easily run TOC instead of COD or BOD. This is a better measure of the total carbons that bacteria will see as a food source than waiting for a 5 day BOD test. Results are real time and can be used for process control daily. Hach makes test N tube reagents that make it easy to run an onsite test for TOC. When you get the results, do the math calculation on N loading. As long as you do not have final effluent permits that are extremely low, typical loadings are 100-5-1 of Carbon-nitrogen to phosphorus.

You will then feed the bacteria the correct amount of nutrients instead of underdosing them and causing filaments or zooglea to grow in your plant. You might want to consider checking also into adding micronutrients if you constantly have BOD swings at your plant.

Another typical mistake plants make with nutrients is the time they dose their nutrients. Some plants slug feed and some use a continuous feed rate. Make sure you are not slug feeding nutrients unless you get a huge slug of BOD. Typically the nutrients should be dosed according to the load. If the largest load is spread out during the day, then feed your nutrients continually. If you get huge swings at the end of the day when the plant shuts down or has high loading from clean-up processes, then increase during that loading period. Remember that the life span of the bacteria is 20 minutes to two hours. If you dose a ton in the morning, and they are not around until the evening, they will not see the nutrients you have loaded. You really need to feed nutrients based upon the influent loading. If you plant runs 24/7 and has continual consistent feed, a slow, continuous feed of nutrients is recommended. If, on the other hand, your plant runs only shifts, or tends to have batch dumps of high loadings, you need to slug feed your nutrients again based upon your feed loading.

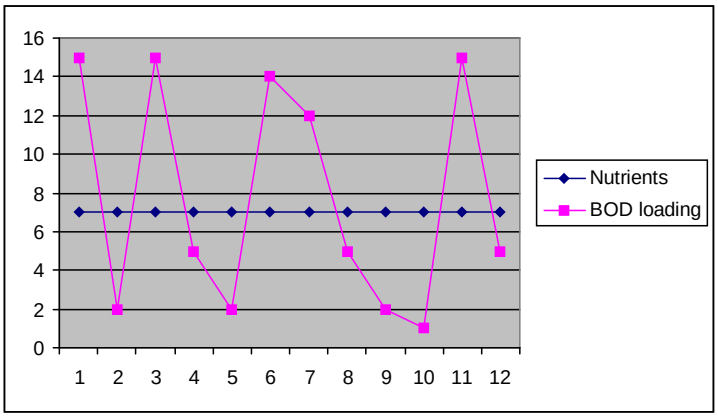
A typical loading of nutrients is 100-5-1 of carbon, to nitrogen to phosphorus in order for optimal bacterial growth. During wide swing loads, nutrients should be increased. Nutrient deficiency can cause serious problems. It is already harder for the floc forming bacteria to work when high organic instant BOD swings come through, but add the stress of nutrient deficiency and this 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.

Think of it this way, if I gave you 5 hamburgers for breakfast, but nothing for lunch or dinner, you would be hungry by nighttime. Why, you had tons of food? It is the same with the bacteria. Think of this, many of the bacteria in the wastewater treatment plant have a life span of 20 minutes to 2 hours. If they are in the late shift, they never saw the nutrients that were loaded earlier.

Check your nutrients - Base loading on influent TOC - Adjust feed rate based upon influent loading

If necessary, test ammonia and phosphate at the influent and back end a few times to get a baseline and determine if overdosing or underdosing

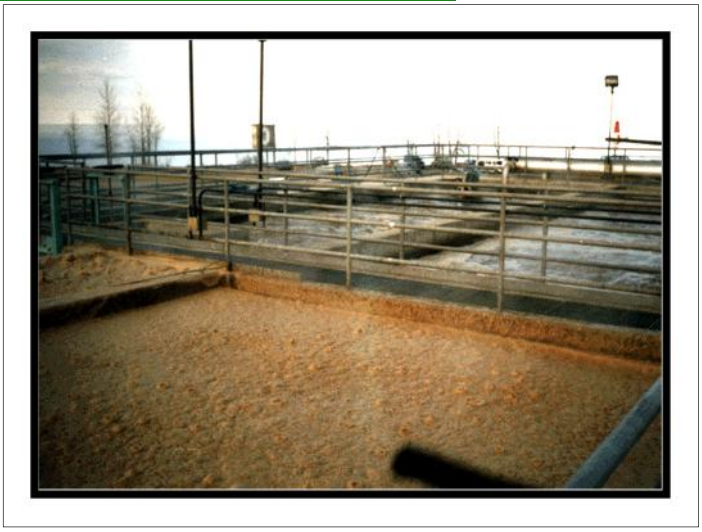
Most importantly, make sure the bacteria are getting the right amount of nutrients at the right time. Too much and you are wasting money and running the plant inefficiently; too little and you can get zooglea or filamentous bacteria problems and create worse problems!



But I am doing that and it still is a problem? Have you taken into the calculations from your supernatant off your digestor, belt press or sludge dewatering units? Many plants have digestors and sludge dewatering units. The supernatant off these units is returned to the front of the plant. This stream is almost always high in N and P. Run tests on this stream. Make a calculation on how many nutrients you are returning to the front of the system, and make sure to take that portion out of your math calculation when you are figuring out front loading dosing of nutrients. This is often a very important source of nutrients that is overlooked at many plants. Optimization of a plant's costs can be significant if this variable is considered.

Do you have backwash water from a local drinking plant or final filter somewhere in the plant? Are you feeding ferric chloride or alum for some type of pH adjustment or metal precipitation? All of these can seriously deplete any nutrients.

Ferric chloride can have a significant impact on the nutrient levels of phosphorus in a wastewater treatment plant if the levels are high enough. Ferric has a high affinity to pull out



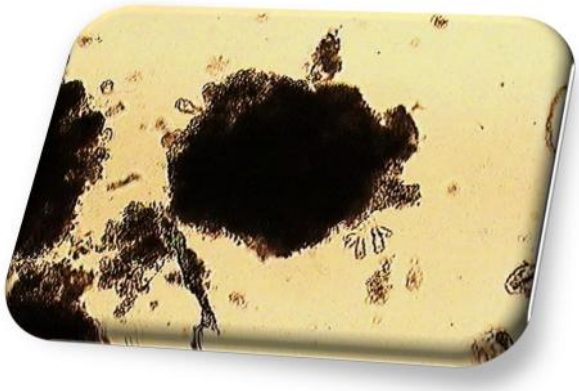
phosphorus. We were working with one wastewater treatment plant. They had signs of nutrient deficiency occasionally, which is usually rare for a municipality that does not have any industry or pretreatment dischargers. We noticed on one walkthrough of the plant that the primaries were bright red. We had them run levels on phosphorous on the primary effluent, aeration basin effluent and final clarifier. The ferric pulled out all of the phosphorus in the primary influent. Rather than supplement phosphoric acid or alternative sources of phosphorus, we ran an analyses on the belt press and digestor supernatant. There were high levels of phosphorus in the streams. We asked them to rearrange their timing for decanting and dewatering in order to utilize the nutrients available in those streams to supplement when the drinking water plant is discharging.

We have seen nutrient deficiency turn an entire wastewater plant to slime. The clarifiers would not settle; the aeration basins had floating foam and scum on the surface. We have seen it at a dairy, a juice factory, a meat plant, a winery, and a chocolate factory. We were running a MLSS of around 4000 ppm at a frosting factory. Overnight, someone dumped a load of those simple sugars found in frosting. We came back in the morning to a MLSS of 16,000! Luckily, we had a DAF prior to the aeration basin, so there was more than enough DO, but we were a bit nutrient deficient. We saw this at a winery; the typical BOD was 8000 ppm. Overnight again, a loading up to 32,000 BOD came through. Granted, these are extremes, but it shows you how quickly changes can happen in a plant.

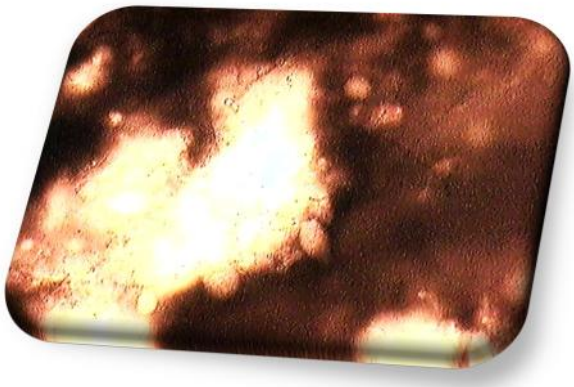
Here is a case history with a plant that had nutrient deficiency. Here is our first sample. This was from a **Pig farm.** There were some round, compact floc structures, some stalked ciliates present and some rotifers. They are having a hard time dewatering the sludge and it was very jelly like. We looked closer, guess what we saw - There was a ton of fingered zooglea and fungi present. We asked them if the pH was low at the plant. They adjusted pH at the plant and checked for nutrients since they were deficient at the plant slightly. The plant now has solved its problems with the help of the microscope!

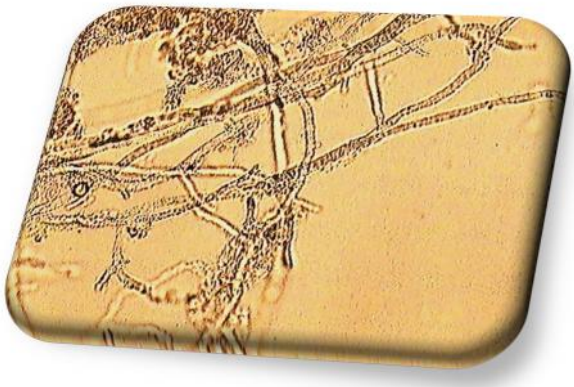
You can always contact us by phone or email at Elfenvironmental@aol.com

Below is compact floc and stalks 100x Bright Field



Here is fingered zooglea at 400x Bright field





The polysaccharide coating was very high here
We did perform Gram and Neisser stains.

There was a ton of Fungi 400x Bright field. 100x India Ink

1000x Gram stains fingered zooglea
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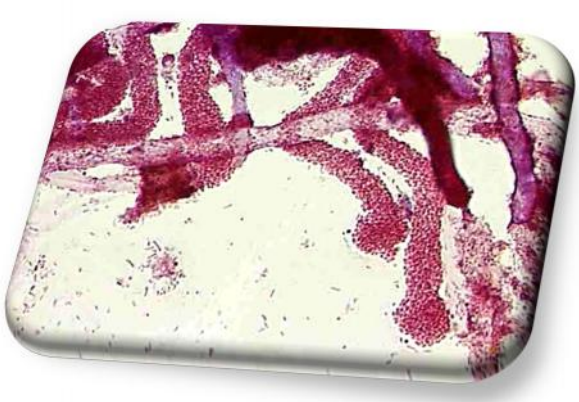

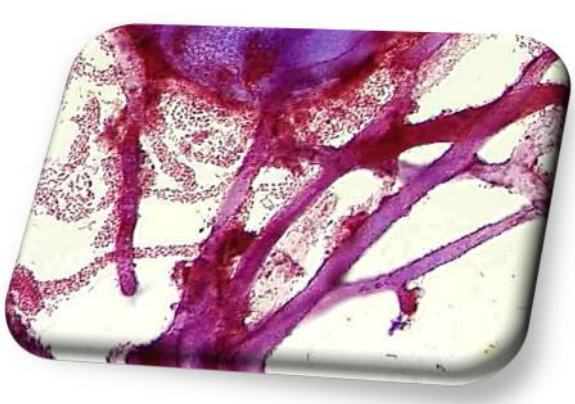

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Here is a second one at a packaged meats plant-This plant had weak, dispersed floc, but some black spots in the floc structures. The pH of the influent was 5 and the pond was at 6.2. There was evidence of low DO by the black spots. There were very few filaments, but some fungi and mostly zooglea. We asked them to adjust the pH, increase their nutrients and bump up the DO if possible.