October '07 Volume 4.10

The Wastewater Insight

GREASE AND SEPTICITY

Grease impact on wastewater treatment systems

Yes I know we covered quite a bit of this last month. But since then, we worked with a few places that have done some additional testing on grease for us. We figured you would like to know the outcome and see how this could correlate to your plant.

We have worked with many plants that do not have screening, primaries, or functional skimmers. All of these can make a huge impact on the amount of dollars you spend on electricity, and solids handling costs. All are relatively important in biological wastewater treatment systems. Ok here is a primary clarifier with a ton of grease. This primary clarifier does not have surface skimmers.

Here is the primary. As you can see there is a huge buildup of solids in the primary. The solids are so thick, that a stick was put into the solids and stood up by itself! This level of solids is very hard on the rakes, as well as very hard on the hydraulics of the system, not to mention the loading to the aeration basin.
The solids will not only slowly release some of the BOD from the grease, but will also turn septic sitting so long in the primary. Pretreatment of the primary with screening upstream first should be looked at.

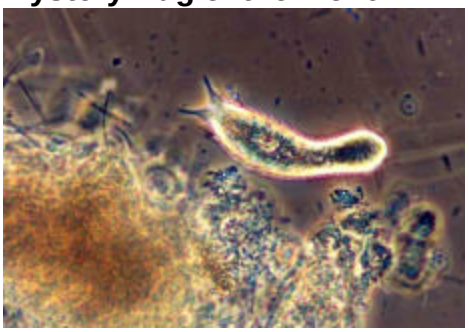
Let's address all of those questions.

Screening-Right away if I see this on the surface of the primary what does it tell you? You should go back and check your screening. It may have broken screens, be clogged or stuff is getting through. Anything you can physically remove prior to the primaries, the easier it will be for the primary to function. Screening is supposed to remove any large debris so it protects pumps, and mechanical equipment. This plant has a huge amount of debris that has gotten through. Small adjustments to the screening can have big impacts on the rest of the equipment.

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

Screening can significantly affect the entire operation of a plant. The ability of fine screens to remove smaller particles from the wastewater will provide a degree of BOD5 and TSS removal. Screens are not designed to remove trace metals, toxic organics, oils and grease, or soluble materials. However, the association of these contaminants with suspended solids will result in some removal. For example, oil and grease will coagulate on fibrous materials and other solids, which fine screens remove. Anything you can physically remove from the system vs. biologically having to treat can make a serious impact on mechanical, chemical, electricity as well as solids handling costs.
Electricity and solids handling are typically the two highest costs in a wastewater treatment plant. By impacting how much solids get into the system, the type of solids, the condition of the incoming or returning water, all will impact both of these

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variables.

Primaries and solids handling- Septicity

Most primaries are designed with movable scum skimmers, scum trough or baffles. The purpose of optimizing these are two-fold. One the solids that settle to the bottom need to be removed as quickly as possible so they do not turn septic, the same for the grease and floating solids on the surface. Septic water sent to the

Hydrogen sulfide is the most common odorous gas found in municipal wastewater collection and treatment systems. Colorless, emitting a characteristic odor of rotten eggs, the gas is extremely toxic and can lead to significant corrosion problems, pipeline collapses, and even loss of human life.

Sulfur is one of the constituents of many proteins and vitamins and hormones. It recycles like other biogeochemical cycles. The essential steps of the sulfur cycle are:

- Mineralization of organic sulfur to the inorganic form, hydrogen sulfide: (H2S).
- Oxidation of sulfide and elemental sulfur (S) and related compounds to sulfate (SO42-).
- Reduction of sulfate to sulfide.
- Microbial immobilization of the sulfur compounds and subsequent incorporation into the organic form of sulfur.

aeration basin will impact the amount of electricity used in a plant. Low pH, and septicity can also increase the corrosion effects on a clarifier. Bacteria will eat anything given enough time, including mechanical parts if given time. See our newsletter on corrosion. Low pH, anaerobic bacteria, sulfur bacteria and septicity will allow for a condition to develop in a piece of equipment where normal wear and tear on machinery is sped up.

Typical Oxygen requirements in a wastewater plant

- 5 lbs. oxygen oxidizes 1 lb. nitrogen
- 3 lbs. oxygen oxidizes 1 lb. carbon
- 1-1.5 lbs. oxygen oxidizes 1 lb. B.O.D. -
- 1 lb. oxygen oxidizes 1 lb. hydrogen sulfide
- .67 lb. oxygen oxidizes 1 lb. manganese
- .4 lb. oxygen oxidizes 1 lb. iron

You can see that it almost takes as much oxygen just for septicity as it would for BOD removal. Make sure you do not return septic influent, supernatant or decant to a system. Septicity will quickly remove oxygen, vs. the amount of time it takes to biologically consume the oxygen. You may be starving your bacteria of oxygen or just increasing your electricity bill. The other thing is that septicity will promote the growth of certain kinds of filaments, which increase solids handling cost. Spirillum will increase turbidity as they will not settle out and can impact TSS.

Why does it matter how long I hold the solids?

Holding primary influent or effluent and associated solids too long generally causes not only septic conditions, which can generates odors, but also generates low D.O. conditions. Low D.O. conditions cause the bacteria to generate specific compounds with sulfides and/or organic acids. Holding times of influent should always be kept to a minimum. Generation of septic conditions can also contribute to ashing in the clarifier, since the solids are turning anaerobic in the bottom of the clarifier and generate gases that cause clumps of solids to float to the top. This increases solids carryover. These conditions usually lead to the growth of excessive levels of filaments later on in the aerobic biological portion of the system. Sometimes, anaerobic sludge is sent to the primary clarifier via the belt press supernatant. This can also lead to an increase in septic conditions in a primary clarifier, since you are seeding the system with bacteria that like to grow in anaerobic or facultative conditions.

One way to tell if the solids are being held too long in the clarifier is if there is ashing on the clarifier or gassing.

Ashing occurs when little pieces of floc float up to the top of the clarifier due to trapped air bubbles in the floc. This is usually caused by the biological formation of H2S or N2 gas when the floc is held too long in the clarifier and runs out of O2. The bacteria do not stop growing in a clarifier unless there is no more food. If the conditions are not right, many problems are caused. Generation of H2S gassing can cause major safety issues.

When you allow solids to build up in any tanks without mixing or aeration, anaerobic activity will occur. Sulfur compounds are generated, organic acids are created. Septic influent when sent anywhere will pull out oxygen just to oxidize any of the sulfur compounds. It can also reduce the amount of free oxygen available for the aerobic bacteria to degrade any organics.

These are often termed as follows:

Assimilative sulfate reduction (see also sulfur assimilation) in which sulfate (SO42-) is reduced to organic sulfhydryl groups (R-SH) by plants, fungi and various prokaryotes. The oxidation states of sulfur are +6 in sulfate and -2 in R-SH.

Desulfuration in which organic molecules containing sulfur can be desulfurated, producing hydrogen sulfide gas (H2S), oxidation state = -2. Note the similarity to deamination.

Oxidation of hydrogen sulfide produces elemental sulfur (So), oxidation state = 0. This reaction is done by the photosynthetic green and purple sulfur bacteria and some chemolithotrophs.

Further oxidation of elemental sulfur by sulfur oxidizers produces sulfate. Dissimilative sulfur reduction in which elemental sulfur can be reduced to hydrogen sulfide.

Dissimilative sulfate reduction in which sulfate reducers generate hydrogen sulfide from sulfate.

Hydrogen sulfide can be oxidized to elemental sulfur:

$H_2S + 1/2\ O_2$ -----> $S^o + H_2O$ + energy

b. Elemental sulfur in turn can be oxidized to sulfate:

$S^o + 1\ 1/2\ O_2 + H_2O$ ---> $SO_4^{2-} + 2\ H^+$ + energy

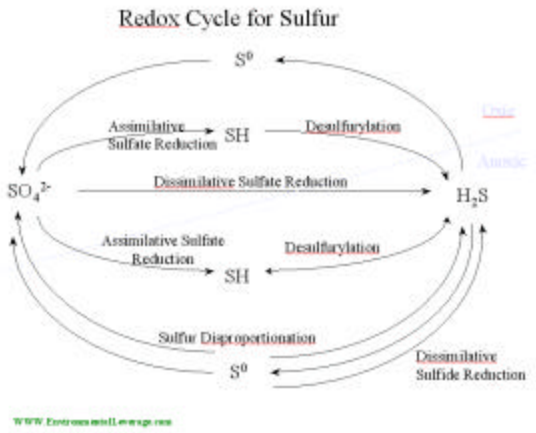
Desulfuration of decaying organic material releases hydrogen sulfide; Sulfate reducers can generate hydrogen sulfide;

The control of hydrogen sulfide in wastewater collection and treatment systems is very important. The presence of hydrogen sulfide is a safety concern, in addition to being an odor and corrosion problem. Sulfide odor is objectionable in low concentrations and can be toxic at higher concentrations. It can cause serious and expensive damage to the crowns of concrete mains. If digester gas is used as a fuel, the hydrogen sulfide needs to be removed to protect the engines from corrosion and to meet SOx emissions regulations.

H_2S Formation

The main cause of hydrogen sulfide generation is the biological decomposition of organic matter containing sulfur or from the reduction of sulfur compounds in the wastewater. The hydrogen sulfide is formed during anaerobic conditions, that is, neither

oxygen nor nitrate is present. If hydrogen sulfide is present and the conditions change from anaerobic to aerobic in moist conditions, bacteria will convert free hydrogen sulfide into sulfuric acid. The sulfuric acid generated is the major cause of corrosion problems in the system by attacking the concrete in the sewers and pumping stations.
Sulfate-reducing bacteria use sulfate instead of oxygen in their metabolism of organic matter; in the process, the bacteria

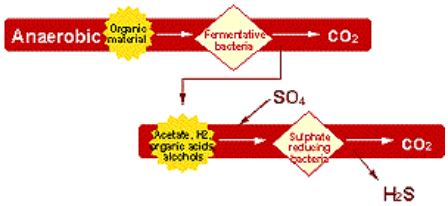


change (reduce) sulfate to sulfide, a very reactive substance. Sulfide reacts with metals to form insoluble metal sulfides such as pyrite (fig. 5) and with organic matter to form organic sulfur compounds. Anyone who has ever visited a salt marsh may remember the "rotten egg" smell of the sulfide produced by sulfate reduction.

What is septicity ?

The presence of hydrogen sulfide (H2S) in waste water and sludge is defined as a septic condition. Septicity is a result of anaerobic bacterial activity in absence of oxygen or nitrate. By preventing septic conditions from arising, negative effects like odors, health hazards, corrosion and reduced efficiency of the treatment plant, can be eliminated or reduced

Most undesirable property of H2S is its “rotten egg” odor, which has a very low odor threshold concentration (reported as low as 0.005 mg/L). Odors from water containing 0.1 mg/L H2S or greater are considered offensive. Other problems:



corrosiveness, the growth of filamentous sulfur bacteria, toxicity, etc. Aeration oxidizes H2S to odorless sulfur species, generating either free sulfur or sulfate. pH modification establishes basic pH conditions (7.5 – 8.0) so that the majority of the sulfide occurs in the odorless hydrosulfide ion form (HS-).

You can see how holding the solids too long can make a big impact on not only what happens in the primary, but also carry through to the aeration basin.

Primaries and grease-Why does it matter if the grease is in the primary?

Well, a primary is not a holding tank. Its function is to remove as much of the physical loading that the screening missed. The more you physically take off the loading to the aeration basin, the less you will spend on aeration and solids handling. The longer the grease sits in the primary, the more chances are that water will wash up against it in the flow and dissolve some of the grease into the water and it will then carryover into the aeration basin. If you have manual skimmers, check them once or twice a day, more after rain washes grease down and make sure you do not ignore them on the weekend. Hire a college kid if needed to come in and turn the skimmers once a day on the weekend. In the long run, the cost is minor compared to the overall impact it can have on your system.

We pulled some grease from one of the primaries. The COD was extremely high on the grease-3,690,000. That is huge. A typical loading into a municipality is 150-200 ppm of BOD. Imagine a spike of grease like this into your system. Granted all grease is not the same, but still anything over 1000, much less one million is extremely high. Take a sample from your primary - .1 gram since the COD is so high. We had another municipality try to run BOD and it was impossible. There was not enough air for the sample to run properly, no wonder. Make dilutions, let me know what you find. I am sure it will be high- significantly higher than your normal 150-200 daily BOD loading!!!!

Imagine how many solids will be generated by this grease if it gets into the system, as well as zooglea, Nocardia, cost of electricity, solids handling, polymers, etc. It is so much easier and cheaper to physically take loading out of a system and landfill them, then to try to biologically treat if at all possible.

When it comes to floating solids and grease, these also need to be removed quickly. Even though your BOD on the influent may be 150 -200, one small chuck of grease that gets over the weirs may be 10 times that amount. The faster you remove the grease, the less can get over the weirs or even dissolve into the water. Grease will provide food for the bacteria in the primary and help cause the septic conditions. It is not sterile anywhere in your system, not the collections system, wet wells, primaries, etc. Anywhere you have food, biological activity will grow. By controlling the amount of time solids can be in a clarifier, whether primary or secondary, you can change the growth in your system.

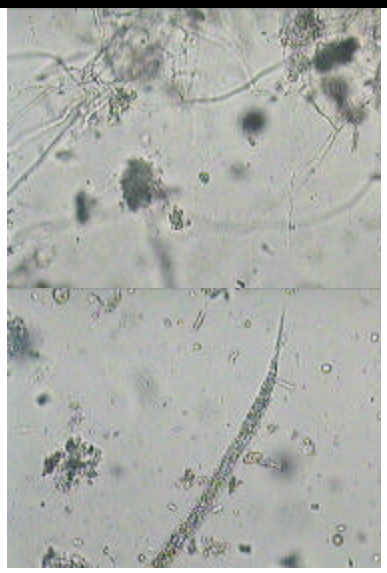
Some Average Solids Generation Ratios To Use As Benchmarks

	BOD:Sludge
Basic Steel (coke):	1.0:0.15
Petroleum Refining	1.0:0.35
Chemical Process	1.0:0.35
Sanitary (Municipal)	1.0:0.3-0.5
Pulp & Paper	1.0:0.5
Brewing	1.0:0.6
Food Processing	1.0:0.7

Skimmers are required in both primary and secondary clarifier for control of scum, and especially in primaries for grease control. Grease is the number one cause of filamentous problem in municipalities. Nocardia and M parvicella can make a serious problem for Municipalities and can affect sludge handling costs by 40-60%, including polymer or sludge haul off costs.

Microscopic evaluation:

We looked at this grease and solids under the microscope. Not only were there huge amounts of grease, which is the number one cause of Nocardia, but there were indications of low pH and septicity also. Fungi and yeast were present, spirillum, N limicola and a few other filaments. Worms were present, dark, black floc, high TSS.



Fungi, septic sludge, worms

You would not think some things so minor could have such a major impact on your biological system.

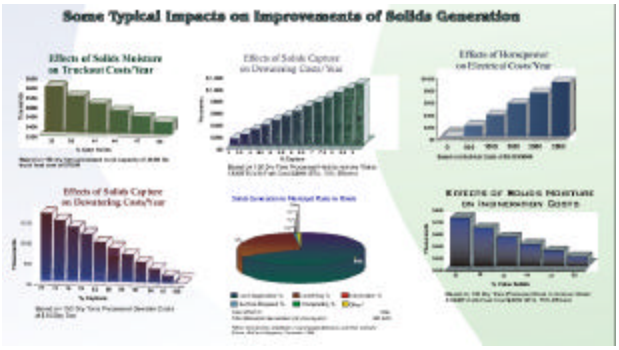
Analytical Report

Client:		**Date**	09/06/07
Project ID:	VA - WWTP PO# 64120	**Time**	10:15
Sample	Primary Tank #1 Pass 3	**Date Received:**	09/07/07
Sample	7-3986-001	**Date**	09/12/07

Results are reported on a dry weight basis.

Analyte	Result	R.L.	Units	Date Analyzed	Method
Oil & Grease	748,000	10	mg/kg	09/12/0	9071B
Specific Gravity	1.00	1.00		09/11/0	2710F
COD	3,690,000	100	mg/kg	09/10/0	5220D

Now lets see how this grease with high BOD loading impacts not



only your aeration basin, but your digester.
Typically most plants are designed to remove screening solids to a dumpster and they are out of the system.
Many plants though take the solids off the primary as well as the skimming off the top and send it to the digester. Basically they are feeding the digester a very high loading of food.

What is the purpose of a digester? The whole reason you run a digester is to starve the bacteria and reduce some of the soldis so you can reduce your solids handling costs. Again, two biggest costs in a plant, electricity for mechanical pieces and aeration and solids handling costs- polymers, sludge hauling costs.

The only difference between the aeration basin and the digester in reality to the bacteria is that you are not supposed to be feeding them so therefore some of the biosolids die and you then wind up with less solids. If you take all those grease solids and send them to your digester, your digester in reality has a higher loading than your aeration basin. Look under the microscope. If you see tons of amoebae and flagellates, your digester is not old, it is young and you are feeding it grease and tons of BOD. Take the grease from your primary and landfill it. The cost to land fill this small amount of grease compared to the amount of biosolids that will be generated is minimal.

What if you do not have a primary?
The only thing then that you can do to lesson the load of grease to your system is cheat and do a little bioaugmentation upstream in the lift stations or manholes. The main concept in wastewater is always a time and numbers game, time is limited by the pieces of equipment you have. You can only control the numbers in order to achieve the desired treatment.
By bioaugmenting upstream in the pipes, you are basically allowing for more time and adding more numbers.
We can help you with this or even optimization of your current system. Call our office for more information.

You can see how important grease removal is in a wastewater plant and how many variables it can impact. We cannot stress this enough. Many times little changes can make a big impact.

Last Month's Mystery Bug
Last month we had Giant stalks as our Mystery Bug. There are tons of these on our website. Every Bug of the month we have in our newsletter is posted on it's own separate

page with more critical information on the species type, the environment found, and what it indicates about the conditions present in your wastewater treatment plant.

Misc. websites

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 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 . . . . .

Membrane Equipment