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Turning Liabilities into Leverage
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What is Septicity

How does it impact my plant?

Septicity can cause odor control problems as well as toxicity to nitrifiers. Septicity can cause the growth of filaments, which can cause bulking as well as increased sludge dewatering costs.

Septicity can be due to insufficient mixing or aeration in the EQ, anoxic tank, SBR's, Aeration basin, or in the digester. Holding solids too long in the clarifier also can cause septicity. Foam build up can start to turn septic as the bacteria sit on the surface too long without mixing, food or air.

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, and reduce the amount of free oxygen available for the aerobic bacteria to degrade any organics.

Typical aeration requirements

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

Hydrogen sulfide is the most common odorous gas found in municipal and industrial 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.

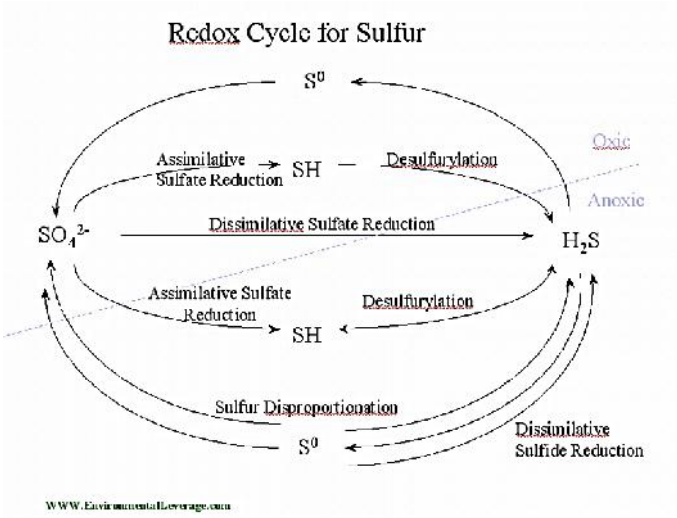
EQ tank with serious gassing - R image

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.

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

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

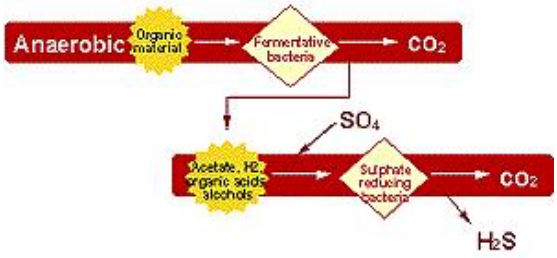
The main cause of hydrogen sulfide generation is the biological decomposition of organic matter containing sulfur or from the reduction of sulfur compounds in the wastewater. The hydrogen sulfide is formed during anaerobic conditions, that is, neither oxygen nor nitrate is present. If hydrogen sulfide 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 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 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 (H_2S) 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-).

Septicity can cause gassing, which can cause solids to float to the top in EQ tanks, primaries, digesters, and clarifiers.

Here is an EQ tank at a paper mill. High levels of solids and debris in the tank also help increase the development of septicity.

This is a primary tank with gassing and serious ashing. Notice the large black clumps of solids, Move solids quicker through a primary to avoid septicity.

On the left is a secondary clarifier with solids build up on the support structures. Ashing and Gassing is present. Make sure to clean side walls, struts, center wells as well as make sure the solids on the bottom of the clarifier do not turn septic and run out of air.

Please let us know if you have questions or need additional troubleshooting advise at your facility. You can reach us by phone 630-906-9791 or email ... wastewater@environmentalLeverage.com