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A Discussion Paper on the Merits of
Attached Growth versus Suspended Growth Technology
for Sewage Wastewater Treatment

Suspended Growth Technology

Suspended Growth Technology is the basis of Extended Aeration treatment systems wherein a pre-determined amount of air is delivered and introduced into sewage wastewater. Common methods of diffusion into the wastewater are by either coarse or fine bubble diffusers.

It is not the intention of this discussion paper to present the various merits for either the coarse bubble or the fine bubble diffusion method in Suspended Growth systems.

Suspended Growth systems take the principle of pumping air into sewage wastewater to create a mixing action of air and sewage wastewater. This mixing action is designed to keep the organic matter in suspension and cause the oxygen in the air to develop the naturally occurring aerobic bacterial microorganisms to become active. The aerobic microorganisms digest the sewage while in suspension.

This aeration mixing action and aerobic sewage digestion typically occurs in the "aeration chamber" portion of suspended growth systems. The aeration chamber is typically designed to facilitate the mixing action and is sized to retain incoming sewage wastewater for a specific period of time. The term "extended aeration" refers to this specific period of time of aeration required for the volume and concentration of sewage wastewater.

There are generally accepted industry standards for the length of time of aeration and the volume of air for a given amount and concentration of sewage wastewater.

From the aeration chamber the mixed biomass of water, organic matter and air enter a chamber or area that is generally termed as a "clarifier". The intent of the clarifier is to allow for the organic matter in suspension (Total Suspended Solids) to settle out to the bottom of the clarifier and allow the clarified treated wastewater to exit the system for dispersal into the environment or additional treatment such as disinfection or nutrient removal prior to dispersal into the environment.

Extended Aeration, as found in Suspended Growth and in some Attached Growth systems, provides a reasonable level of sewage digestion that generally results in lower amounts of sludge build up within the system. Therefore, the amount sludge (a.k.a. biosolids) to be removed and disposed is reduced.

The downside to suspended growth systems is that they usually have a larger footprint and are prone to pin point floc, under-aeration in some circumstances and "flushing-out action".

Pin point floc is the condition of thin and lightweight microorganisms that do not settle-out in the clarifier due to their lightweight. Pin point floc is created when the amount of air being introduced into the aeration chamber is greater than is required for the incoming sewage wastewater hydraulic or biological loading.

As the suspended growth system is delivering a pre-determined amount of air, a decrease in the volume and concentration of sewage will cause over-aeration. Over-aeration excites the aerobic microorganisms when there is a low food source for them to digest. This results in the microorganisms becoming too thin and lightweight to settle-out in the clarifier.

The pin point floc exits the clarifier to accumulate down stream of the plant. The accumulation may cause environmental harm over time.

Under-aeration is the reverse condition of that of the pin point floc. In this case the pre-set amount of air is lower than the volume and concentration of incoming sewage wastewater. There is simply too much biomass and sewage is under-treated causing an elevated amount of suspended solids to enter the clarifier.

The clarifier becomes undersized and the clarifier must have the sludge removed or the organic matter overflows the clarifier.

Flushing-out of the suspended growth systems is caused when the volume of sewage is greater, either temporarily or consistently, than the design of the system. As the biomass is in suspension it is easier for the incoming volume to flush the organic matter in suspension through the aeration chamber and through the clarifier out of the system.

Attached Growth Technology

Attached Growth Technology is based also on the introduction of air to the sewage but with the application of a material (a.k.a. media) for the microorganisms to attach themselves to in order for them to growth and digest sewage.

The method of air introduction may be either by an active or passive method. The Active method is using a mechanical means of air introduction such as, but not limited to, an air pump or fan. The Passive method is by allowing the surrounding atmospheric air to simply make contact with the sewage.

An example of an attached growth system using an Active method of air introduction would be the FAST® system using an air pump to force air into the sewage through an airlift assembly. An example of a Passive method would be the Rotating Biological Contactor (RBC) wherein the rotating discs are partially in the sewage and the remainder exposed to atmospheric air.

The media used for the microorganisms to attach to range from plastic, glass, foam, peat, sand, gravel to textile fabrics.

Setting aside the method of air introduction and media type, the attached growth technology is generally designed around the principle of an amount of surface area of the media for the microorganisms to attach to.

The media in contact with the sewage wastewater allows for the microorganisms to attach to the media and digest the sewage as it passes by. The organic matter attached to the media reduces the amount of solids in suspension. The media also acts as biological filter that filters organic matter.

In attached growth systems the biomass is not in a constant state of suspension but is attached to the media.

Attached Growth systems are therefore a more robust system in their ability to handle a temporary increase in the volume and concentration of incoming sewage due to the filtering effect of the media. Surges of sewage are buffered by the presence of the media by slowing the flow and allowing for the attached microorganisms to digest the sewage.

Surges of sewage flow do not disrupt or wash off the attached microorganisms as the media provides a "breakwater" effect on the motion of the liquid and the microorganisms are affixed to something instead of free floating.

Pin point floc is generally not created as the microorganisms attach to the media and stay attached while they grow on the available food source passing by. Over-aeration in the attached growth systems results in a slower build up of the biomass in or on the media.

In attached growth, a temporary under-aeration condition (more organic matter than air available) results in the excess organic matter residing within the media for treatment when normal conditions return.

The benefits of attached growth is typically a smaller footprint and higher level of treatment. Sludge (biosolids) build up for removal and disposal will vary dependent on the specific attached growth technology selected.

The FAST® System Advantage

FAST® means Fixed Activated Sludge Treatment and is an attached growth technology with all of the benefits described above for attached growth.

The FAST® sewage wastewater treatment system does offer additional advantages due its design and layout.

The FAST® system offers the benefits derived from an "extended aeration airlift system", "activated sludge return process" and "denitrification".

In the FAST® system the Extended Aeration Airlift System is created by using an external air pump to force atmospheric air into the middle of the attached growth media. The airlift also acts

similar to a coarse bubble diffuser. This removes any servicing and cleaning issues normally associated with air diffusion. The airlift action also helps prevent plugging of the media that can happen in some attached growth systems using trickling filter's technology.

Activated Sludge Return Process is created by the biomass that is attached to the media sloughing-off (a.k.a. activated sludge) and falling to the bottom of the system. The airlift assembly picks up this activated sludge and returns it to the media pack area for use in sewage digestion and treatment. This reduces the sludge (biosolids) build up that would have normally needed to removed and disposed off. In addition, the FAST® media tends to act like a series of little clarifiers to reduce discharge of TSS.

Denitrification is the creation of an anoxic zone within the FAST® system's tank wherein Total Nitrogen reduction occurs. The result is to reduce the amount of ammonia-nitrogen, nitrite and nitrate (a.k.a. Total Nitrogen) leaving the FAST® system. The FAST® system has the capabilities to reduce Total Nitrogen by 70%.

The FAST® sewage wastewater treatment system offers easy maintenance and non-clogging features. The only moving part is the external air blower that is located outside of the plant and there is NO need to remove, replace, clean or service any FAST® part that is in contact with sewage. The FAST® media offers non-clogging traits as discussed above. These are advantages FAST® has on ALL types of treatment systems.

General Comments

Regardless of the treatment technology type and system's design and function, all treatment technologies are based on an expected volume and concentration of sewage wastewater.

Attached Growth systems are better able to handle temporary changes and surges of hydraulic and biological loading over that of Suspended Growth.

Long-term consistent increased levels of daily sewage flows and concentrations will over-power any treatment system and may cause environmental damage downstream of the system such as, but not limited to, plugging drain fields and creating a health hazard.

Not all attached growth systems offer the benefits that the FAST® technology does. For example, Trickling Filter types of attached growth such as sand, peat, foam or textile filters can be overloaded and plug up. Be sure to investigate the operational and maintenance advantages that the FAST® system provides.

Ensure during the pre-planning and design phase that you take into account any increased levels of biological loading that may result from commercial and/or industrial facilities.

This paper is not a discussion of all the merits and aspects of FAST® or any other process mentioned here. Contact us for more detail and technical bulletins.