Fixed Activated Sludge Treatment (FAST®) Process Technology Overview

Biological treatment systems for small communities and even single-family dwellings have been available in the general water pollution control market for many years. These systems are basically scaled-down versions of the activated sludge process, utilizing suspended growth systems. Historically, the main operational problem associated with these systems has been the management of the sludge solids. In very small plants, flow rate variations can be extremely large and cause unintentional wasting or loss of the biological solids from the suspended growth reactor.

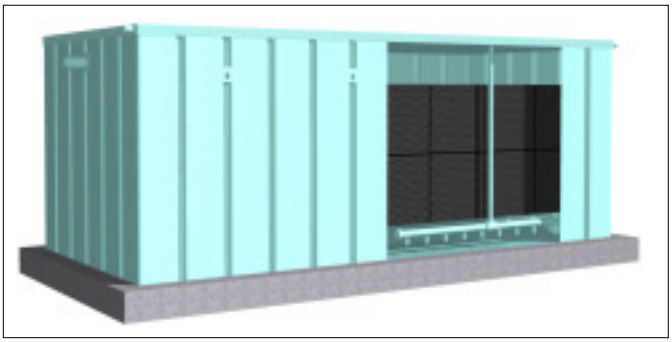
The FAST® (**F**ixed **A**ctivated **S**ludge **T**reatment) system eliminates many of the operational problems inherent with conventional suspended growth systems. It utilizes fixed media submerged in the aeration tank upon which the bacteria grow. Hence, the term "Fixed Activated Sludge Treatment."

The **FAST®** treatment system consists of a vessel packed with a media that provides a high surface area to volume ratio. The media is fully submerged in the liquid. Air diffusers below the media provide circulation of the waste to be treated through the media, and provide oxygenation to the liquid. The bacteria, unlike conventional activated sludge suspended growth systems, grow on the media while the liquor circulating through the bacteria-laden media is essentially clear and free of suspended solids. As the system operates, bacteria grow and flourish on the media and reach a point where they sluff from the media. The solids that are removed by this sluffing action are not overly gelatinous and slimy but tend to be very large and settle very rapidly.

In larger systems, these sluffed solids can easily be removed by a clarifier. Once removed from the effluent, these solids can be thrown away or returned to the aeration basin. Even without the return of the solids, the effective sludge age for this system is quite long, generally 40 to 100 days, depending upon loading rates, etc. The effective mixed liquid suspended solids levels are in the range of 4000 to 8000 mg/L. The concentration of bacteria is dependent on the concentration of the waste. The system is self-regulating.

The type of media is similar to media used in trickling filter towers. It has discreet channel flow paths, which cause self-cleaning action. The flow through the stacked-type media completely eliminates the need for any media maintenance.

The **FAST®** system offers numerous advantages:



1. The system handles peak shock and toxic loads, along with low loadings as a biological system.

Conceptually, what occurs in the system is a bit different in theory than a conventional suspended growth system. The bacteria, unlike conventional activated sludge suspended growth systems, grow on the media and the liquor circulating through the bacteria-laden media.

This growth pattern results in subsurface anaerobic microbes and surface aerobic microbes, both attached to the media. In case of a peak shock or toxic load, only the surface aerobic microbes would die and sluff off. The subsurface anaerobic microbes once exposed to air will quickly convert to aerobic microbes and degrade the incoming organics.

If the loading conditions to the **FAST®** system varies, the microbial mass will adjust to these conditions but, unlike a conventional active sludge system, the excess mass is not lost in the effluent, but rather remains in the system attached to the media.

2. The system can handle a very high biomass population.

In a conventional activated sludge system, the Sludge Volume Index (SVI) is a key factor in the system design. Indirectly it limits the reactor basin MLSS concentration and, in turn, the MLVSS that can be achieved because it controls the settling tank underflow concentration. Thus, for a given (SVI) and return sludge rate, the maximum MLSS and MLVSS is fixed with narrow limits.

Because of the conceptual difference of the **FAST®** process, the system does not depend on the return sludge rate and,

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therefore, not on a given SVI value. No sludge has to be returned to the **FAST®** system once normal operation has been established.

3. The media is submerged one hundred percent (100%) of the time.

Because the media is submerged one hundred percent of the time, an intimate contact between the organics and the biomass on the media is provided at all times and, hence, increases the rate of reduction, whereas in a Rotating Biological Contactor (RBC) for example, only part of the media is submerged in the wastewater; therefore, only part of the biomass comes in contact with the organics in the wastewater, resulting in a lower reduction efficiency.

4. There are no moving parts for maintenance.

Again, a comparison with the RBC process shows the **FAST®** system advantage. The RBC process consists of a series of closely-spaced discs mounted on a horizontal shaft and rotated through the wastewater, resulting in a number of operational and maintenance problems. In the **FAST®** system, the media and the air distribution system are fixed in place. The only moving part of the system is the wastewater flowing through.

5. The system saves space because of its unique design and biological loading characteristics.

The **FAST®** system consists of a vessel packed with a media which provides a high surface area to volume ratio. Since the biomass is fixed on the media rather than suspended in the vessel, like in a conventional activated sludge system, the design criteria is lbs. BOD/1000cf (kg BOD / cm) of media rather than lbs. BOD/1000cf of aeration volume. This results in a smaller aeration volume needed; therefore, in smaller vessel dimensions.

6. The system maintains sludge ages of 40 to 100 days, allowing for sludge stability because of the long period of time.

In a conventional activated sludge system, both the Food-To-Mass (F/M) ratio and the solids retention time (SRT) are controlled by wasting of organisms; they are interrelated. A high F/M ratio corresponds to a short SRT, and a low F/M ratio corresponds to a long SRT. A typical SRT value for a conventional activated sludge system is 30 days. Also, a long SRT means a larger and more costly aeration tank. It means a higher requirement for oxygen and subsequent higher power costs. Problems with poor sludge settleability in the final clarifier may be encountered if the SRT is too long.

Because of the independence of the **FAST®** system regarding the SVI, a higher sludge age can be achieved. As the surface aerobes grow and increase in thickness, the film strength of the bacteria growth weakens, and a sluffing of surface solids occurs. The anaerobic action of the microbes results in continuing reduction in cell mass and a reduced excess biological sludge accumulation without larger and more costly aeration tanks.

7. If properly operated, the system should achieve BOD and suspended solids removal in excess of 90%.

In comparison with a conventional activated sludge system or an RBC system, less operation attention will be needed for the **FAST®** system but still a better than 90% reduction can be achieved.

8. No control is necessary for this type of system.

Whereas, in a conventional activated sludge system having highly varying influent condition, the return and waste sludge rates, i.e., the MLSS (MLVSS) have to be controlled, no control is necessary with the FAST system for the reasons mentioned in Comments #2 and #6.

Then employing the RBC process, the RPM of the rotating shaft is a means of control to enhance treatment efficiencies. With the **FAST®** system, the fixed biomass is the controlling factor and self-regulating.

Conclusion

The **FAST®** design produces a biological treatment system that is a hybrid of activated sludge, trickling filter, SBR and RBC technologies. The advantages of each of the technologies are maintained, and the disadvantages are eliminated. The aeration tank is completely mixed and a high concentration of bacteria is in intimate contact with the waste. The system, however, is not dependent on return sludge from a clarifier. The bacteria are self-regulating, manpower is kept to a minimum and low effluent concentrations are produced. For more information, please consult Smith & Loveless.

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