WEBITAT ADVANCED IFAS SYSTEM ADDRESSES COMMON FIXED MEDIA CONCERNS

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ABSTRACT

Integrated Fixed-Film/Activated Sludge (IFAS) technology has received widespread acceptance in the engineering community as the most economical new way to upgrade wastewater plants without building new aeration basins or clarifiers. BioWeb™ is a knit web-like fabric with high surface area designed to be installed directly into aeration basins to create a colony of attached growth biomass in the system. Webitat™ is a new BioWeb IFAS system engineered to actively manage the attached biomass environment. Enhanced mixing keeps the biofilm thin and healthy, yielding higher kinetic reaction rates than previously measured in thick biomass. Individual dissolved oxygen control prevents and controls redworms to keep them from stripping the media of biomass. The patent pending Webitat system answers all of the questions that have been raised by engineers about the effectiveness of rope-type media IFAS processes.

KEYWORDS

IFAS, BioWeb, Biofilm, Fixed-film, Redworms

INTRODUCTION

Integrated Fixed-Film/Activated Sludge (IFAS) technology has received widespread acceptance in the engineering community as the most economical new way to expand wastewater plant capacity without building new aeration basins or clarifiers. It also can be used to increase treatment levels at existing plants in order to meet new permits for ammonia or total nitrogen. IFAS technology is simply adding a high surface area attached growth media directly into the aeration basins of an existing activated sludge plant to increase the amount of biomass available in the system.

In most conventional activated sludge plants, the treatment capacity is limited by the solids loading on the secondary clarifiers. All the bugs have to be continuously settled and returned to the aeration basin and there is a limit to the suspended growth population that can be effectively maintained. By adding a synthetic media directly into the aeration tank, a new population of attached growth biology is formed and adds to the existing suspended growth bugs. The new population is in the form of a thin layer of film attached to the surfaces of the media. The fixed film biomass is integrated with the activated sludge biomass. Hence the name, Integrated Fixed Film/Activated Sludge technology, or IFAS as it has become known in the industry. It is a new

hybrid system with fixed biomass and suspended biomass working together to treat even more wastewater or remove higher levels of contaminants.

Now many consultants are seeking information on how to apply IFAS properly to their individual projects, especially on how to choose the right media. There are several different kinds of synthetic media available for IFAS upgrades, and even more different manufacturers of these media. The two main categories of IFAS media are free-floating and fixed media.

The free-floating media are sometimes referred to as "suspended media" or "carrier elements". There are several IFAS installations using this type of media in North America and elsewhere. The carrier elements are small plastic pieces with high surface area, ranging in diameter from 1 to 2 cm and resembling pasta. The media is generally made of a plastic with a specific gravity less than, but close to 1.0, so that it will stay afloat and well mixed in an aeration basin. Usually coarse bubble diffusers are used to provide enough mixing energy to keep the media well mixed. The turbulence of the media pieces keeps the biofilm on each piece very thin. The thin biofilm and abundance of surface area provides high efficiency treatment. Several drawbacks of this type of media include the fine screens required in the plant headworks, the retention screens required to keep the media in the appropriate zones of the aeration basins, the low energy efficiency of coarse bubble diffusers, and the maintenance hassle associated with millions of small pieces of media.

Figure 1 – Closeup of BioPortz Free-Floating IFAS Media

Fixed synthetic IFAS media also has its advantages and disadvantages. This type of media is typically a knit fabric or cord with added thread loops to create more available surface area for biofilm growth. It is mounted on steel frames and the entire frame is suspended in the aeration basin. An early brand of fixed media called Ringlace came from Japan and had several installations in the U.S. with mixed results.

At the Annapolis WRF where Ringlace was installed, measurable nitrification was found to occur in the biofilm on the media. (Copithorn, 2000) A dramatic change in influent loading caused a bloom of redworms appeared in the media, but subjecting the media to anoxic

conditions and briefly chlorinating the RAS solved the problem and they plant has never had a problem with the redworms since. A stable population of redworms is said to exist in the biofilm but it has not caused a problem with permit compliance. However in Blacklick, OH an installation of Ringlace also developed a redworm problem and the media was subsequently removed.

Figure 2: Ringlace installation at Annapolis WRF

An article on the subject of IFAS media options was published in WE&T in November 2005. (Johnson, 2000) Concerns have been raised about the applicability of fixed, rope-type media for IFAS projects. These concerns mainly center on the control of biofilm quality and thickness, raising questions about whether biofilms growing on rope media can contain autotrophic, nitrifying bacteria. Another major concern is based on the occurrence of redworms on the rope media, and whether they can significantly impair nitrification in the biofilm. These questions and concerns are directly resolved by a new patent pending IFAS technology, called Webitat.

Webitat is a new twist on an old product, BioWeb fabric media for IFAS. BioWeb is a knit web-like fabric with high surface area designed to be installed directly into aeration basins to create a colony of attached growth biomass in the system. It is typically supported vertically on stainless steel frames that are either suspended from the top of the basin walls or are supported on legs off of the tank floor, leaving room for the air diffusers below. BioWeb has been installed in thirteen wastewater treatment plants since 1996 and has been tested in several others.

Figure 3: Closeup of BioWeb Fixed-film Media

Figure 4: Installation of BioWeb Media Mounted on Typical Stainless Steel Frames

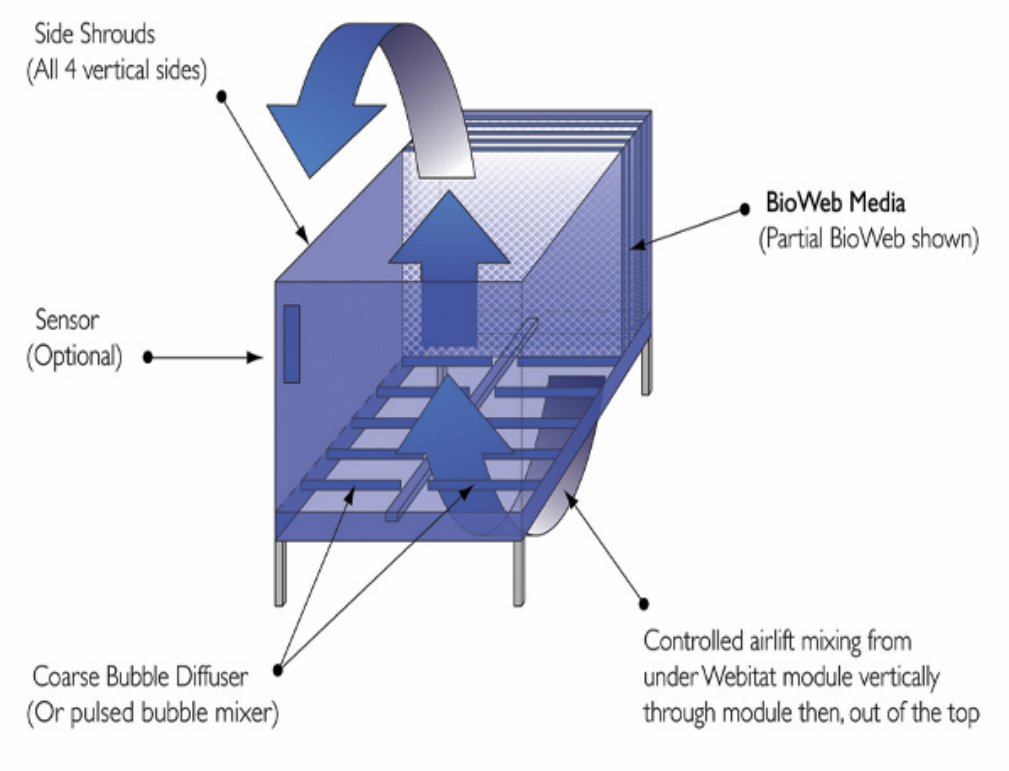
Webitat is a new, next generation BioWeb™ IFAS system engineered to actively manage the attached biomass environment. Shrouding the four vertical sides of the module and providing dedicated air supply underneath substantially enhances mixing and ensures a thin-film biomass. The enclosed Webitat module with its controlled biofilm thickness is a high-rate biological reactor.

Figure 5: Webitat module with media enclosed on four sides

A few of the past BioWeb tests and installations have had arguable success in helping with nitrification, and redworms have been found growing on some media samples. As previously mentioned, redworms were found at a couple of other rope-type media installations, but in the Annapolis, Maryland installation, the redworms were subsequently controlled and discouraged from repopulating. Little information is available on the exact species and characteristics of these nuisance organisms, but it has been reported that the redworms are strict aerobes and that when dissolved oxygen in the wastewater drops to near zero, the worms detach from the media. Webitat controls these nuisance organisms by timed cycling of the air supply between aerobic and anoxic environments. Each module is equipped with individual aeration diffusers that allow for dissolved oxygen control within the module, exclusive from the bulk liquid outside the module.

Another reason that has been reported for the less than optimal performance of past BioWeb installations is ineffective mixing of the wastewater through the module. Without good mixing the biofilm does not get fully exposed to substrate or dissolved oxygen, potentially leading to anoxic or anaerobic conditions within the fixed film biomass. This problem is exacerbated by inadequate shear forces to keep the biofilm thin, causing an overgrowth of thick biofilm. Webitat ensures good mixing through the media by enclosing the vertical sides of the frame and using individual diffusers, directly under the media. The Webitat unit works like a large air-lift pump, forcing the wastewater directly up through the media with high momentum. This keeps the biofilm thin and aerobic, for healthy nitrifier growth. The net result is a biomass closer to the thin films typically seen in moving media systems, with resultant higher rate kinetics.

Figure 6: Webitat description



Webitat is appropriate for upgrades of existing conventional activated sludge systems, SBR's, and is especially useful for lagoon upgrades. Webitat modules can be easily added to lagoon systems that need to upgrade for nitrification. The modules can be floated out to specific locations in the lagoon and dropped to sit on the lagoon floor. Webitat modules for lagoons are modified with a flat plate on the bottom with sloped edges to keep the plate from disturbing the lagoon lining or floor. Individual diffusers are included with each Webitat unit that are attached to air lines to provide the media and the lagoon with the aeration and mixing necessary for nitrification.

Another feature of Webitat is the ability to regulate the aeration of an individual module or a group of modules. Not only can the dissolved oxygen inside the module be adjusted for predator control, if needed denitrification performance can be optimized. BioWeb IFAS systems operated at low threshold D.O. levels have achieved significant levels of simultaneous nitrification and denitrification. With Webitat the D.O. in the bulk liquid can be set high enough to ensure good nitrification while the D.O. inside the media is lower to drive denitrification. Alternatively, the air can be cycled, resulting in alternating oxic and anoxic conditions, again, enhancing simultaneous Denitrification.

In early 2006 the Stewert Creek Wastewater Treatment plant in the city of The Colony upgraded their wastewater treatment plant using integrated fixed-film/activated sludge (IFAS) technology. The upgrade included 24 BioWeb media modules that were each fitted with Webitat air bubble

mixers in order to create better mixing and control any potential redworm population that might appear. Since startup the plant has performed well and no redworms have been seen.

Figure 7: Webitat air bubble mixers underneath BioWeb media

CONCLUSIONS

The patent pending Webitat system effectively and efficiently answers all of the questions that have been raised by engineers about the effectiveness of rope-type media IFAS processes. Enhanced mixing keeps the biofilm thin and healthy, yielding higher kinetic reaction rates than previously measured in thick biomass. Individual dissolved oxygen control prevents and controls redworms to keep them from stripping the media of biomass. Simultaneous nitrification and denitrification is optimized in the Webitat environment. Lagoons, SBR's, and conventional activated sludge systems can all benefit from the Webitat IFAS process.

REFERENCES

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