REVIEW ON " ACTIVATED SLUDGE PROCESS "

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ABSTRACT

Activated sludge process is an environmental and engineered system. Wastewater is an outcome of agricultural activities ,industries and municipalities. The chemical composition of waste water indicates it's origin. Organic materials from waste water needs to be disposed so that the quality standards can be meet . The methods that are used for wastewater treatment are Activated sludge process, oxidation pond, anaerobic process , drop filtration. This overview shows the available information about the removal of organic material by active sludge process. Activated sludge process is the biological aerobic wastewater purification system that uses microorganisms and air to biologically oxidize the organic pollutants. This uses naturally occurring bacteria and protozoa, so it is an environmentally friendly and also an economical process. The active sludge process proved to be an effective method with room for further research in terms of cost-effectiveness, effluent of good quality, efficient removal of BOD and COD.

KEYWORDS: Mixed Liquor Suspended Solids (MLSS), Mixed Liquor Volatile Suspended Solids (MLVSS), Food / microorganism ratio(F:M ratio), Cell Residence Time(CRT), Return Activated Sludge (RAS), Sludge Volume Index (SVI), Sludge Density Index (SDI).

I INTRODUCTION

Activated sludge is a sludge particle that is reduced in the wastewater by the growth of organisms in aeration tanks. The term 'activated' comes from the fact that the particles are teaming with bacteria, fungi and protozoa and differs from primary sludge in the sense that the sludge particles contain many living organisms that can feed on the incoming waste water. Described simply, screened wastewater is mixed with varying amounts of recycled liquid containing a high percentage of organisms taken from a secondary clarification tank, and it becomes a product called mixed drink. This mixture is stirred and injected with large amounts of air, until care for oxygen and keep solids in suspension. After a while, mixed liquid flows to a settler where it can settle. Some of the bacteria are removed when it settles and the partly cleaned water continues to flow for further treatment. The result has been resolved solids, the activated sludge, are returned to the first tank to start the process again. Today a number of variations on the basis process have been developed. This issue of Pipeline contains descriptions of three of the most common variations: extensive aeration, sequencing batch reactors and

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oxidation locks. The activated sludge plant is the most popular biological treatment process for larger installations.

II PROCESS

A primary settler (or primary pre-cleaner) can be introduced to a part of the suspended solids present in the influent and this reduces the organic load to the activated sludge system. The biological reactor or aeration tank is filled with a mixture of activated sludge and influent, known as "mixed liquor". It is necessary to maintain certain mixed spirits suspended solids (MLSS) in the aerated tank maintain good removal efficiency. The aeration equipment transfers the oxygen required for the oxidation of organic material in the reactor, while at the same time sufficient turbulence is introduced to the sludge flakes in suspension. The continuous introduction of new influent results in a continuous discharge of mixed liquid to the secondary settler where separation of solids and liquid takes place. The liquid leaves the system as treated effluent, while part of the sludge is returned to the aeration tank called 'return sludge' and the rest of the sludge is taken anaerobic digestion.

III OVERVIEW OF CONTROL FACTORS

The proper functioning of an activated sludge installation requires knowledge of biological and physical factors that influence the efficiency of the process.

These factors include:

- organic and hydraulic loads of the aeration tank
- dissolved oxygen in the aeration tank
- waste percentage of bio solids
- return the amount of activated sludge
- load occupancy rate
- solid particles sedimentation and compaction properties

3.1 ORGANIC LOADING

Organic loading refers to the number of kilos per day that BOD enters the process. In most activated sludge plants this is based on the primary effluent, but in installations without primary clarification sources it would be based on the flow of the influent of the installation. Pounds per day BOD load can easily be calculated using the Pounds formula. Multiply the flow rate in million gallons per day by the weight of one gallon of water (8.34 lbs / gallon) and multiply the milligrams per liter of BOD in the flow to give the number of kilos per day of BOD in that flow.

It may be advantageous to calculate the organic load as a moving average of five days or seven days. This helps to moderate day-to-day load fluctuations, allowing more consistent control of operation. A moving average of seven days would be calculated by averaging the pound BOD for a given day with values for the six days before.

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3.2 QUANTITYOF MICRO ORGANISMS

The concentration of the mixed liquid (MLSS) is determined by analyzing the suspended particles of the suspension in the aeration tank. Because this suspension comprises both biological mass and inorganic material in the waste water, the amount of biological mass is estimated by determining the organic content of the MLSS. Mixed Liquor Volatile Suspended Solids (MLVSS) is determined by lighting a sample of the dried MLSS in a muffle furnace at 550 ° C. The material that burns at that temperature is considered organic and therefore estimates the biological mass. The material that remains (non-volatile or solid) estimates the inorganic fraction of the MLSS. Thus, in process control calculations where all solids are to be considered, MLSS is used in the calculation. In calculations where only the active biological population must be taken into account, MLVSS is used. Food / microorganism ratio (F: M) is one of the primary controls used in plants with activated sludge. This helps the operator to maintain a balance between the amount of food available with the amount of microorganisms in the aeration tanks. Although the best treatment may not occur at the same F: M ratio in different plants, the range for conventional activated sludge plants is often given as 0.25 to 0.45. Activated sludge plants operating in the extended aeration mode typically work with F: M in the range of 0.05 to 0.15.

3.3 CELL RESIDENCE TIME

Cell Residence Time (CRT), also known as Sludge Age (SA) or Solids Retention Time (SRT), can be defined as the average duration in days that an organism remains in the secondary treatment system. When a food supply is brought into a biological treatment plant that is in operation, there is an abundance of food but very few organisms. It is said that the organisms are in the Lag phase when they begin acclimatizing to the waste, produce the required enzymes and the population starts to rise. Once the organisms have been acclimatized, the growth rate increases rapidly in the log growth phase. At this point, the food supply is not a limiting factor because BOD is converted into biological mass, producing large quantities of sludge. In the declining growth phase, the population has grown to such an extent that the available food supplies begin to reduce the production of new cells and that organisms begin to compete for food. As the population ages (CRT 5 days or longer), larger and more complex organisms that are able to compete for the remaining food are more numerous, and predatory organisms begin to feed on smaller ones when a food chain develops. In the endogenous phase the food supply is depleted and as the age of the population increases (CRT is now up to >15 days), the growth rate of the organism continues to decline. Food that the organisms have stored is metabolized and the organisms feed on each other in endogenous breathing. Although the concentration of organisms is large, sludge production is lower. In view of the objectives and the costs of waste water treatment, there are clear advantages in operating an active sludge system in the extended aeration mode. BOD will have almost completely disappeared, producing high-quality waste water and sludge production will be the lowest

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3.4 RETURN ACTIVATED SLUDGE

Return Activated Sludge (RAS) refers to the biological solids (solids of mixed liquids) that settle in the secondary settling tank and are continuously returned to the aeration tank. There are two main reasons for returning these organisms

3.5 SLUDGE VOLUME INDEX

SVI is used by operators to determine and compare the settling capacity of mixed liquids. It relates mathematically to the settled sludge volume in the settleometer to the MLSS concentration. The definition for SVI is the volume in milliliters occupied by one gram of activated sludge that has been established for 30 minutes. Note that SVI relates the sludge volume in milliliters to the MLSS concentration in grams per litre

3.6 SLUDGE DENSITY INDEX

SDI is another way to express sludge compaction, uses the same information as SVI, but expresses it as sludge density (weight by volume instead of volume by weight). The definition for SDI is the number of g of active sludge that takes up volume of 100 ml after 30 minutes of sedimentation.

3.7 AERATION REQUIRMENTS

Aeration of the contents of the active sludge reactor accomplishes two important requirements. Mixing must take place to make contact between biomass and incoming pollutants; ensure that the entire content of the aeration tank is kept in suspension. Dead zones in the tank may allow for deposition and mixed liquid will collect at the bottom of the tank. When this settled material begins to decompose, an area with little dissolved oxygen is created, creating conditions conducive to the growth of filamentous bacteria. These filaments bridge between floc particles, reduce the density of the mixed liquid and cause sedimentation problems in the secondary settler. In facilities where aeration equipment does not provide adequate mixing, additional mixing may be required.

Aeration should also provide oxygen to the vast population of aerobic and facultative bacteria and other organisms in the mixed fluid. Operators usually control the aeration rate to ensure a concentration of 2 - 3 mg / L dissolved oxygen (D.O.) at the discharge end of the aeration tank. Higher D.O. concentrations of waste capacity, while low D.O. (<1 mg / L) can stimulate the growth of filamentous bacteria. The amount of air that must be supplied to the aeration tank for the required D.O. concentration depends on various factors. As BOD (biochemical oxygen demand) increases, the organisms will need more oxygen to metabolise the waste and more air must be supplied to the D.O. concentration within the desired range. Likewise, since the number of pounds of biomass in the system is increasing, the air supply must be increased; each organism will use the amount of oxygen needed to sustain itself. Treatment goals such as nitrification and denitrification are also factors that determine how much air must be supplied. Although it takes 1.0 to 1.5 pounds of oxygen to degrade 1 pound of BOD, it takes 4.5 pounds of oxygen to convert 1 pound of ammonia into nitrate (nitrification). The oxygen transfer efficiency of the aeration equipment plays a major role in determining how much oxygen is supplied to the organisms at each cubic foot of air delivered into the aeration tank. Not all oxygen supplied to the aeration tank is dissolved in the water; most if it remains in gaseous form, bubbles to the surface and disappears for the atmosphere. The Standard Oxygen Transfer Efficiency (SOTE) for different aeration equipment ranges from about 10% to about 40% in clean water and up to 15 feet of immersion (diffuse aeration). Oxygen transfer can also be given as standard oxygen transfer rate (SOTR) given in units of kilogram of oxygen transferred per horsepower. The actual oxygen transfer efficiency (AOTE) or the actual transfer rate of oxygen (AOTR) in wastewater will be considerably less than the SOTE or the SOTR. The transfer of oxygen is influenced by many factors, including the type of equipment used (and how well it is maintained), the air temperature, the chemical properties of the water and the speed with which the organisms use the oxygen (oxygen uptake rate). For example, while the SOTR can reach as high as 6.5 pounds of oxygen per horsepower for a particular aeration device, the AOTR can be expected to be in the range of 2.5 pounds of oxygen per horsepower.

3.8 AERATION EQUIPMENT MECHANICAL AERATION

Air can be supplied to the aeration tank with the aid of mechanical aerators or a diffuse aeration system. Mechanical aerators splash the mixed liquid into the air, causing oxygen to dissolve in the water. There are many types of mechanical aerators, including vertical and horizontal designs. Vertical aerators can pump mixed liquid away from the bottom of the tank and place it against a deflector, or can act as large impellers, partially submerged in the mixed liquid near the surface of the aeration tank. Adjusting the depth of immersion changes the amount of aeration and mixing that occurs. Horizontal mechanical aerators, or rotors, are often seen in oxidation channel arrangements in which a long horizontal axis is suspended just above the surface of the aeration tank. Metal brushes or plastic discs mounted on the shaft rotate partially immersed in the mixed liquid, causing aeration and imparting speed to the mixed liquid that keeps the biomass in suspension. Here too, the aeration rate can be changed by adjusting the depth of the liquid in the tank, thereby increasing or decreasing the immersion of the rotor. Actual oxygen transfer rates for mechanical aerators range from about 1.8 to 2.5 pounds of oxygen per hour per hour. Aeration equipment - Diffuse aeration The most common aeration method in conventional installations with activated sludge is the diffuse aeration system. In this system a blower (compressor) is used to supply air at low pressure to a piping composition with air diffusers submerged near the bottom of the aeration tank. The diffusers break the airflow into small bubbles from which oxygen is transferred to the liquid as the bubbles rise to the surface. Increasing the amount of time that the bubble is in contact with the liquid increases the efficiency of the oxygen transfer. Aeration tanks are typically deep enough designed (often about 15 - 18 feet) to maximize the travel time from the bubble to the surface, but not so deep that so much head (pressure) against the blower arises that it is out of reach for maximum efficiency. Aeration tanks are sometimes also configured to cause a rolling movement of the liquid in the tank, again to keep the air bubbles in contact with the mixed liquid for as long as possible.

BLOWERS

1)Centrifugal Blowers

Centrifugal blowers are used in almost all medium to large installations with activated sludge. These work as turbines with a high speed, with air outputs of 20,000 - 150,000 CFM. The volume of the pumped air is variable within a range, adjusted by controlling an inlet guide vane (throttle valve on the suction side of the fan). Positive displacement fans are often called rotating lobes blowers. As the rotating lobes rotate, a fixed volume of air is displaced each time the lobes come together. These blowers operate at lower revolutions than centrifugal blowers and generally produce less than 20,000 CFM of air. Unlike centrifugal blowers, the air delivery of blowers with positive displacement can not be varied by the use of throttle valves. Air output can only be changed by changing the speed at which the blower operates, for example by changing the pulley size on the blower or the engine.

BLOWER MAINTENANCE

Whether centrifugal or positive displacement, blowers are difficult and expensive to repair, largely due to the fact that they work at high speed and are machined to a very close tolerance. The shops of wastewater treatment plants are rarely equipped to carry out major repairs on this type of equipment and usually contract this work. Heat, vibration and dust are often causes of premature wear and failure of the fan. Improperly maintained air filters that result in air restrictions on the suction side or leaks that allow dust to enter the blower are harmful to both types of blowers. Lubrication and other preventive maintenance must be carried out in accordance with the manufacturer's specifications. Pipes connecting the blower to the air diffusion system at the aeration tank may be a simple down pipe extending from the deck of the aeration tank to the bottom of the tank, or may be a sway system. The advantage of the swing system is that hinges in the pipes allow the operator to remove an aeration battery from the tank using a tap on the deck of the tank when maintenance of the diffuser is required. Naturally, this operation requires an adequate crew and careful compliance with all safety considerations.

DIFFUSION EQUIPMENT

Air diffusers have been designed in many shapes and sizes over the years; some are more successful than others. Air vents can generally be classified as either coarse bubbles or fine bubbles.

Coarse bubble spreaders

Coarse bubble spreaders have been used for many years in installations for activated sludge. Because compressed air from the blower flows from the air supply through a small opening in the diffuser, the air is inflated in small bubbles. The diffusers are usually made of plastic or stainless steel and ensure good mixing and aeration with minimal loss of the head. These diffusers are resistant to clogging and can work for a long period with minimal maintenance. Reported standard oxygen transfer efficiency in clean water for diffuse diffusers for coarse bubbles ranges from 9% to 13% at 15 foot immersion. Actual oxygen transfer rates vary from about 1 to 2 pounds of oxygen per horsepower, depending on the type of diffuser and the configuration of the aeration tank.

Fine bubble spreaders

Fine bubble spreaders began to gain popularity in the 1970s when energy costs increased and the limits for discharge licenses became stricter. Since energy costs for the use of the aeration system in an active sludge installation represent a very large part of the annual budget for the installation, the need to maximize the efficiency of aeration systems is obvious. Reported standard oxygen transfer Efficiency varies greatly depending on the type of diffuser, ranging from 13% to 40% in clean water at 15 feet of immersion. Again, it should be noted that actual transfer efficiency in waste water will be lower than in clean water, especially as the system ages. Actual transfer rates of oxygen range from about 1.3 to 2.5 pounds of oxygen per hour per hour.

IV CONCLUSION

The efficiency of activated sludge process is dependent on the organic loading rate, dissolved oxygen in the tank and the external oxygen entrained by using aeration process. Compared to the other process of wastewater treatment, activated sludge process is more efficient, sustainable, economical and more wastewater can be treated.

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