Small System Operators Continued

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By the time this article reaches print, summer will be gone and fall will be upon us. Lagoon operators will be anxiously checking how much room is left on the freeboard or how much water is left covering the sludge blanket. Depending, of course, on the type of discharge permit you have, (summer or winter discharge).

As promised this is the second part of the series Small Systems Operators. In part one, the symbiosis relationship between algae and microorganisms were discussed. In this part of the series we will be looking at how the microbial process works in an activated sludge system. Lagoon and activated sludge wastewater organisms are similar in many ways. However in activated sludge, oxygen is supplied for the organisms by some type of mechanical means, usually in an aeration basin.

A qualifier and definition of activated sludge must be stated here. The definition of activated sludge according to the California State University's "A Field Study Training Program" Volume II, Chapter 11 describes ACTIVATED SLUDGE as: Sludge particles produced in raw or settled wastewater (primary effluent) by the growth of organisms (including zoogleal bacteria) in aeration tanks in the process of dissolved oxygen. The term "activated" comes from the fact that the partials are teeming with bacteria, fungi, and protozoa. Activated sludge is different from primary sludge in that the sludge particles contain many living organisms, which can feed on the incoming wastewater. Also included in the definitions is the term ACTIVATED SLUDGE PROCESS that states the process as a biological wastewater treatment process which speeds up the decomposition of waste in the wastewater being treated. Activated sludge is added to wastewater and the mixture (mixed liquor) is aerated and agitated. After some time in the aeration tank, the activated sludge is allowed to settle out by sedimentation and disposed of (wasted) or reused (returned to the aeration tank) as needed. The remaining wastewater then undergoes more treatment.

There are many types and variations of activated sludge systems and the term activated sludge is used with a very broad brush. Sequencing Batch Reactor, Oxidation Ditches, Package Plants, Rotating Biological Contactors, and Trickling Filter Solids Contact Systems are some of the type of systems that are considered to be "activated sludge". For the purpose of this series we are going to concentrate on what is known and referred to as "Conventional Activated Sludge Plants". Bear in mind that the parameters described for conventional sludge plants do not necessarily apply to the above-mentioned processes.

Unlike the lagoon system that requires minimal operation and control strategies, the activated sludge process demands a maximum of control and operation strategies. To completely understand how the process works an operator must be a microbiologist, chemist, lab technician, mechanic, electrician, and somewhat of a soothsayer. Understand that it takes volumes of books and text to explain all the workings of activated sludge and I am giving you a very condensed version. So let's get started.
I am skipping the collection system and preliminary treatment process and will begin with the **primary treatment** process, which is used to remove settleable & floatable materials.

Most smaller facilities and even some larger systems skip the primary treatment process altogether and the influent flows directly into the aeration basin. At this point the process becomes what is known as **secondary treatment.**

Process Description

Secondary treatment in the form of the activated sludge process is aimed at oxidation and removal of soluble and or finely divided suspended materials that were not removed by previous treatment. Aerobic organisms do this in a few hours as wastewater flows through the aeration basin. The microorganisms stabilize soluble or finely divided suspended matter by partial oxidation forming carbon dioxide, water, and sulfate and nitrate compounds. The remaining solids are changed to a form that can be settled and removed as sludge during sedimentation.

When wastewater enters the aeration basin, it is mixed with the activated sludge, carrier water, and influent solids. These solids come from many sources such as factories, businesses and of coarse homes. The activated sludge that is added contains many different types of helpful organisms that were grown during previous contact with wastewater. These organisms are the workers and the backbone of the treatment process. They use the incoming wastes for food and as a source of energy for there life processes and for the reproduction of more organisms. Thus these organisms will use more food contained in the wastewater in treating waste.

Conversion of dissolved and suspended material to settleable solids is the objective of activated sludge. In the activated sludge process, the biochemical oxidation carried out by living organisms is stressed. The same organisms also are effective in conversion to settleable solids if the plant is operated properly.

After the aeration period, the wastewater is routed to a secondary settling tank for a water-solids separation. Settled organisms in the final clarifier are in a deteriorating condition due to lack of oxygen and food and should be returned to the aeration tank as quickly as possible. The remaining clarifier effluent is usually disinfected and discharged from the plant.

Activated sludge solids concentrations in the aerator and the secondary clarifier should be determined by the operator for process control purposes. As mentioned earlier solids are in a deteriorating condition as long as they remain in the secondary clarifier. Depth of sludge blanket in the secondary clarifier and concentrations of solids in the aerator are very important for successful wastewater treatment. Precise solids tests should be made periodically for comparison with centrifuge solids test. Before any changes are made in the mode of operation, precise solids measurements should be obtained. Settleability tests show the degree and volume of solids settling that may be obtained in a secondary clarifier; however, visual plant checks show what is actually happening.

The successful operation of an activated sludge facility requires the operator to be aware of the many factors influencing the process and to check them repeatedly. To keep the organisms working in the activated sludge, you **must** provide a suitable environment. High concentrations of acids, bases, and other toxic substances are undesirable and may kill the working organisms. Uneven flows of wastewater may cause overfeeding, starvation, and other problems that will upset the activated sludge process. Failure to supply enough oxygen can cause an unfavorable environment that may result in decreased organism activity.

While successful operation of an activated sludge plant involves an understanding of many factors, actual control of the process is relatively simple. **Control consists of maintaining the proper solids (flock mass) concentration in the aerator for the waste (food) inflow by adjusting the waste sludge pumping rate and regulating the oxygen supply to maintain a satisfactory level of dissolved oxygen in the process.**

This concludes this part of the series and as I stated earlier in this article, it is only the very tip of the iceberg. So tell me what you think. Would you like a more in-depth discussion on process control? E-mail me and let me know or better yet write an article and summit it for the next edition of H2Oregon. My e-mail address is wwtech@oregonvos.net. See ya next time around, Dave