Aerated Lagoons for the Treatment of Fats and Oil Industry Wastes

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Abstract

This paper discusses the effects of discharging waste materials into receiving streams, and the methods whereby a treatment system condenses the biological cycle to a few days. Also covered are the three basic types of lagoon operations, their advantages and limitations, typical biochemical oxygen demand and solids reduction, as well as the associated economics of each type of system. Methods of installing and positioning mechanical surface aerators in a lagoon, both platform or bridge mounted and floating platform units, are included.

When a biodegradable waste flow is discharged directly into a normal clean receiving stream, at least two predictable phenomena occur as a result of the biological reaction. The dissolved oxygen level of the stream starts to decrease, and the bacterial growth starts to increase, as the natural cleansing process of the stream begins to take place. This is illustrated graphically in Figure 1.

Depending on the relative flows of the waste and receiving streams, BOD loading (the quantity of oxygen utilized in the biochemical oxidation of organic matter in a specified time and at a specified temperature) of the effluent, solids content, etc., this cleaning process may take up to several days and many miles to return the stream quality to its original condition. The effect of BOD pollution is what happens between these two points of clean water, with the sag point of the stream showing the lowest dissolved oxygen level. The dissolved oxygen sag point will normally slightly precede the maximum point of biological growth since the microorganisms will briefly continue to multiply from the momentum of the logarithmic growth stage. Figure 2 illustrates the reduction of BOD from the step discharge of the waste into a stream. The BOD is reduced by the microorganisms, which in turn require dissolved oxygen for their respiration. Therefore, the length of time for a polluted stream to recover naturally is very dependent on the rate at which the oxygen transfer takes place.

The degree of pollution in a given river or stream can be a highly emotional quantity. This may vary from the one extreme of a fisherman who calls a trout stream polluted if he does not catch his limit in an hour, to the offending party who may consider the stream acceptable if its is capable of floating a boat. Regulatory agencies, in recognition of this fact, have very often classified rivers and streams according to their major uses, such as recreation, potable water supply, navigable waterways, etc. As public sentiment and government controls persistently increase, it is safe to say that in the foreseeable future, practically all industry and municipal wastes not presently being treated will require treatment to at least some degree. When the decision, or order, to treat the waste has been made, the next logical step is to determine the best way. The methods available are many, and the best one is dictated by many variables, including the total waste flow, the strength, solids present, land availability, location, flow and classification of the receiving stream, and the degree of treatment required.

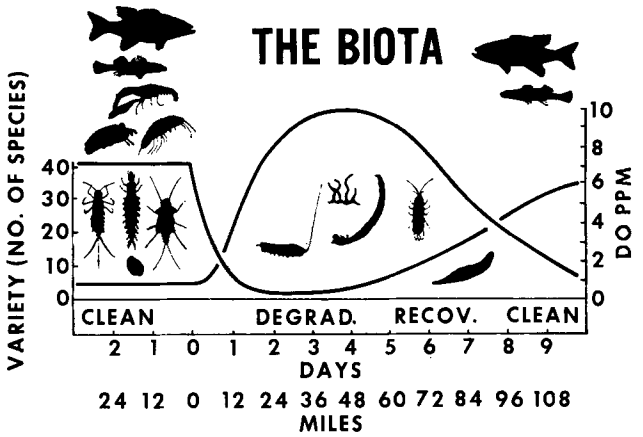

FIG. 1. Graphical representation of biological activity and dissolved oxygen level in a river after a step discharge of biodegradable-waste.

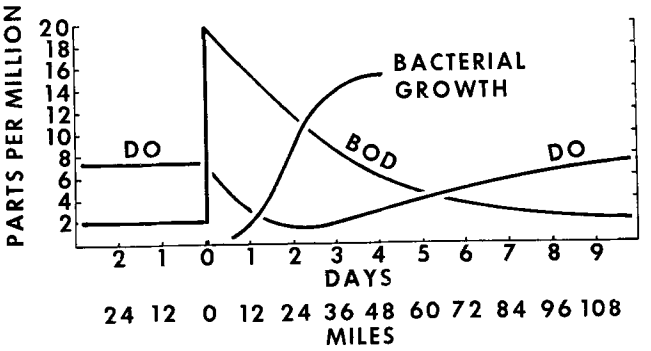

FIG. 2. BOD reduction, etc., as function of time and distance along a river.

The treatment of biodegradable waste is nothing more than isolating, and normally accelerating, the same cleansing action which would occur in a river, thereby minimizing the river activity as a waste treatment plant. Common nomenclature refers to primary treatment as the removal of settleable and floating solids from the raw waste stream, and secondary treatment as the addition of oxygen for the biological reaction. Tertiary treatment may refer to the recovery of solids generated in the aeration chamber, a disinfection stage, or any of a number of other things.

In general terms, the two extremes of sophistication for treating biodegradable wastes are an activated sludge system at the highest level, and a stabilization pond as the simplest. Activated sludge type systems handle the highest concentrations of BOD and microorganisms, and require the least volume or detention time, a typical range would be 3 to 8 hr. A clarifier is required to remove the microorganisms and recirculate a portion of them back to the aeration basin to maintain a high solids concentration. This system, while it has relatively high efficiencies and requires the least land area, is more costly and more sensitive to upsets in the form of variations of the influent composition.

Where unlimited space is available and odor is no problem, almost any degree of treatment can be obtained with

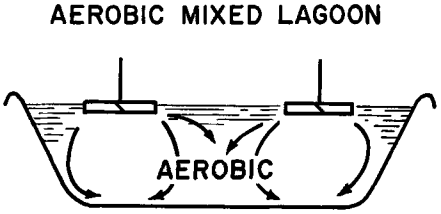

FIG. 3. A completely mixed aerobic lagoon.