is that oxygen is only slightly soluble in water despite its abundance in the atmosphere. In pure water, only about eight parts of oxygen may be dissolved in a million parts of water at typical summer temperatures. If this low initial concentration is decreased by much more than about 60 percent, the aquatic environment may be affected. Under conditions of complete oxygen depletion, fish cannot live and anaerobic decomposition may occur.

In view of these undesirable effects, it is necessary for the regulatory agencies to specify minimum dissolved oxygen requirements for a given stream. Unfortunately, the minimum dissolved oxygen requirements set by many States are somewhat higher than authoritative aquatic biology research indicates is necessary.

Unfortunately for the protection of aquatic life, the treatment of pulp and paper mill wastes for the removal of suspended matter does not produce a proportionate reduction in the BOD of these effluents. This is because 65 to 80 percent of the BOD is in a dissolved state and is unaffected by removal of suspended solid materials. Chemical and physical techniques, such as ion exchange, dialysis, and electrical methods to remove the BOD fraction, have been tried and found either economically unfeasible or mechanically impractical. Research conducted by the National Council and others in this field has indicated that the use of biological treatment methods is the most promising method for disposition of the BOD content of these wastes.

Biological treatment may be of two general types—aerobic and anaerobic. Anaerobic digestion is decomposition of organic matter in the absence of free oxygen. In the aerobic treatment processes, bacterial and other micro-organisms oxidize the organic matter in the presence of dissolved oxygen. Oxygen is supplied to these aerobic treatment systems through either natural means, as in some oxidation lagoons, or mechanically in activated sludge plants and aerated stabilization basins and trickling filters.

One of the simpler forms of aerobic treatment is the oxidation lagoon, where the wastes are stored while biological action reduces the BOD. In the Southern United States, substantial BOD removals are being obtained in storage periods as short as a few weeks. The factors affecting the efficiency of this process, such as depth, detention time, temperature, and nutrient addition, were extensively studied by the National Council at Louisiana State University. These studies showed that the detention time to accomplish BOD reduction is greatly decreased if the oxygen transfer from the atmosphere is accelerated by mechanical means. There is a growing tendency, therefore, to diffuse air into lagoon systems. Various techniques are used for this, including recirculation over concrete steps, diffused compressed air, or mechanical aerators which agitate the surface of the lagoon, thus enhancing oxygen solution from the atmosphere. With this supplemental aeration, it is possible to obtain a substantial BOD reduction with 5 to 7 days' storage under summer conditions.

Where large land areas are not available, and a rapid BOD removal method is required, attention of the pulp and paper industry has been focused on the trickling filter and activated sludge processes. In the former method, the wastes are sprayed on beds of stones or another filter medium, on which biological growth are developed. The pas-