The waste disposal problems of the pulp and paper industry are many and diverse. Different mills produce different wastes, and the characteristics of the receiving waters vary substantially in assimilative capability depending on hydrology and other natural conditions, usage and regulatory control. Thus, in a narrow sense, each situation constitutes a different problem. Through the years, however, an overall and broader concept of the basic problems has emerged. Under this concept, numerous individual problems are susceptible of categorization and solution under the following classifications:

(1) Stream analysis and reoxygenation of rivers.
(2) Suspended solids removal, dewatering, and disposal.
(3) Aquatic biology.
(4) Treatment of wastes for biochemical oxygen demand, (BOD) reduction.
(5) Decolorization of wastes.

The progress which has been made through industry research in each of these areas is summarized below.

*(1) Stream analysis and reoxygenation of rivers*

The pulp and paper industry was the first to employ stream analysis techniques on a wide scale, for formally analyzing the effects of effluents on receiving waters and for predicting the degree of treatment required to meet given water quality requirements. Through a national council project, begun at Manhattan College and continuing to this time at the University of Michigan, not only was effective use made of existing methods of analysis, but improved techniques were developed. For instance, in addition to forecasting the dissolved oxygen sag curve resulting from the discharge of organic wastes, storage requirements, and discharge schedules can now be prescheduled for locations where runoff is highly seasonal and mill effluent must be impounded for long periods. Such forecasts are of vital importance as existing mills expand in size and new mills must be built in locations exhibiting extreme seasonal fluctuation inflow, especially when there may be extended low flow periods.

The stream analysis techniques developed are widely used for establishing waste impoundment and release schedules. Several large impoundments of this type are used where it is necessary to regulate waste discharge to wide changes in waste assimilation capacity caused by natural variation in runoff and dissolved oxygen content or by peaking operation of hydroelectric power stations.

The basic fact of river reoxygenation is that replenishing of oxygen-depleted water by absorption of oxygen from the air is relatively slow. Restoration of dissolved oxygen removed by wastes through the decomposition of organic matter occurs only through adsorption from the atmosphere. The rate at which it occurs only depends upon many physical characteristics of the stream such as depth, surface area, temperature, rate of flow, and turbulence. For many years, the national council has been prominent in evaluating and seeking means by which the rates of reoxygenation could be enhanced in sections of streams where critical conditions occur.

Mr. DADDARIO. Mr. Knowlton, do you have any examples to show how this has worked out? Have you any successes as a result of reoxygenation work?