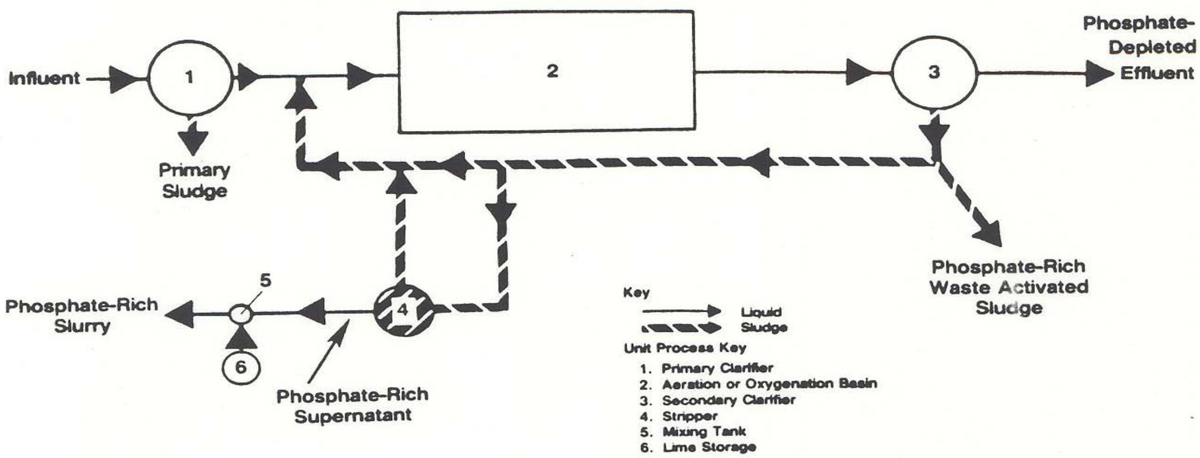
PhoStrip System Offers Low Cost Removal Of Chesapeake Bay Phosphorus

Standard PhoStrip® Process Flow Diagram



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Phosphorus removal has been generally accepted as an important means of controlling excessive growth of aquatic vegetation in the Chesapeake Bay. With last December's signing of a tri-state agreement to cut nutrients entering the Bay by 40 percent in just over one decade, phosphorous removal from wastewater is receiving mounting attention in all regions of the Chesapeake Bay embayment due to the additional treatment costs that are going to be borne by the taxpayers of Maryland, Virginia, Pennsylvania and the District of Columbia.

Regional Taxpayers Will Share the Tax Burden

Already, complaints about the increased wastewater treatment responsibilities have been made public, including a November 30, 1987 ***Washington Post*** editorial which claimed that Washington, D.C. has taken too much of the burden and expense of nutrient removal, and that it is time that other cities and regions, such as Baltimore and Richmond, increase their support.

Complaints notwithstanding, it will inevitably cost taxpayers more in most areas to have further treatment for phosphorus removal. The cost will vary from region to region depending on phosphorous loadings, effuent standards, and to a considerable extent, with the type of phosphorous removal process used.

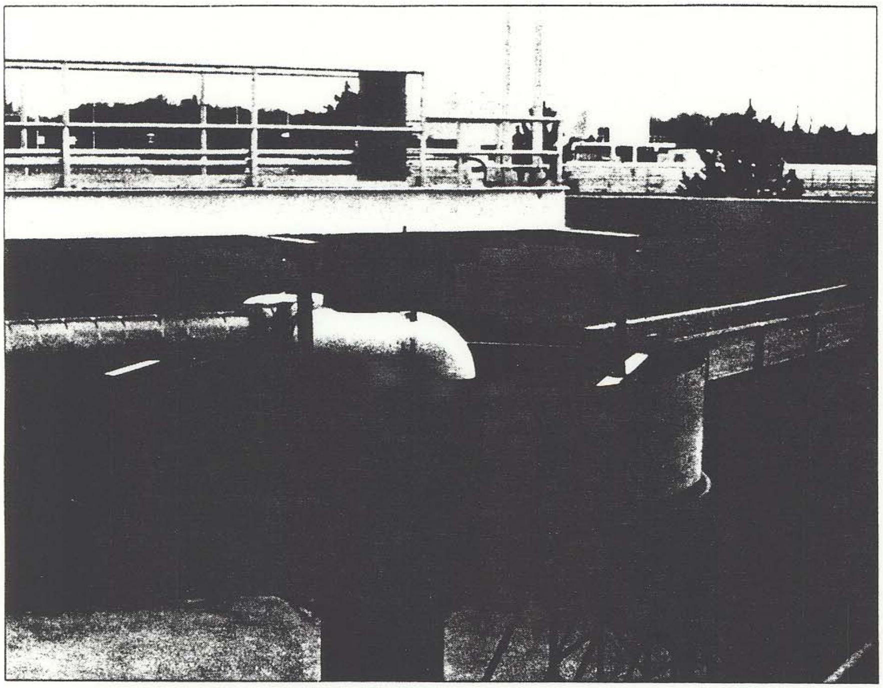
For many years the only means available for phosphorous removal from municipal wastewater was the addition of chemicals to the entire wastewater stream. The dissolved phosphate was precipitated separately or combined with waste biological sludge. All such methods require the application of prodigious amounts of chemicals which are expensive and which also produce large quanities of additional sludge requiring costly removal. This is still the most commonly used method, but an alternative has been receiving growing recognition.

The PhoStrip Method Offers Cost-Cutting Treatment

The PhoStrip process, the original biological removal process, was developed by Levin and Shaheen in 1967 in order to provide a cost-effective alternative to chemical addition.

The PhoStrip process harnesses wastewater activated sludge microorganisms to take up phosphate from aerating mixed liquor and to release it in more concentrated form when the settled sludge is subjected to anaerobic conditioning. Because only the microbal sludge, the agent responsible for taking up and then releasing the phosphate, is subjected to anaerobiosis, the PhoStrip is a "sidestream" process.

A general flow diagram for the PhoStrip process is presented in the figure above. Primary clarifier effluent enroute to the aeration basin is joined with return activated sludge as in the case of normal activated sludge treatment. However, a portion of the return activated sludge is routed through the stripper tank where it undergoes anaerobic detention. During the anaerobic detention period, the sludge releases dissolved phosphate which is carried away in the supernatant from the stripper tank. Typically, the supernatant is dosed with lime, subjected to a brief mixing period and pumped back to the primary clarifier where the precipitated phosphate settles. The subnatant sludge from the stripper tank is conveyed to meet the direct return activated sludge,



A stripper tank operates as a gravity thickener.

and both join the primary clarifier effluent in discharging into the aeration basin. After a period of conditioning in the anaerobic/aerobic cycle administerd by the PhoStrip process, enzymatic activity is induced in the microorganisms which enables them to absorb essentially all of the dissolved phosphate in the mixed liquor during the aeration period. The mixed liquor flows to the secondary clarifier where the sludge settles leaving a low-phosphate supernantant for discharge or further treatment. Activated sludge normally wasted from the subnatant stream of the secondary clarifier is now rich in intracellular phosphate.

Thus, the PhoStrip process provides two sinks for phosphorous removal:

1. The precipitation of phosphate from the stripper tank supernatant.
2. The wasting of phosphorous-rich activated sludge from the secondary clarifier.

About two-thirds of the phosphorous removed from wastewater is precipitated from the stripper tank supernatant. Lime is the precipitant of choice because of its very high efficiency under the supernatant conditions of high phosphate concentration and small flow volume. The remaining third of the phosphorous is removed with the waste biological sludge.

The PhoStrip process is compatible with all forms of activated sludge treatment, and it has been operated with mixed liquor suspended solids ranging from 600 mg/L to 5,000 mg/L and with aeration retention times ranging from one to 10 hours. Successful operating experience includes, but is not limited to: influent BOD values ranging from 70 mg/L to 300 mg/L; influent phosphorous concentration ranging from 3 mg/L to 20 mg/L; wastewater temperature ranging from 5° to 30°C; and secondary clarifier NO_2/NO_3-N concentration ranging from 1 mg/L to 30 mg/L. Any F/M ratio or P/BOD ratio suitable for the activated sludge process will also permit fully efficient operation of the PhoStrip process. Under each set of the above conditions, the process has produced an effuent containing an average of 1.0 mg/L or less total P, the effluent standard generally enforced when phosphorous removal is required.

Vast Reduction In Treatment Cost For Chemicals

Because the PhoStrip process is chiefly biological in nature, the quanity of chemicals required is substantially less. With only a small supernatant stream in which to precipitate phosphorous, only a fraction of the chemicals is required for the PhoStrip process compared with the requirement of fullstream chemical addition. Likewise, the quanity of waste chemical sludge requiring disposal is greatly reduced. Overall, there is approximately a 50 to 70 percent cost savings through the use of the PhoStrip and lime process, versus the use of alum dosed to the full wastewater stream. With these cost savings over chemical addition, the capital cost for the PhoStrip process would be returned in only a few years.

Although the PhoStrip process is established in virtually every region of the continental U.S. and is starting in Europe, only one plant, located in Howard County (Maryland) is presently using the PhoStrip process in the Chesapeake Bay region. Almost invariably, other plants are still using costly chemical addition. Habits die hard and long established methods of wastewater treatment are difficult to dislodge, even with the promise of substantial cost savings. However, through first-hand PhoStrip success at the Howard County facility, pilot plant demonstrations and more than 20 years of successful operation, the tide of favorable opinion is turning in the PhoStrip favor. Increased use of the PhoStrip process could lead to lower utility costs and improved water quality for the entire Bay region.