INTRODUCTION

Eutrophication is commonly known as the state of a waterbody which is manifested by an intense proliferation of algae and higher aquatic plants and their accumulation in excessive quantities.\(^1\) Eutrophication can be most efficiently fought by reducing the input of aquatic plant nutrients, mainly nitrogen and phosphorus, to surface waters. Therefore, policies to reduce the phosphate (P) input from several sources have been implemented worldwide.

Over the last decade emphasis has been placed on phosphate removal from point sources of nutrients such as municipal and industrial sewage. However, current practice has not been sufficient to reduce eutrophication to acceptable levels, so it is likely that stricter
policies will be adopted in the future. In recent years, growing attention has been paid to diffuse nutrient sources such as surface runoff from urban and agricultural areas, atmospheric precipitation and regeneration of sediments. Methods have been developed that lead to recovery in a concentrated form, suitable for re-use, thus reducing the need for disposal of sludge as well as the phosphorus input to the environment.

Since virtually all methods for P-removal are implemented as a third step in conventional wastewater treatment processes, these are described first. Then the different phosphate removal methods are presented from a technological point of view. Finally, the phosphate removal by precipitation of calcium phosphate in a fluidized bed as a modern method for the recovery of phosphate from waste streams is discussed in more detail.

PHOSPHATE REMOVAL IN WASTEWATER TREATMENT PLANTS

Primary And Secondary Waste Water Treatment

Conventional treatment of domestic wastewater usually consists of the so-called primary and secondary treatment, as illustrated in Figure 1. In the primary treatment a portion of the suspended solids and organic matter is removed from the wastewater through physical unit operations such as screening and sedimentation. Secondary treatment is directed mainly towards the removal of organic material and additional suspended solids through a combination of physical unit operations (e.g., sedimentation) and biological processes (e.g., activated sludge and fixed-media filter processes). The biological solids from the primary as well as from the secondary treatment are further treated for reuse, disposal or incineration. The purified water may be disinfected with chlorine prior to discharge to a receiving watercourse. Tertiary treatment is sometimes applied to remove nutrients, toxic compounds, organic material or suspended solids.

Industrial wastewater is often treated by the same methods as domestic wastewater, e.g., for the food industry (e.g., dairy industry, potato processing) and for the manure processing industry. Sometimes the domestic and industrial wastes are treated together in a single municipal treatment plant. In these cases, the P-load to the water is often substantially increased. So the treatment process must be designed accordingly.