

Phosphorus Removal from Wastewater

A PRIMER

During conventional treatment (BOD removal), some amount of phosphorus is removed from the wastestream and converted to bacterial mass. Generally not nearly enough to meet permit conditions.

Two methods of enhanced phosphorus removal are available to wastewater treatment facilities: biological and chemical. Phosphorus can be chemically removed using a number of compounds. Even so, it is often necessary to filter the effluent to remove the insoluble, particulate phosphorus in order to achieve very low effluent phosphorus limits.

BIOLOGICAL PHOSPHORUS REMOVAL. The environmental conditions which provide for enhanced biological phosphorus removal are: initially, a period of anaerobic treatment (zero oxygen), followed by aerobic treatment.

Anaerobic bacteria create certain chemical compounds – volatile fatty acids (VFAs) – that stimulate other bacteria to take up large amounts of phosphorus during conventional aerobic treatment. The phosphorus is removed with the bacteria as waste sludge.

It is generally possible to attain effluent phosphorus concentrations of less than 0.5 mg/L using biological phosphorus removal. But, only when effluent suspended solids concentrations are very low. This, because a 10 mg/L TSS effluent contains approximately 0.5 mg/L of “suspended” phosphorus.

Since anaerobic conditions followed by aerobic conditions promote biological phosphorus removal, any of the following will promote phosphorus removal: adding septic tank pump-out waste into the aeration tank, returning anaerobically treated sludge (RAS or WAS) into the wastestream, or creating a pre-anaerobic zone for the wastewater to pass through.

CHEMICAL PHOSPHORUS REMOVAL. Chemical phosphorus removal is accomplished by the coagulation and precipitation of phosphorus. Three categories of chemicals are commonly used for phosphorus removal: iron compounds, aluminum compounds, and lime.

Iron salts. Iron is commercially available in three forms: ferric chloride, ferrous chloride, and ferrous sulfate. All are corrosive and, as such, pose a safety hazard.

Aluminum salts. Aluminum is commercially available in five forms. Aluminum sulfate (alum) and poly-aluminum chloride (PAC) are the most common. Also available are aluminum chloride, aluminum chlorohydrate, and sodium aluminate.

Lime. Wastewater treatment plants can, but generally do not, use lime. Lime dosage is more influenced by alkalinity than phosphorus concentration; the pH must be raised to 10.5 for phosphorus removal to occur. The amount of lime required is approximately 1.5 times the alkalinity concentration in mg/L. Lime must be “slaked” – put into solution – to be of use.

