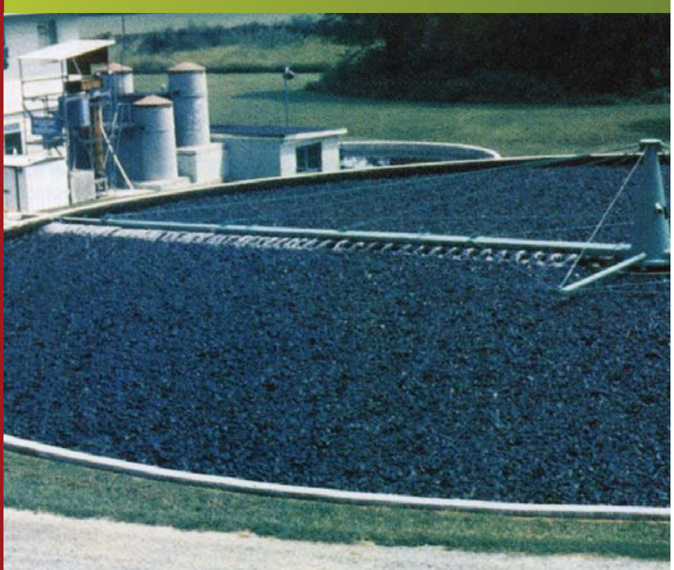
NUTRIENT REMOVAL

Wastewater treatment systems have traditionally been subject to specific effluent discharge limits for BOD, suspended solids, and fecal coliform, as well as other conventional pollutants. For many years these parameters defined the technologies used and level of treatment provided at wastewater plants.

The treatment of nutrients—phosphorus and nitrogen—is necessary when they create environmental or public health threats in the plant's receiving waters. Phosphorus can over-fertilize lakes and other impounded waters, contributing to algal blooms, poor water quality, and oxygen depletion due to algal die-off. Nitrogen is a concern as either ammonia or nitrate, but ammonia is generally a greater environmental threat as an oxygen-depleting substance or a toxin to aquatic life.



Today, nutrient removal is more the rule than the exception. Phosphorus impacts are seen in a wide variety of receiving water types, including streams and rivers, and ammonia discharges can be too great for a receiving water to assimilate without incidents of toxicity or oxygen depletion.

The good news for treatment plant owners facing the need to install nutrient removal is that the activated sludge process designed to reduce BOD and suspended solids is effective—with slight modifications—for phosphorus and ammonia removal as well. Both nutrients can be removed biologically, and together if necessary.

Chemical treatment is an effective alternative for phosphorus removal, particularly in trickling filters, but the chemicals increase the volume of waste sludge that must be handled and treated. Not so with biological phosphorus removal ("Bio-P"), which is achieved by installing unaerated, mixed tanks ahead of the aeration and settling tanks of an activated sludge system. Called "anoxic" or "anaerobic" tanks or zones, these tanks alter the microbial make-up of the process so that it possesses a high phosphorus uptake rate upon entering the aeration tank.

Ammonia reduction is achieved by a process called nitrification. In an oversized aeration tank with greater oxygen supply, specific microbes proliferate that convert ammonia to nitrate. Because these nitrifiers grow at slower rates than carbonaceous-BOD-reducing microbes, the larger tank volume allows them to stay in the system longer before they are wasted to sludge processing.

The two processes—Bio-P and nitrification—can be done simultaneously with the added benefit of nitrate removal. Total nitrogen removal is achieved in this case, which is important when nitrogen in any form degrades water quality in the receiving stream.

Like any treatment process, certain precautions must be observed. For example, nitrified sludge can possess poor settling characteristics, rising in clumps in final clarifiers. Nitrification depletes alkalinity, which can be a problem for low-alkalinity waters. Bio-P is inhibited by the presence of nitrates. But these concerns and others can be resolved with careful design and operation of the processes.

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Think Big. Go Beyond.

If you have any questions on the information provided in this handout or additional questions concerning wastewater, contact Jason Benson, PE at 763-463-5036 (Minneapolis), Shawn Gaddie, PE at 701-746-8087 (Grand Forks), Russell Sorenson, PE at 701-221-0530 (Bismarck), Eric Dodds, PE at 218-299-5610 (Fargo/Moorhead), or Nate Weisenburger at 406-268-0626 (Great Falls).