Ammonia and Phosphorus Recovery Process (Ammonia+ Recovery)

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ABSTRACT

One of the major concerns regarding municipal wastewater treatment plant discharge is the rising concentration of nutrient compounds, specifically nitrogen and phosphorus. There are two possible approaches for reducing nutrients in wastewaters: (1) Nutrient Recovery; and (2) Nutrient Destruction. Biological removal of ammonia is generally achieved by combining anoxic and aerobic treatment systems.

There is a need for simultaneous recovery of both nitrogen and phosphorus from wastewaters. PRD Tech, Inc. has developed a process that can simultaneously, but independently recover nitrogen and phosphorus from wastewater. The process involves the following steps:

1. Precipitation of phosphorus as Calcium Phosphate by using Calcium Hydroxide and advanced settling techniques; this produces a solid Calcium Phosphate plus organic matter product;
2. Addition of Calcium Hydroxide raises the pH, which converts the ammonium to dissolved ammonia gas; this gas is recovered using a membrane process that can produce ammonia-water (19 wt% ammonia), ammonium salt, such as ammonium sulfate or ammonium nitrate or ammonium chloride; The membrane process uses a proprietary module to degas the dissolved ammonia gas from the wastewater.

Digested sludge filtrate from a typical municipal plant has the following range of nutrient concentrations:10-300 mg/L of ortho-P; and 500-800 mg/L of ammonium nitrogen. Nitrification costs can be calculated as follows: 4.6 lbs of oxygen consumed per lb of N removed; 1.1-1.94 lbs of oxygen needed per kWh (fine pore aeration); and electricity costs $0.10-$0.15/kWh, resulting in $0.51 - $1.34/lb N removed by nitrification. Methanol cost for denitrification is $0.50/lb NO_3-N removed. Since 0.45 lbs of ammonia are removed per lb of P during nitrification, cost of P removal by nitrification ranges from $0.34-$0.59/lb P removed.

For the Nutrient Recovery process, cost of Calcium Hydroxide is $300/dry ton, and the required lime consumption (mg $Ca(OH)_2$/L) is approximately 1.5 times the total alkalinity (as mg $CaCO_3$/L). Cost of calcium hydroxide will be $0.75/lb P removed for 1,000 mg/L alkalinity. However, although nitrification can only remove a fraction of P present in the wastewater, A+RU process can remove P at over 95% efficiency and N at over 98% efficiency.

The cost of coagulant, calcium hydroxide and acid can be paid from sales of the fertilizer products (calcium phosphate + organic solids and ammonium sulfate) resulting in a net positive cash flow. Economic comparison with conventional nitrogen destruction approaches which includes nitrification and denitrification, has shown that there are significant investment and operating cost savings with the Nutrient Recovery process.