Modular Waste Water Treatment System For Ammonia using ENPAR's Patented AmmEl Technology

Case Histories

Background

The AmmEl system is a two-stage water treatment process for the removal of ammonia from industrial and municipal water including wastewater, storm water and sewage effluent. The first stage of the process can consists of one of two proven approaches for the removal of ammonium from the waste stream; 1) Ion-Exchange and 2) Strip & Scrub units. The second stage involves treatment of the Stage I ammonia concentrate using an electrochemical reactor that converts ammonium to environmentally friendly nitrogen gas (N_2).

Some of the advantages of the technology over conventional systems are:

- Operates independent of temperature
- Treats water with high suspended solids and limited organic compounds
- Relatively small footprint
- Rapid start-up and shut-down
- Lower capital cost than biosystems of similar capabilities
- Fully automated and remotely monitored

Numerous projects have been conducted by ENPAR to demonstrate the applicability of the AmmEl technology to treat wastewater, storm water and process water produced by industrial and municipal institutions. The following case histories represent a summary of data from selected representative case histories.

Case History 1: Plant Recycle Water, Fort M^{c}Murray, Alta, Canada

The overall objective of this study was to evaluate the effectiveness of the AmmEl system to treat ammonia in plant recycle water associated with an oil sands recovery project. The recycle water provided by the operator was characterized by ammonia concentrations of 13 to 18 mg/L as well as high chloride ion concentrations (750 to 950 mg/L) and 30 to 55 mg/L of oil and grease. The chemical composition of the recycle water and the temperature of the water make treatment by traditional biological methods difficult. In comparison, the AmmEl system has proven to be very effective at treating water of this nature.

The recycle water was delivered to **ENPAR's** laboratory and treated using a pilot-scale unit at a flow rate of 1 L/min without any pre-treatment. A total of three test runs using separate water

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samples were completed, with the test column being regenerated after each run. The objective of each test was to maintain the concentration of ammonia in the effluent from the treatment system at less than 2 mg/L.

Figure 1 summarizes ammonia-N removal as a function of the number of ion-exchange column bed volumes, or in other words the volume of water treated. The results clearly demonstrate that the AmmEl system is extremely effective at removing ammonia-N from the recycle water to less **2 mg/L**.

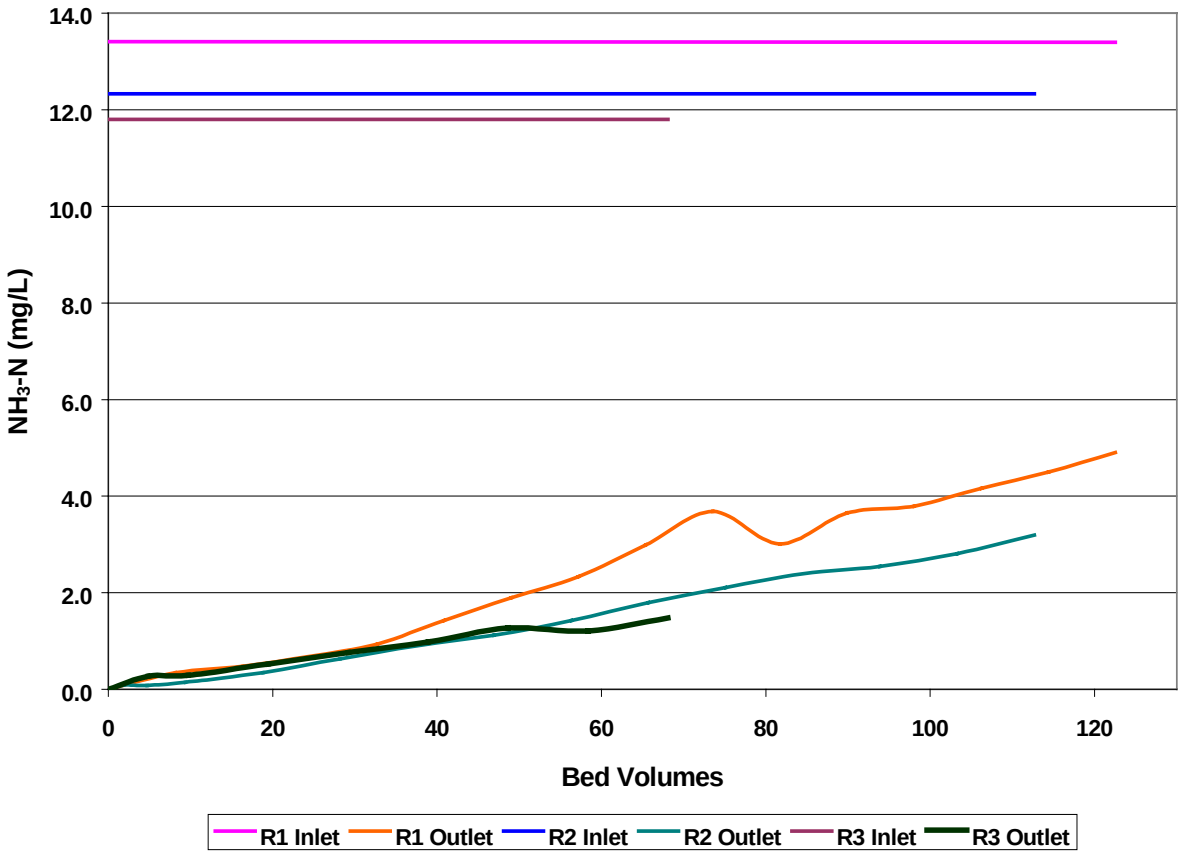

Figure 1: Results of Testing

Electrochemical regeneration of the column was successful with no carry-over or build up of ammonia observed in the column between runs. The presence of particulate matter and oil in the recycle water did not adversely affect performance of the system over the duration of the testing.

The results clearly demonstrate that ENPAR's AmmEl system is a viable alternative for the treatment of ammonia in recycle water characterized with physico-chemical properties not necessarily conducive to treatment using conventional biological approaches.

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Case History 2: City of Guelph Waste Water Treatment Plant

A wastewater stream originating from the sludge de-watering process at the City of Guelph sewage treatment plant (GWWTP) typically averages 30 to 60 mg/L ammonia-N with maximum concentration peaks in the range of 500 to 1000 mg/L. Currently, the waste stream is directed back into the headworks of the wastewater treatment process. The waste stream represents a significant nitrogen load to the wastewater treatment plant and the City of Guelph is exploring options to reduce or eliminate ammonia from this waste stream to help meet future anticipated receiving water quality objectives. The close proximity of the GWWTP and the City of Guelph's keen interest in supporting local industry and the advancement of environmental technology made the GWWTP an excellent site to conduct the demonstration.

The pilot-scale AmmEl system consisted of a total of 3 ion-exchange columns (Figure 2). Two of the columns were operated in series to treat the wastewater with the third column undergoing electrochemical regeneration. The wastewater used in the testing originated from the sludge de-watering process and consisted of ammonia-N concentrations **averaging 700 mg/L.** The wastewater was supplied to the treatment system at flow rates of 2.0 L/min. The treatment system was operated with a recycle loop at flow rates of 14 to 16 L/min. The objective of this component of the overall study was to reduce ammonia-N loading to **<100 mg/L**

Figure 2. AmmEl Test Unit

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An example of the results of the AmmEl pilot-test conducted at the City of Guelph Waste Water Treatment Plant are presented in Figure 3.

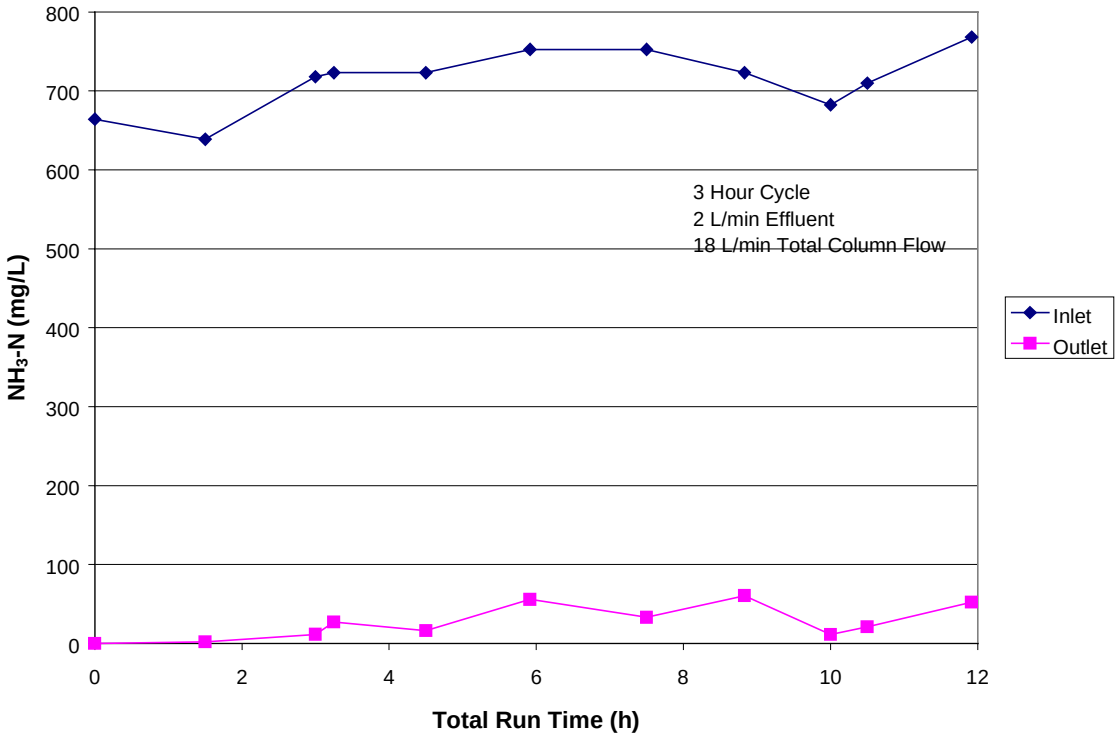

Figure 3: Concentration of ammonia-N in City of Guelph wastewater (typical 12 hour run) before and after treatment using the pilot-scale AmmEl system

In general, the treatment system consistently demonstrated greater than 95% removal of ammonia from wastewater streams containing up to 960 mg/L ammonia-N. Treatment costs for the system depended on the operational parameters of the system and ranged from $1.70 to $2.00/kg of N removed.

Case History 3: Region of Niagara - Garner Road Storm Water Pond

The Region of Niagara manages a detention storage pond of approximately 5,890 m^3 at its Garner Road Biosolids Waste Management Site. The Region is authorized for direct discharge to an access road ditch during the periods March 01 to May 31 and November 01 to December 15th provided the water to be discharged does not exceed a concentration of 3.0 mg NH_3-N /L. The storm pond must be managed to provide rainwater collection from the site and still retain freeboard capacity to contain a spill from the sewage lagoons. Storm water collected in the storm ponds routinely exceeds the discharge limit of 3.0 mg/L of ammonia-N and consequently, storm water must be hauled from the site to maintain a safe working level in the pond.

For a period of eight months, the AmmEl pilot plant was sited at the Garner Road Biosolids Waste Management Site to treat storm water with the objective of reducing the concentration of ammonia to below discharge limits and allow discharge of storm water. An example of the results of the AmmEl pilot-test conducted at the Garner Road Site is presented in Figure 4.

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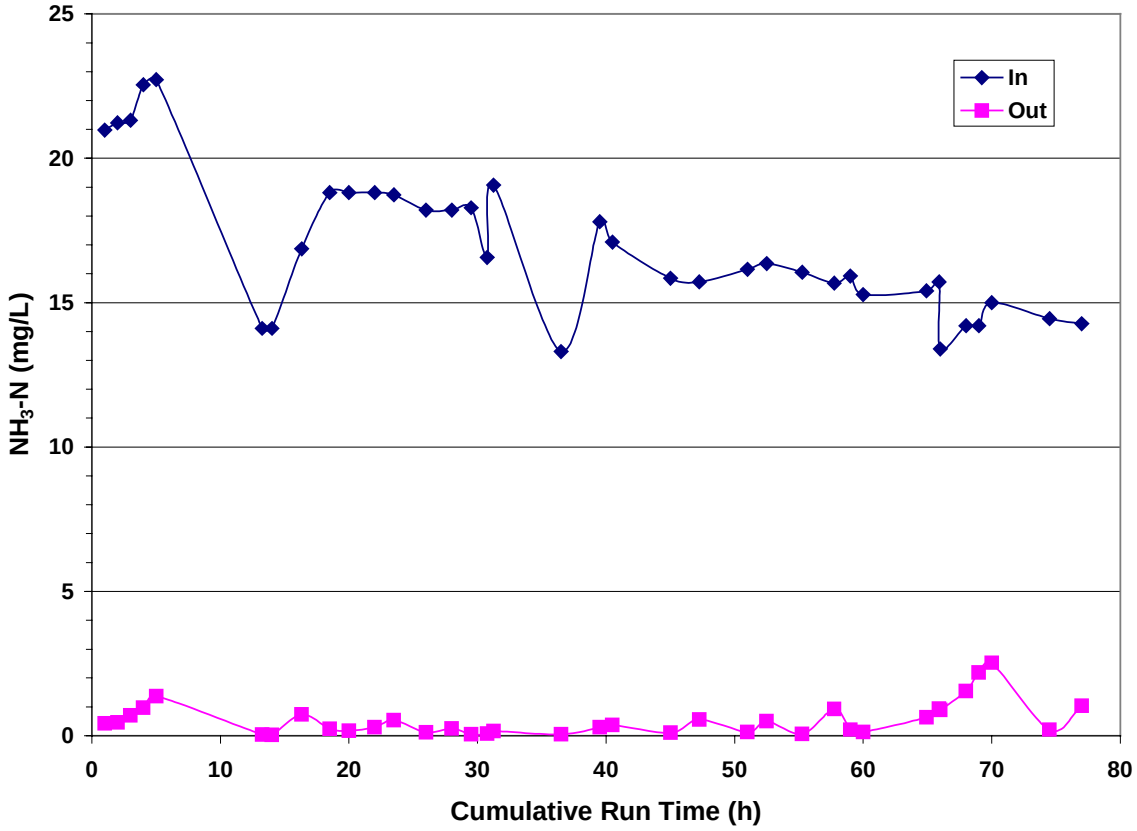

Figure 4: Concentration of NH_3-N (mg/L) in storm water before (IN) and after (OUT) treatment with the AmmEl system.

The concentration of NH_3-N (mg/L) in the input storm water decreasing gradually with time from >20 mg/L to approximately 14 mg/L by the end of the test period (Figure 4). Treatment of the storm water at flow rates of 16 L/min using the AmmEl system reduced the concentration of NH_3-N in the storm water to values <2.6 mg/L with an average value of 0.55 NH_3-N mg/L. Assuming an average value of 17 mg/L for the input stream, this represented a 96% reduction in the total concentration of NH_3-N in the storm water after treatment.

Please note that lower concentrations of ammonia in the treated water can be obtained in all three cases with minor modifications to the above mentioned operations.

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