ELGRESSY
WATER TECHNOLOGIES LTD

Ammonia Removal Treatment

EAR

Thinking outside the box
Developing innovative technologies

What is Ammonia?

- Ammonia is a **chemical** that is made both by nature and by humans.

- The ammonia is a colorless alkaline gas, composed by one part nitrogen (N) and three parts hydrogen (H3) with the formula NH3.

- Ammonia contributes significantly to the nutritional needs of terrestrial organisms by serving as a precursor to food and fertilizers and either directly or indirectly, is also a building block for the synthesis of many pharmaceuticals and is used in many commercial cleaning products.

- The global industrial production of ammonia is ~ 180,000,000 tones a year.

- Although common in nature and in wide use, ammonia is both **caustic** and **hazardous** in its concentrated form. It is classified as an extremely hazardous substance and therefore is **subject to strict reporting requirements** by facilities which produce, store, or use it in significant quantities.

- Ammonia common side effects often manifest in the following; a **pungent odor**, **irritating sensation** to the skin, eyes, nose, throat, and lungs.

Ammonia main uses

Ammonia is essential for many biological processes and has various industrial applications, such as:

- **Fertilizer** - when applied to soil, ammonia helps provide increased yields of crops
- **Cleaner** - household ammonia (NH_3; ammonium hydroxide) is used as a general cleaner for many surfaces, the most common uses is to clean glass, porcelain, ovens and stainless steel.
- **Food industry** - Ammonia is used as a source of nitrogen for microorganisms and to adjust pH during fermentation. Ammonia is also known as "strongly antiseptic" and used to kill *E. coli*.
- **Cowsheds and pigsty** - large quantities of animal waste containing ammonia produced naturally and now treating the wastewater to remove the ammonia so that it is not discharged back into the environment is crucial.
- **Chemical Industry** - as a cleaning and bleaching agent
- **Refrigeration** - because of ammonia's vaporization properties, it is a useful refrigerant widely used in industrial refrigeration applications because of its high energy efficiency and low cost.
- **Textile industry** - liquid ammonia is used for treatment of cotton materials.

The problem

Nowadays, around the world most of the water bodies are polluted and nitrogen compounds in wastewater are an increasing problem.

Ammonia is a great environmental challenge to the modern science and technologies as techniques of ammonia removal applied today are not environmentally safe and so development of technologies is crucial for the human society.

Our solution

- We have found that ammonia can be oxidized electrochemically into nitrogen gas, nitrate, or nitrite by direct or in-direct oxidation processes.
- Different from biological treatment, this process physically converts ammonia in wastewater to nitrogen
- In fact, the process can remove up to 90% of the ammonia in the wastewater.
- The process:
  - The Elgressy ammonia removal system uses unique anodes developed by Elgressy that do not dissolve in the water.
  - When a DC current is passed through the anodes, a reaction occurs and oxygen, ozone, active chlorine, chlorine dioxide and other oxygenation agents are produced.
  - In the area around the cathode a very high PH level is achieved which cause metal ions, ammonium ions and others to sink. The sediments are removed automatically by the system at the end of the process.

- The Elgressy ammonia removal system has the **advantage** of :
  - High treatment efficiency
  - Saving maintenance and operational costs
  - Saving space as only small area occupied by the plant without changing or replacing the plant existing structure
  - Low investment costs
  - Conversion of ammonia into non-toxic gas
  - Prevent bad smell odor
  - Disinfect the water in addition to the ammonia removal
  - Green technology - No chemical injection

Electrochemical reactions

The process described here is aimed to remove the ammonium ions:

Anode: $2Cl^- \rightarrow Cl_{2(g)} + 2e^-$

Cathode: $2H^+ + 2e^- \rightarrow H_2$

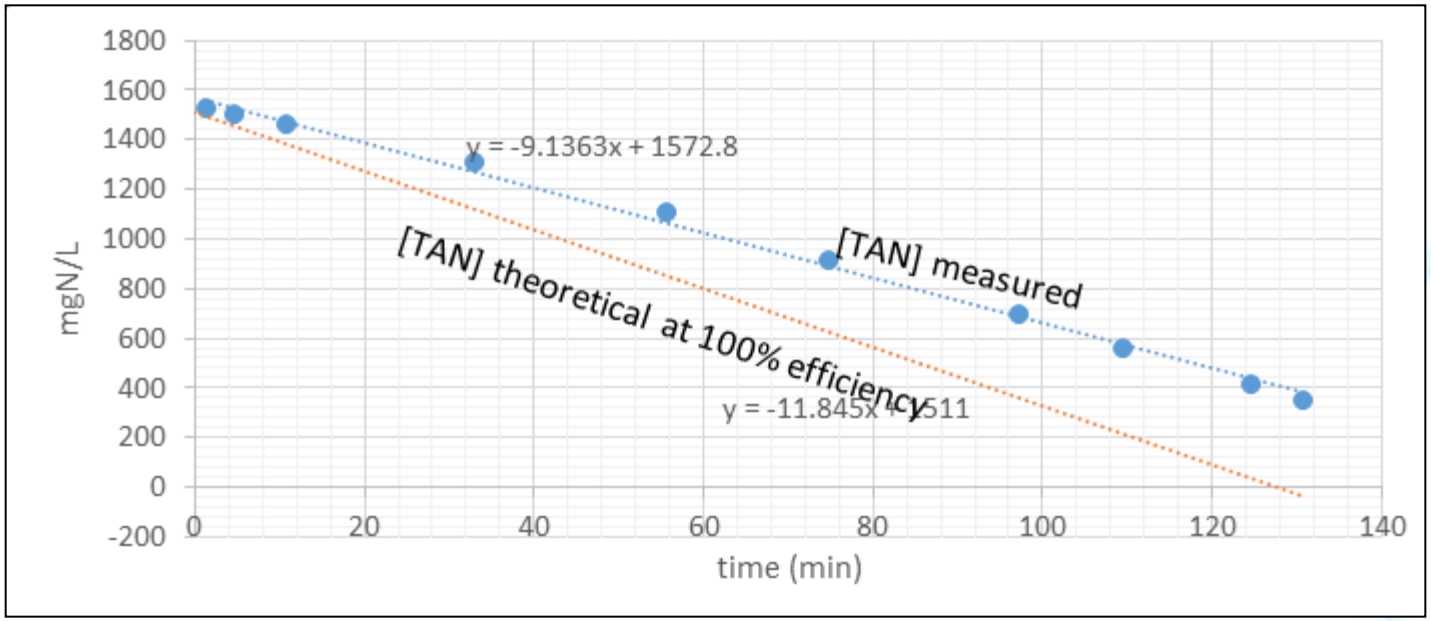
Bulk electrolyte: $Cl_{2(g)} + H_2O \leftrightarrow HOCl + H^+ + Cl^-$

$1.5HOCl + NH_4^+ \rightarrow 0.5\ N_2 + 1.5\ H_2O + 2.5\ H^+ + 1.5Cl^-$

Overall Reaction: $2NH_4^+ \rightarrow N_{2(g)} + 3H_2 + 2H^+$

Results

Figure one shows the change of ammonia concentration with time.



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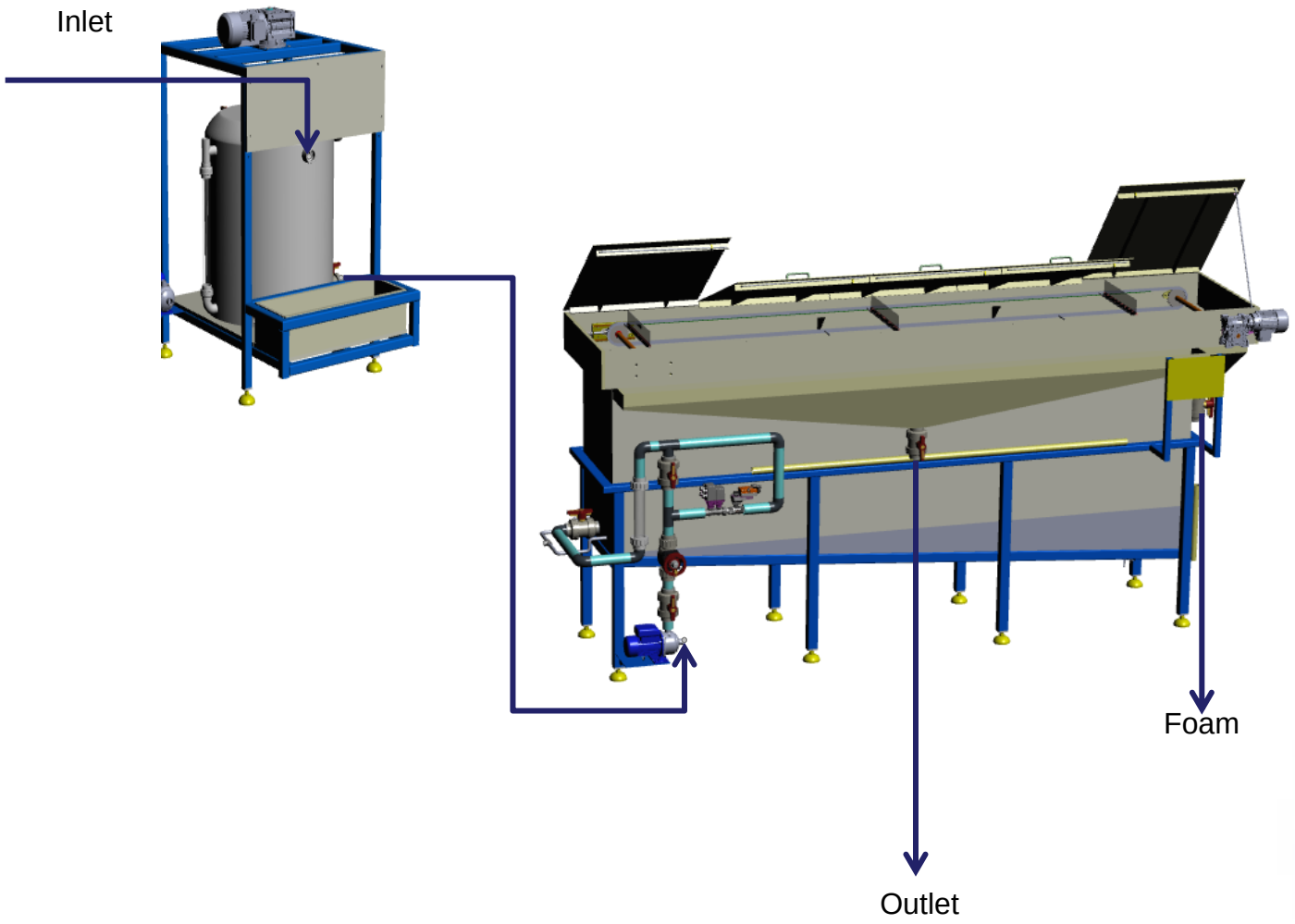
The Ammonia Removal System



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