5800 Amber Drive, Suite 118, Mississauga, ON, Canada L4W 4J4 | T: 905.766.9590 | www.xogen.ca

# Treatment of Ammonia in Landfill Leachate

## by Advanced Electro Oxidation (AEO)

Prepared by: Xogen Technologies Inc.

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# ADVANCED ELECTRO OXIDATION (AEO)

## Effective, Efficient & Reliable Ammonia Destruction

Xogen AEO is a patented process to destroy ammonia fast and effectively to ensure ammonia permit compliance under any conditions. The core benefit of Xogen AEO is that it can give you the confidence to know that you are meeting your regulatory requirements on Ammonia no matter the weather or the condition of the leachate.

## KEY BENEFITS OF Xogen® AEO

- **Remove high concentrations of ammonia**
- **High efficiency removal of ammonia regardless of temperature and pH**
- **Fast start-up, do not need to grow bacteria**
- **High process flexibility, can start and stop the process on-demand**
- **Small footprint and space requirement**
- **Automated system, low operator involvement**

## HOW DOES Xogen® AEO WORK?

Screened wastewater is pumped through Xogen's electrolysis reactor. When the wastewater contacts an electrode in the reactor a direct oxidation of the contaminants occurs on the surface of the electrode as well as the generation of highly oxidizing species including ozone, hydrogen peroxide and hydroxyl radicals. As these highly oxidative species form, they immediately react with organic matter, ammonia compounds and other constituents in the aqueous solution and get converted into a mixture of hydrogen, oxygen, carbon dioxide and nitrogen gas. Suspended solids in the wastewater will precipitate or float to the surface by the micro-bubbles of gas generated while pathogens are completely killed.

# Xogen® AEO COMPARISON

| Treatment Process | Xogen Advanced Electro Oxidation (AEO) | Air Stripping | SBR | MBBR | MBR |
|---|---|---|---|---|---|
| **CAPEX** | Very Low | Low | Medium | High | Very High |
| **Treatment Capacity** | Ammonia<br>COD<br>Organics<br>$H_2S$<br>Sulphide<br>Poly vinyl<br>Phenols<br>E.Coli | Ammonia<br>VOCs<br>$H_2S$ | Ammonia<br>COD<br>Organics | Ammonia<br>COD<br>Organics | Ammonia<br>COD<br>Organics |
| **Space Requirement** | **Very Low** | **Medium** | **High** | **High** | **High** |
| **UV Transmittance Removal** | Yes<br>Up to 65% removal | No | No | No | No |
| **Temperature Sensitivity** | **Not sensitive**<br>Process is still efficient in winter | **Very Sensitive**<br>Process can't work in winter | **Sensitive**<br>Process is much less efficient in winter | **Sensitive**<br>Process is much less efficient in winter | **Sensitive**<br>Process is much less efficient in winter |
| **pH Sensitivity** | **Low sensitivity**<br>Process works in pH 2 to 9 | Very Sensitive<br>Process works in pH > 9 | Sensitive<br>Process works in pH 6 to 8 | Very Sensitive<br>Process works in pH 6 to 8 | Very Sensitive<br>Process works in pH 6 to 8 |
| **Sludge Deposit Management** | No Requirement<br>Process produces no sludge | Low Requirements<br>Process produces chemical sludge | High Requirements<br>Process produces biological sludge | High Requirements<br>Process produces biological sludge | High Requirements<br>Process produces biological sludge |
| **Start-up Speed** | Very Fast<br>Process can start-up in days | Fast<br>Process can start-up in weeks | Slow<br>Need several months to grow the bacteria | Slow<br>Need several months to grow the bacteria | Slow<br>Need several months to grow the bacteria |
| **Process Flexibility** | **Very Flexible**<br>Can start and stop on-demand | Flexible<br>Can start and stop quickly | Low Flexible<br>Can't start and stop on-demand | Low Flexible<br>Can't start and stop on-demand | Low Flexible<br>Can't start and stop on-demand |
| **Possible Ammonia Removal** | Remove up to 99% from 3,000 ppm without temperature and pH control | Can remove up to 85% from 3,000 ppm **with** temperature and pH control | Can remove up to 65% from 1000 ppm **with** temperature and pH control | Can remove up to 80% from 1,500 ppm **with** temperature and pH control | Can remove up to 65% up to 2,500 ppm **with** temperature and pH control |
| **Fouling Management** | High<br>Requires daily backwash to remove fouling on the electrode | Medium<br>Requires cleaning to remove fouling in the stripping tower | Low<br>Requires no cleaning to remove fouling in the reactor | Low<br>Requires no cleaning to remove fouling in the reactor | High<br>Requires daily cleaning to remove fouling on the membranes |

## Xogen® AEO OTHER BENEFITS

| Contaminants | Remove from | Remove to | Removal rate |
|---|---|---|---|
| $H_2S$ | 5 ppm | <0.3 ppm | 94% |
| Sulphide | 4.64 ppm | <0.02 ppm | 99.5% |
| COD | 6033 ppm | 2473 ppm | 59% |
| Poly Vinyl's | 2.2 ppb | <0.5 ppb | 77% |
| Phenols | 0.05 ppm | <0.02 ppm | 60% |
| E. coli | >14,200 N/100 ml | <100 N/100 ml | 99% |

## Xogen® AEO LANDFILL LEACHATE PROJECTS

### **LEEP Landfill** (Montreal, QC, Canada)


**Leachate Characteristics**
Influent Ammonia: 102 ppm
Conductivity: 2.81 mS/cm
Leachate Colour: Yellow

**Process Parameters:**
Flowrate: 6 gpm
HRT: 2.5 min
Effluent Ammonia: 37.7 ppm

**Project Description:**

In July 2018, Xogen operated its AEO technology to remove ammonia and H2S from the raw leachate using its mobile treatment unit. This landfill is located in populated community and faces pressure from the city to address the ammonia problems in its leachate. The system successfully removed $NH_3$ from 102 ppm in the leachate to less than 38 ppm. It also successfully removed H2S from 5 ppm in the leachate to less than 0.2 ppm

## **Volunteer Landfill** (Oneida, TN, USA)

**Leachate Characteristics**
Influent Ammonia: 950 ppm
Conductivity: 19.97 mS/cm
Leachate Colour: Black

**Process Parameters:**
Flowrate: 4 gpm
HRT: 3.7 min
Effluent Ammonia: 450 ppm

### Project Description:

In April 2018, Xogen operated its AEO technology to remove ammonia from pre-treated leachate (Aeration and Air Stripping) using its mobile treatment unit. The landfill has a permit of 45 lb of ammonia per month to discharge its leachate through the sewer main. However, the ammonia loading in the leachate constantly exceeds the permit level, and the landfill must truck the leachate for offsite disposal at a POTW 50 miles away. The system was operated onsite the landfill and successfully removed ammonia from 950 ppm to 450 ppm.

## **Bristol Hill Landfill** (Oswego, NY, USA)

**Leachate Characteristics**
Influent Ammonia: 467 ppm
Conductivity: 25.17 mS/cm
Leachate Colour: Brown

**Process Parameters:**
Flowrate: 1 gpm
HRT: 3.7 min
Effluent Ammonia: 190 ppm

### Project Description:

In 2014, Xogen built a skid-mount treatment unit for Bristol Hill Landfill to remove ammonia from the leachate. The landfill had been experiencing high ammonia concentrations in the leachate since 2007. In 2010, the landfill was directed to reduce ammonia levels to less than 200 mg/l from 500 mg/l. The system was remotely controlled by PLC and allowed for 24/7 monitoring of the system without the presence of an operator. Ammonia destruction was achieved for 3 months under continuous 24/7 operation.