

Electro-Oxidation technology successfully removes NH₃ from landfill leachate in commercial scale pilot

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Commercial Scale Pilot Proves Case

The application of a commercial scale pilot of an Advanced Electro-Oxidation (AEO) treatment technology by Xogen Technologies at a landfill in a major Canadian city showed it could meet target removal of ammonia on economic terms as well as deal with several other substances which were exceeding regulatory limits.

Landfill Leachate: A Challenge for the 21st Century

Landfill leachate treatment is a significant challenge for landfill operators. Traditionally, landfill operators have dealt with leachate in a simple and inexpensive way – discharge to a sewage treatment plant (STP). However, the game is changing rapidly. Many treatment plants are struggling with tighter regulations and more stringent discharge limits. Landfill leachate is becoming a burden to the municipal sewage treatment plant, mainly due to its high ammonia concentrations. Landfill leachate can easily have 30 to 50 times the ammonia concentration than is typically found in domestic sewage.

Many sewage treatment plants have either stopped accepting landfill leachate or required landfills to meet certain discharge limits. That means landfill operators need to pre-treat the leachate before discharging into the municipal sewer.

Air stripping and biological treatment are two main methods used at landfills to reduce ammonia in landfill leachate. However, both methods have significant drawbacks. Air stripping consumes a lot of energy and is very sensitive to pH and temperature. The biological treatment involves complicate treatment processes and is extremely vulnerable to temperature variations.

Landfill operators are searching for new solutions to overcome their leachate challenges. Advanced Electro-Oxidation (AEO), a new treatment technology, is showing the ability to solve this problem. The AEO process uses electricity to produce a large amount of oxidation ions which quickly react with contaminants such as ammonia, hydrogen sulfide, and organics. The process is simple, clean and efficient.

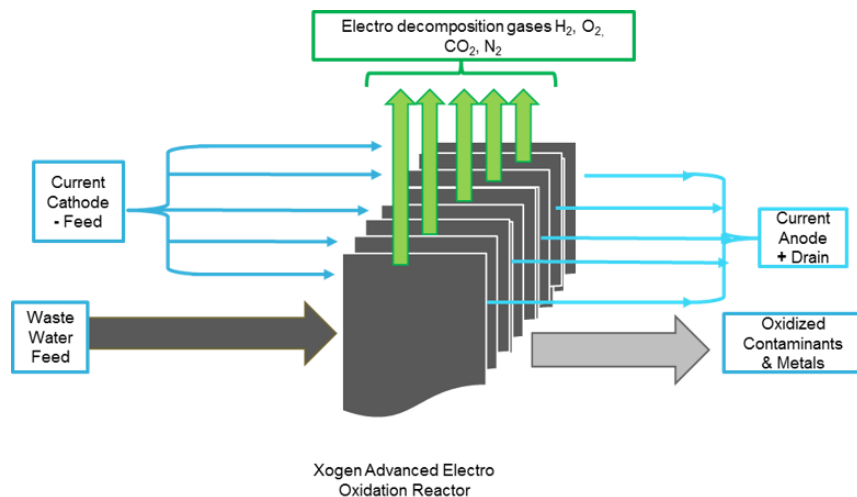


Diagram that shows the principle of electro-oxidation technology

Pilot Target Achievement for Electro-Oxidation System

Xogen Technologies Inc. is the pioneer in the development of Advanced Electro-Oxidation technology. The company has tailored its technology for the treatment of landfill leachate and has achieved many successes recently. The company has installed and tested several electro-oxidation treatment systems in locations including US landfills in New York and Tennessee.

The company recently completed another installation and pilot test project at a landfill located in a Canadian city. The landfill is facing pressure from the city to reduce ammonia (NH₃) concentrations in the leachate prior to discharging in the municipal sewer or risk being cut off from the ability to discharge.

An Xogen AEO system was installed at the landfill site to solve the over-strength ammonia issue. The AEO system was housed in a trailer 20 ft long by 8 ft wide and treated leachate at a rate of 6 gallons per minute (GPM). After a one-month pilot test, results indicate successful removal of ammonia from the leachate to achieve the targeted reduction at close to the projected cost quoted to the client in advance of the test.

Item	Target Value	Achieved Value
Effluent NH ₃	<45 ppm	37 ppm in average
Effluent H ₂ S	<5 ppm	<0.3 ppm
CAPEX	\$633,000 (CAD)	\$670,000 (CAD)
OPEX	\$1.48/m ³ (CAD)	\$1.05~1.85/m ³ (CAD)



The Xogen AEO turnkey treatment system being tested at the landfill site



The Xogen AEO Treatment System, turnkey and fully automated

Results for NH₃ removal

After the treatment, the ammonia level in the leachate dropped from an average 94 ppm to 39 ppm on average against the 45 ppm target. The ammonia level in the leachate reduced based on parameters such as conductivity, hydraulic retention time (HRT) and applied power density. All of these affect the cost of the treatment in terms of both CAPEX and OPEX.

The increase in costs from the initial estimate came because of having to resolve the very low conductivity of the leachate. A commercial unit is the next step and Xogen expects some further reduction in OPEX as commercial volumes are optimized utilizing the three main variants.



The Ammonia removal results

Other Treatment Effects

During the pilot test, the Xogen AEO system also demonstrated beneficial treatment effects on other contaminants such as TKN, H₂S and Total Coliforms, etc. The results are listed in table below.

Contaminants	Before Treatment	After Treatment
BOD (ppm)	26	<3
COD (ppm)	711	546
TKN (ppm)	110	25.3
Sulphide (ppm)	4.64	<0.02
H ₂ S (ppm)	5	<0.3
Phenols (ppm)	0.05	<0.02
Total Coliform (UFC/100ml)	99	<10
pH	7.4	6.94

Estimation of Operating Cost

The operational cost of the Xogen AEO system includes two components: electricity and chemicals. Various chemicals were used to maintain and optimize the treatment process. These chemicals include a highly diluted acid to backwash and remove the scale from electrodes, some defoamer to eliminate the foaming in the leachate, and some salt to increase leachate conductivity. Total operational cost of the pilot was \$1.25~\$1.55 per m³ of leachate treated.

OPEX	Per m³ cost	Per gallon cost
1) Electricity*	\$0.43 ~ 0.50/m ³	\$0.0016 ~ 0.0019/gal
2) Diluted acid	\$0.21 ~ 0.29/m ³	\$0.0008 ~ 0.0011/gal
3) Salt	\$0.13 ~ 0.21/m ³	\$0.0005 ~ 0.0008/gal
4) Defoamer	\$0.48 ~ 0.55/m ³	\$0.0018 ~ 0.0021/gal
Total	\$1.25 ~ 1.55/m³	\$0.0047 ~ 0.0059/gal

* Onsite electricity was \$0.0499/kwh

Conclusion

This pilot test demonstrated the cost-effectiveness of AEO technology to remove NH₃ from the landfill leachate while simultaneously treating other contaminants in the leachate. Xogen AEO technology provides a new and economic solution for landfill operators to manage their leachate treatment issues, enabling compliance to stringent municipal discharge limit.