

Advantages

Unlike biological treatment, this technique has a low sensitivity to concentration variations and it does not produce sludge. It requires only a pH adjustment to degrade the ammonia. The use of the two compartments of the electrochemical cell optimises the power consumption of the process.

Disadvantages

The combined presence of calcium and carbonates promotes the formation of a precipitate on the electrodes, which hinders the degradation process. We must be aware that organic matter may hinder the reduction in the nitrates; if so, it is nonetheless possible to eliminate this interference.

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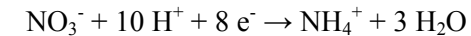


Electro-degradation of toxic nitrate and ammonia ions

Process description

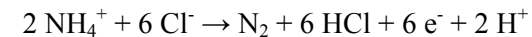
The ELONITA process was initially developed by Laborelec and the Université catholique de Louvain, to eliminate the *nitrate and ammonium ions* present in electrical power plants wastewaters.

On a more practical level, this elimination process takes place in two simultaneous stages. The first stage consists of *reducing nitrate* into *ammonium* ions on the cathodic side of an electrochemical cell:



As it is a batch process, the solution flows through the cell until the nitrate concentration reaches the required threshold. Once this threshold is reached, this solution, which now only contains ammonia, will be processed on the anodic side of the cell (stage 2).

The aim of this *anodic* process is to *oxidise all the ammonium* ions, both those produced in the first stage and those initially present in the wastewater, into harmless *gaseous nitrogen*. This oxidation takes place through the formation of hypochlorous acid, which is responsible for the ammonium oxidation:



The process enables a simultaneous degradation of nitrate and ammonia ions, as a new volume of wastewater can be processed on the cathodic side while stage 2 (oxidation $\text{NH}_4^+ \rightarrow \text{N}_2$) is running. The electrons produced during the process of ammonia oxidation are also used in the nitrates reduction reactions.



The reactions take place in an electro dialysis or filter-press electrochemical cell (figure 2). Figure 1 shows a laboratory installation designed to process about 5 to 10 litres per hour.

The process can be applied to the following cases:

1. Processing of effluent loaded with nitrates: the elimination will necessarily take place in two stages, stage 1 being the ammonia formation;
2. Processing of effluent loaded with nitrates and effluent loaded with ammonia is a two-stage process: the ammonia containing effluent is mixed with the effluent loaded with nitrates after the latter has been treated in the cathodic side of the cell;
3. Processing of effluent loaded only with ammonia: this is a single-stage process in the anodic side of the cell.



Figure 1: Laboratory installation

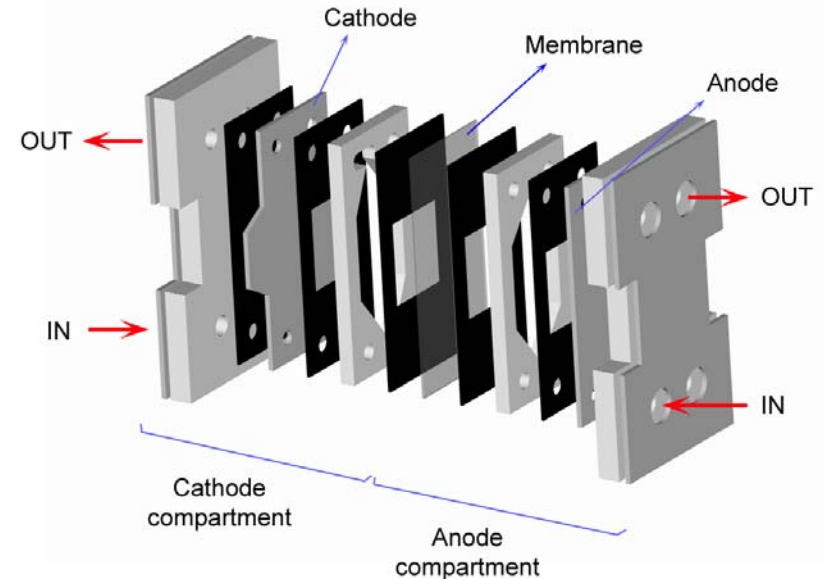


Figure 2: configuration of the electrochemical cell

Performances

The process has already been applied to wastewaters containing up to $1.1\text{g NO}_3^-/\text{l}$ and approximately $1\text{g NH}_4^+/\text{l}$. The degradation rates are $84\text{g NO}_3^-/\text{h/m}^2$ and $62\text{g NH}_3/\text{h/m}^2$ (laboratory tests).

Future

The laboratory tests proved that the process yields acceptable results for eliminating nitrogen pollutants contained in electrical power plant wastewaters. An industrial pilot will soon be built and started up in an electrical power plant to establish the economic viability of the process (LIFE European project, subsidised by the European Commission).

We also plan to test the potential of this technique on other effluents loaded with nitrogen compounds.