

Principle of the ELONITA® process

The ELONITA® 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 (see left reaction on figure 1). The cathode used to perform this reaction is a three-dimensional electrode made of reticulous vitreous carbon (RVC), doped with copper. Three-dimensional electrodes are well suited when treating diluted effluents, and copper is known to favour the transformation $\text{NO}_3^- \rightarrow \text{NH}_3$.

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 (HClO), which is responsible for the ammonium oxidation (see right reaction in figure 1). The anode used in this case is a DSA-Cl₂® electrode, made of titanium covered with a layer of RuO₂, which favours Cl₂ formation instead of O₂ formation. The pH value has to be adjusted between 5 and 7, just to guarantee the formation of HClO, which is most oxidizing than ClO⁻.

An additional step is foreseen before the nitrate reduction. It consists in an oxidation of the organic compounds that are present in the effluent. These organics hinder the nitrate reduction. Oxidizing them limits their interaction with the cathode. The oxidation occurs on the same principle than the oxidation of ammonia (oxidation by hypochlorous acid formation).

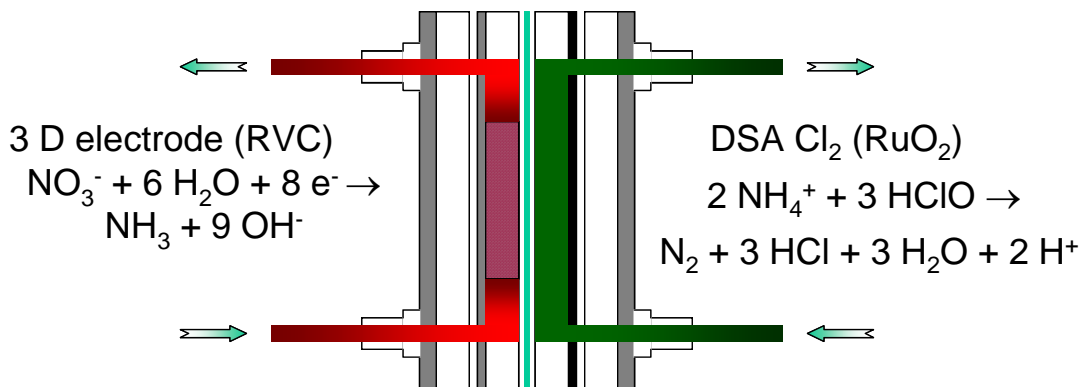


Figure 1: Schematic representation of the reactions taking place in the electrochemical cell

The ELONITA® 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. Because the nitrate reduction step is much longer than the oxidation of organics and oxidation of ammonia, these two latter reactions can both take place in parallel with a nitrate reduction step (see figures 2 and 3).

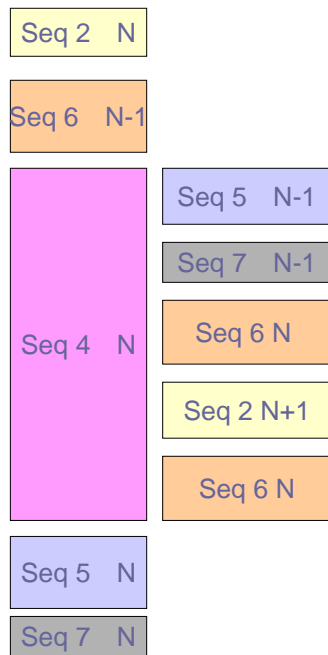


Figure 2: Process description: seq 2= organics oxidation step; seq 4= nitrate reduction step; seq 5= ammonia oxidation step; seq 6= oxidation of a sulfuric acid solution; seq 7= treated effluent discharge

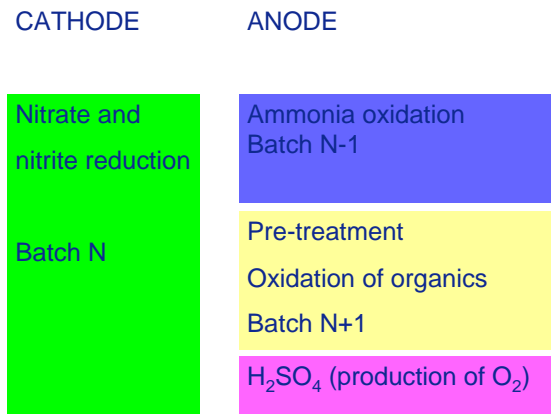


Figure 3: Parallel reactions occurring at the two sides of the electrochemical cell