

The concept of electromembrane technology for reusing of ammonium nitrate-rich waste water in fertilizing production

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PROBLEMATIC

The ammonium nitrate-rich wastewaters are covered under the group nontoxic industrial wastewaters with inorganic contamination. Nowadays they are an unpleasant complication for the big plants, with doesn't have a system for minimization of liquid waste and maximum recirculation of industrial water.

In our case it was necessary to treat the waste water which was produced of the evaporation and concentration of ammonium nitrate solution in the big industrial plant engaged in the manufacture of fertilizers. Pure ammonium nitrate is very good fertilizer with total nitrogen content of 35%. Waste vapor is generated during production process of NH_4NO_3 and its condensate contains pure NH_4NO_3 with small amount of ammonia or nitric acid depending on pH. The ammonium nitrate content in the condensate is up to 10 g/L. It is too high to discharge the solution immediately into the recipient, but it doesn't high enough to use this water again in fertilizers manufacturing process.

THE CONCEPT OF INTEGRATED MEMBRANE TECHNOLOGY

The technology based on electromembrane process – electro dialysis, was offered as the most effective way to solution the problem with problematic waste water. The technology could contain several autonomic parts.

Electrodialysis is a process of solution, containing ions, demineralization by means of constant electrical field and ion-exchange membranes. In constant electric field ions move according to field orientation.

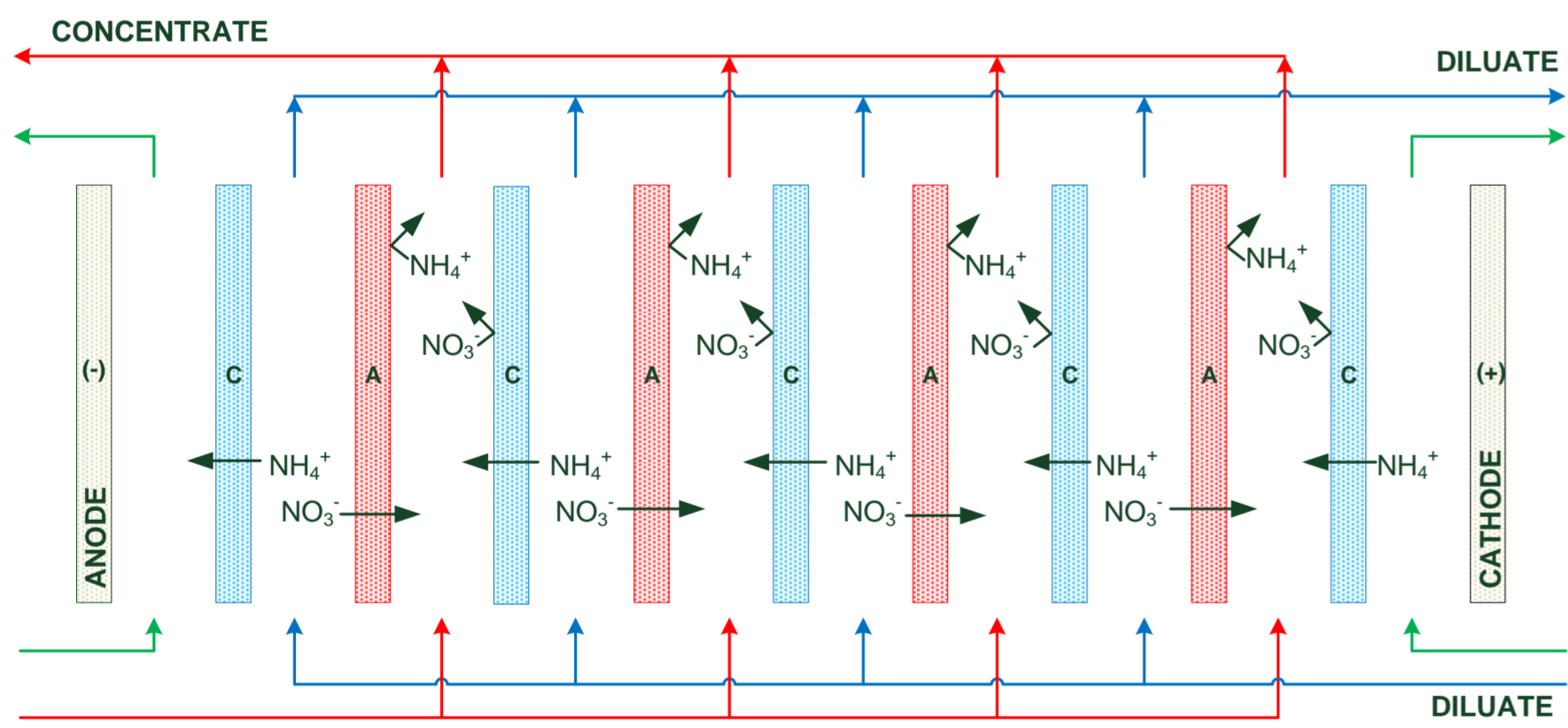


Figure 1: The principal of electro dialysis

Hydraulically, the electro dialyzer consists of three independent circuits. The first circuit washes the electrodes with the electrode solution and leads the electric current to the outside working membranes. The second (diluate) and third (concentrate) circuits flow in an alternating way through the chambers made up from the spacers. Working media (diluate and concentrate) are brought to the membrane chamber through thin distributors fed by main channels fixed on the peripheral frame of the membrane stack. The media are led away from the chamber through distributors on the opposite sides of the chambers to outlet channels similar to the inlet channels. The desalted solution is completely drained away to collecting piping as well as the concentrated solution. All inlets of the solutions are connected through collecting piping to the one side of the electro dialyzer and all outputs are drained away from other side. EDR module is also designed symmetrically for reversal of flow and polarity during process to prevent or decrease the effect of membrane fouling and scaling.

THE RESULTS WERE ACHIEVED WITHIN THE PROJECT OF MEMBRANE INNOVATION CENTRE
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The concept of the technology is based on the fact, that the solution of NH_4NO_3 with the concentration of 10 g/L or even less can be successfully demineralization to a concentration less than 0.5 g/L using electro dialysis. The obtained solution can be dilution with other waste solutions from the production and treated by biological methods or even discharged strait to recipient. Alternatively, it can be used as an input for producing deionized water, using reverse osmosis, electrodeionization, or other desalination methods, and using like the feed water for steam boilers. The concentrate is going to concentrated up to 100 g/L of NH_4NO_3 by the two-stages electro dialysis of the and is reused in the production process of fertilizer.

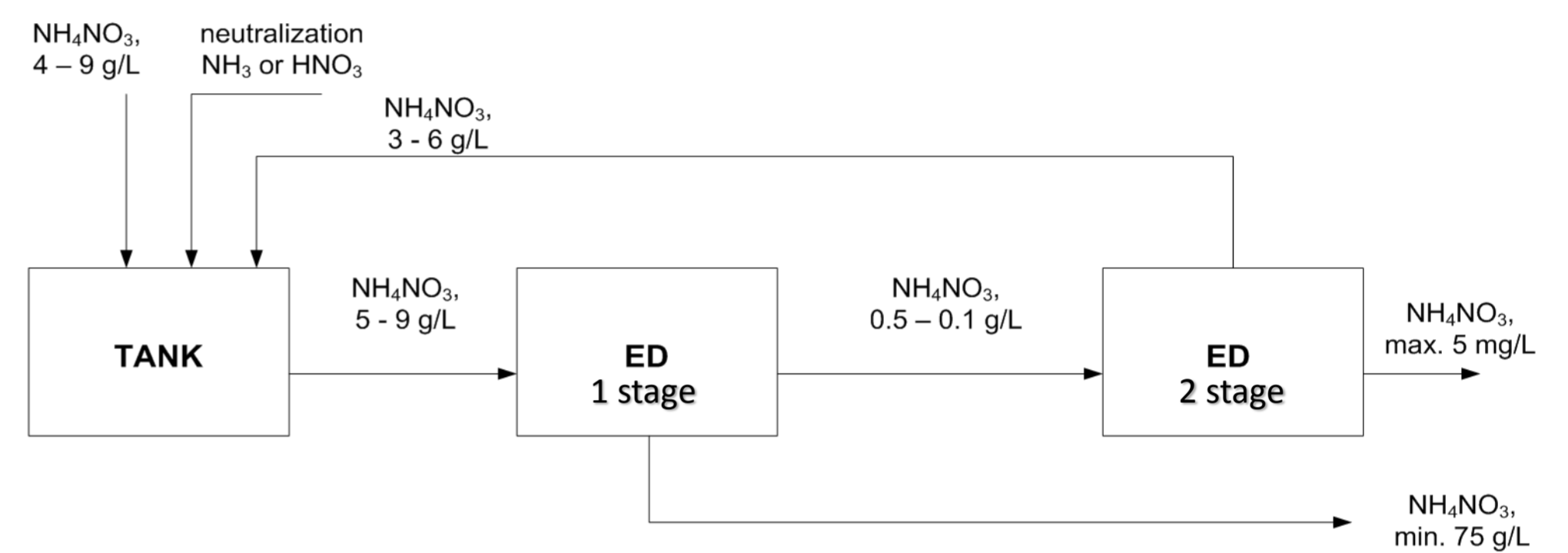


Figure 2: The technological schema

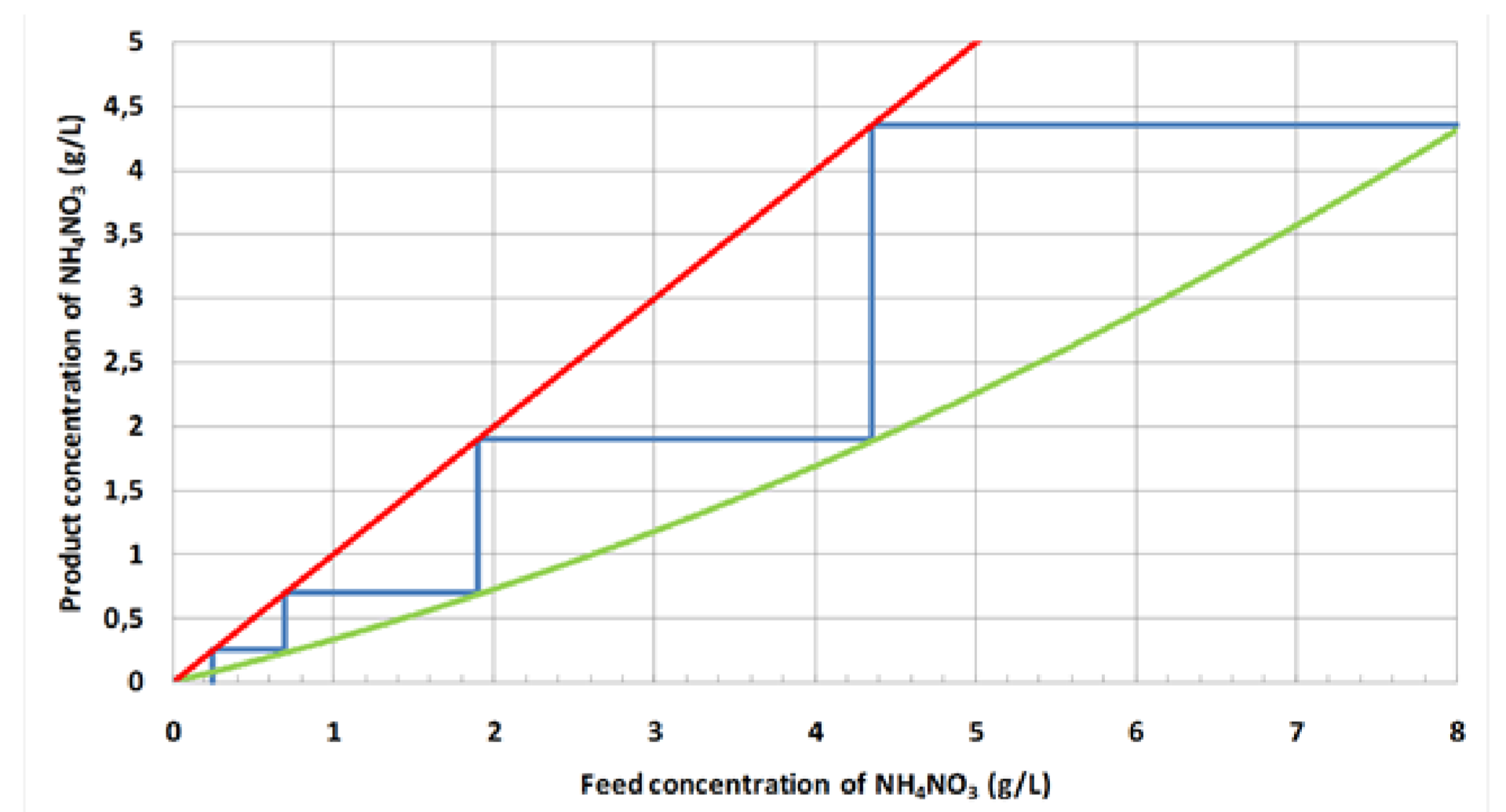


Figure 3: Reduction of NH_4NO_3 from 8 g/L by electro dialysis

CONCLUSION

This technology is present a closed cycle of the technical solution for treatment ammonium nitrate-rich waste water of production of nitrogenous fertilizers, which allow to reuse both pure water and ammonium nitrate concentrate in the production plant. Electro dialysis technology was implemented on a large combine to produce fertilizer. The project meets the current requirements of a modern and progressive technology with minimal impact on the environment and reduce operating costs in waste water treatment. Considerable is also saving on water consumption and minimalizing the nutrients loading of the recipient river system.

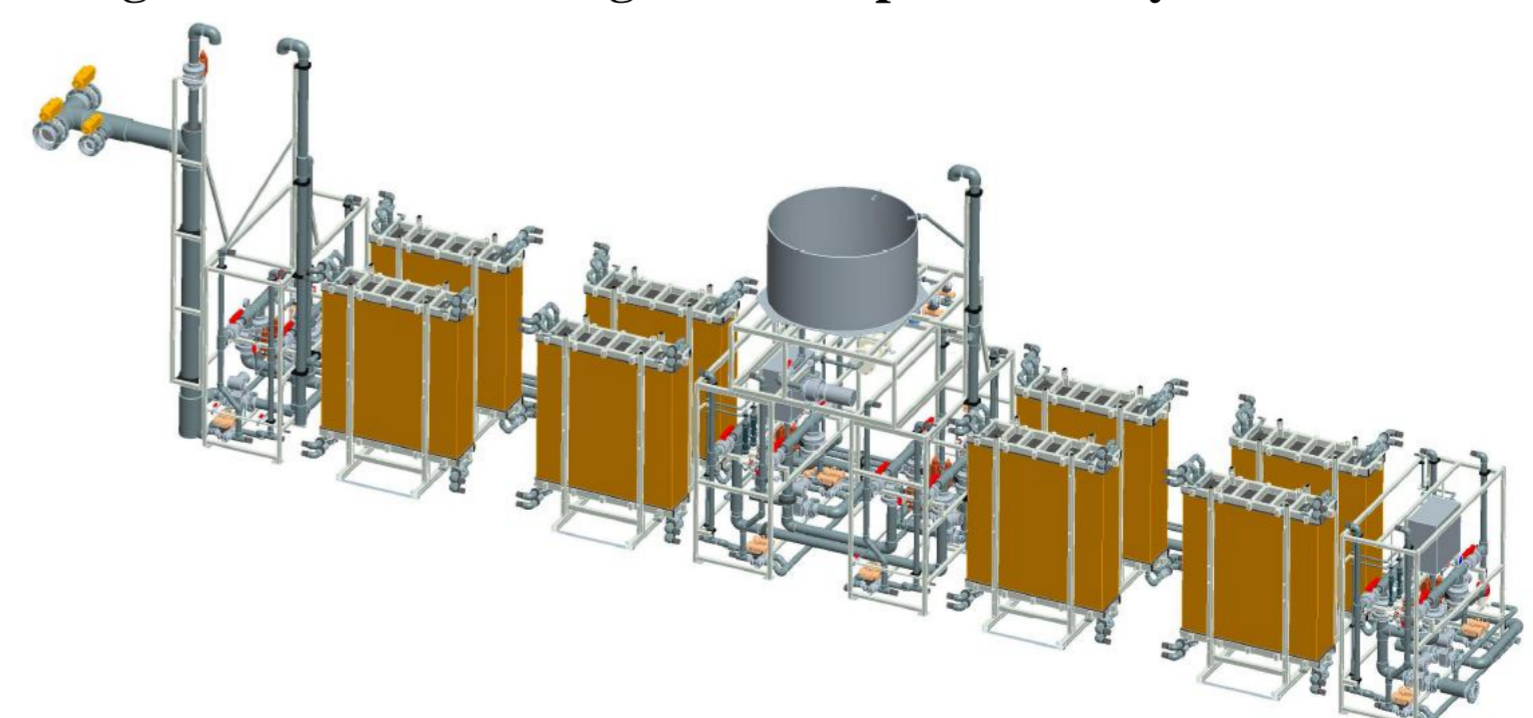


Figure 4: 3D model of EWTU M90 2L/4S EDR-III/600 for industrial use