Evaluation of a Commercial Scale Electrochemical Oxidative System: *Removal of Ammonia, Nitrite, and Nitrate*

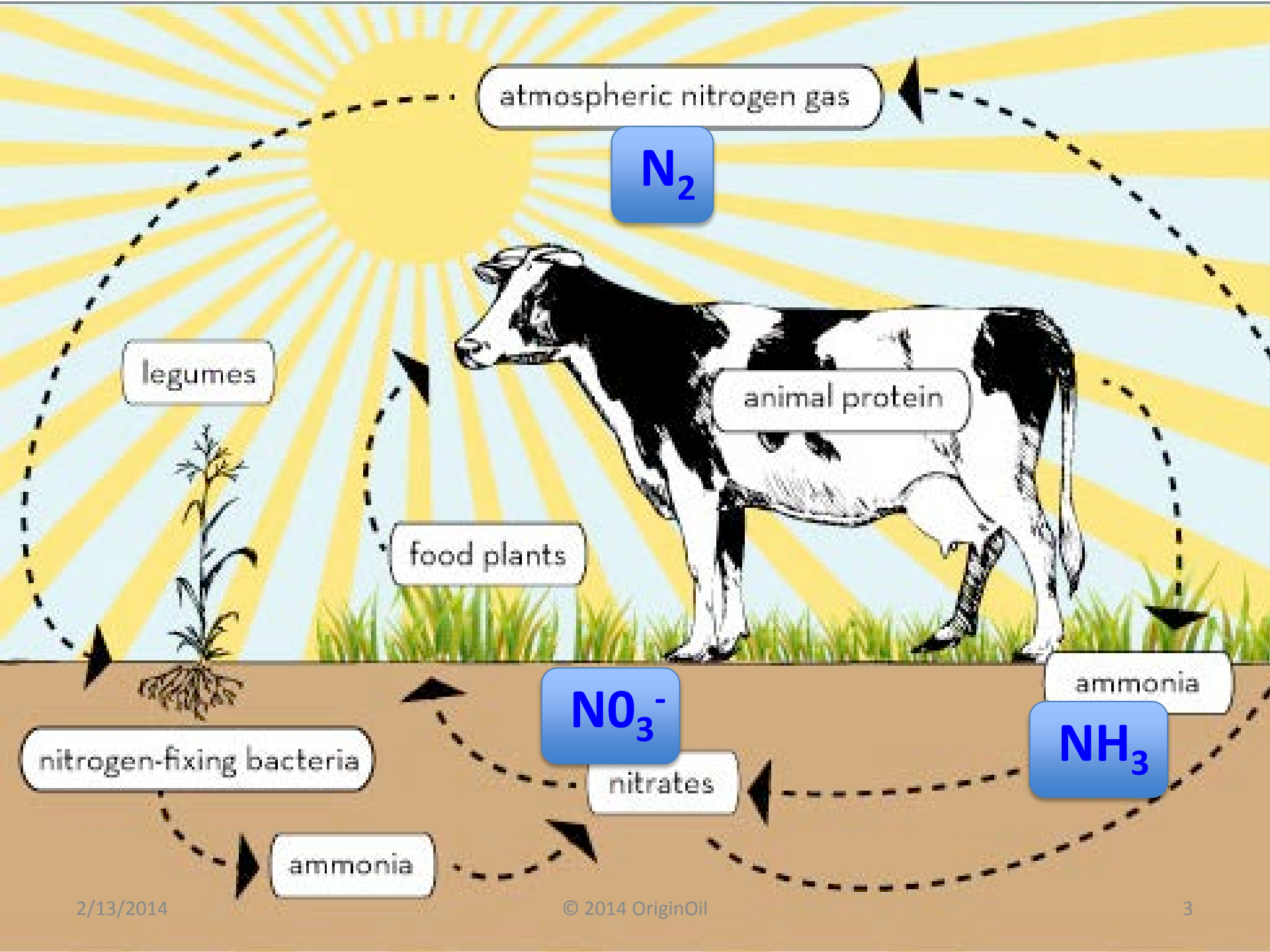
Dave Anderson

Breakthrough water cleanup technology for oil & gas, algae and other water-intensive industries

EWS technology: Electro Water Separation

Three Electrochemical Processes:

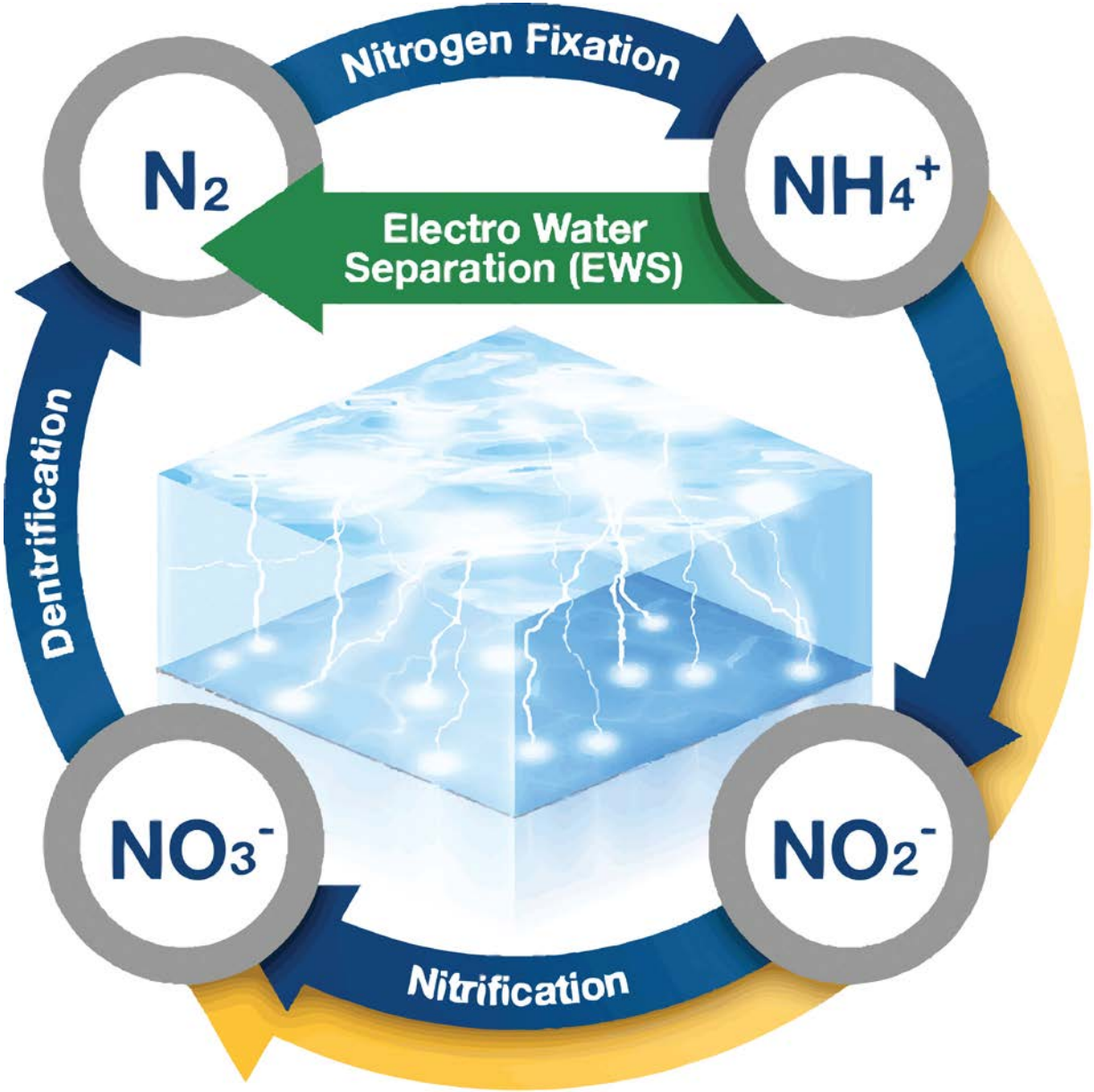
1. **Electrochemical oxidation**
2. Electro-coagulation
3. Electro-floatation



Fritz Haber

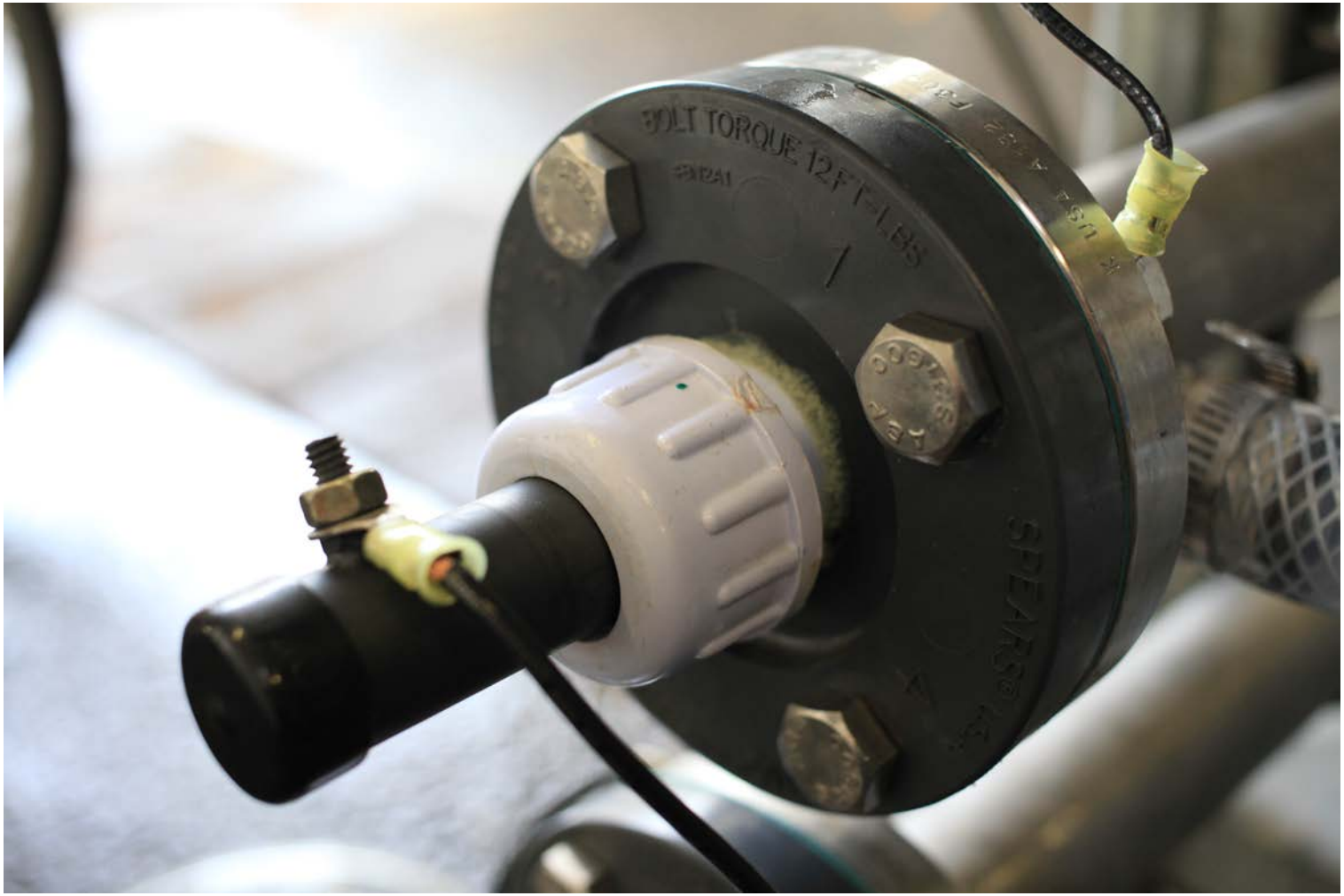
-Nobel Prize Winner, 1918
-Inventor of the Haber Process to create nitrate from atmospheric nitrogen
-Developer of poison gas prior to and during WWI

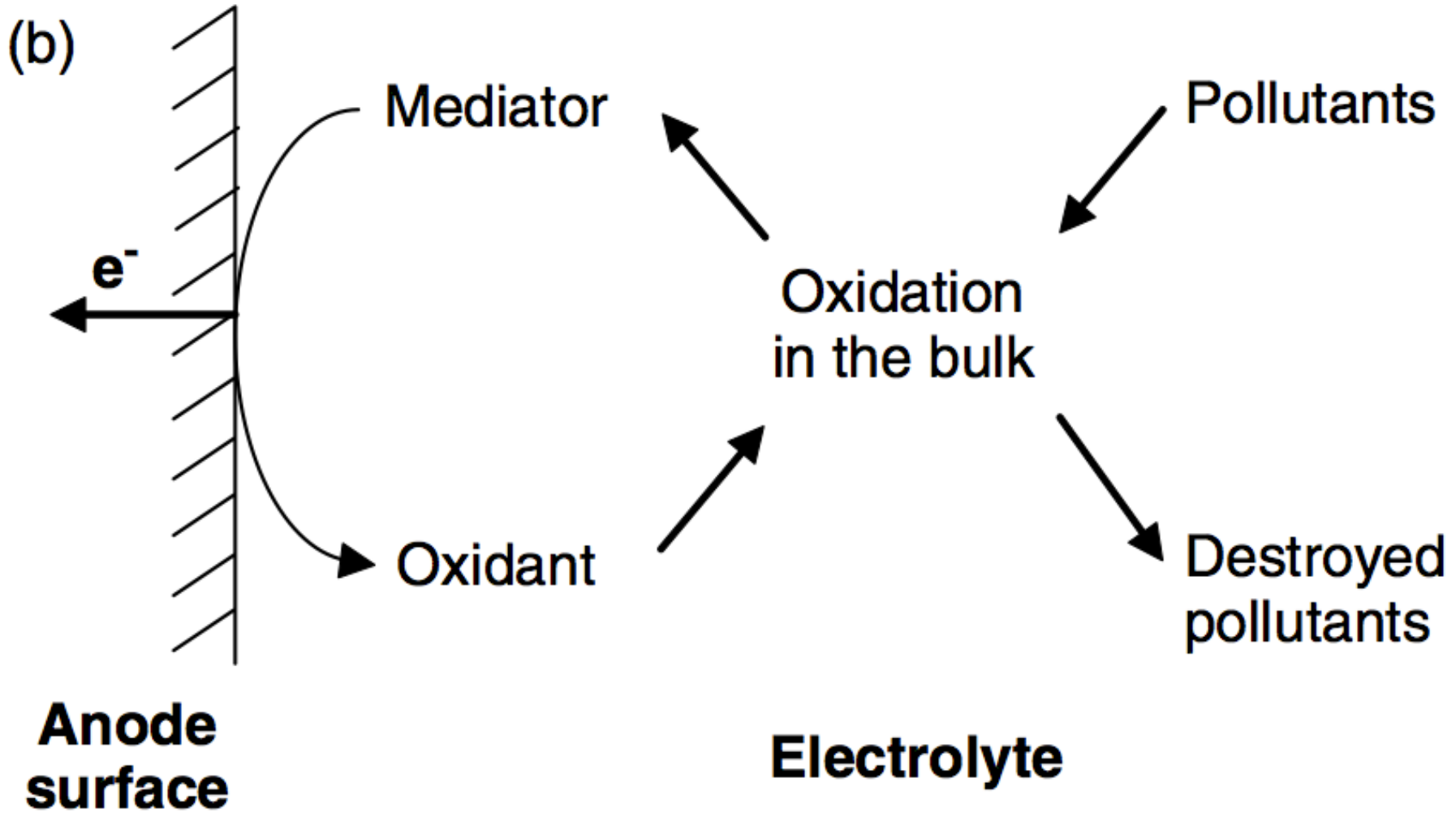
Excess Nitrogen results in Algae Blooms and Dead Zones



EWS Aqua Q60

- Operates at 60 lpm
- Reduces Total Ammonia by 6 ppm
- HRT of 20 min
- Water is filtered and polished after treatment





INDIRECT OXIDATION

Near anode area

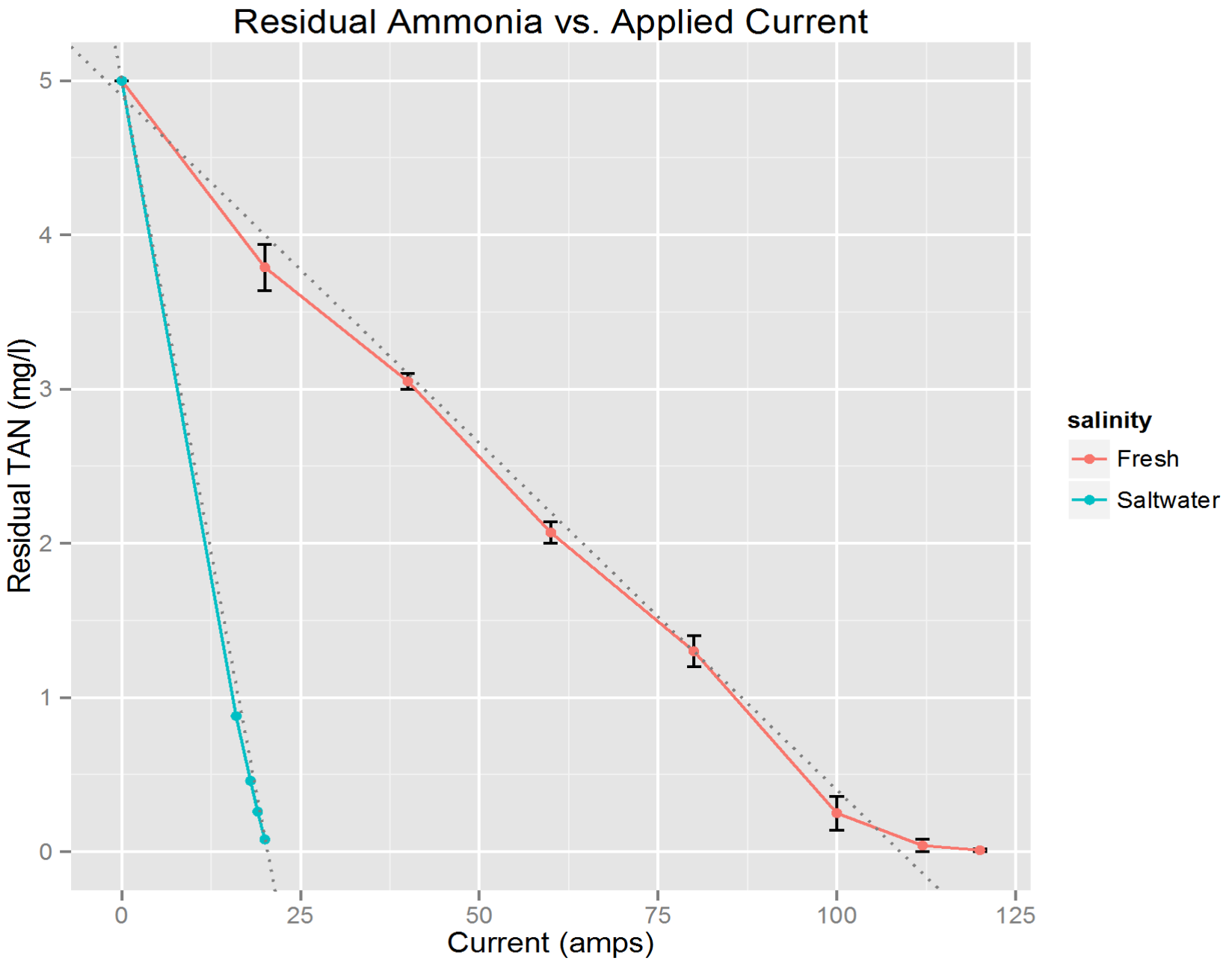
Anode: $2Cl^- \rightarrow Cl_2 + 2e^-$

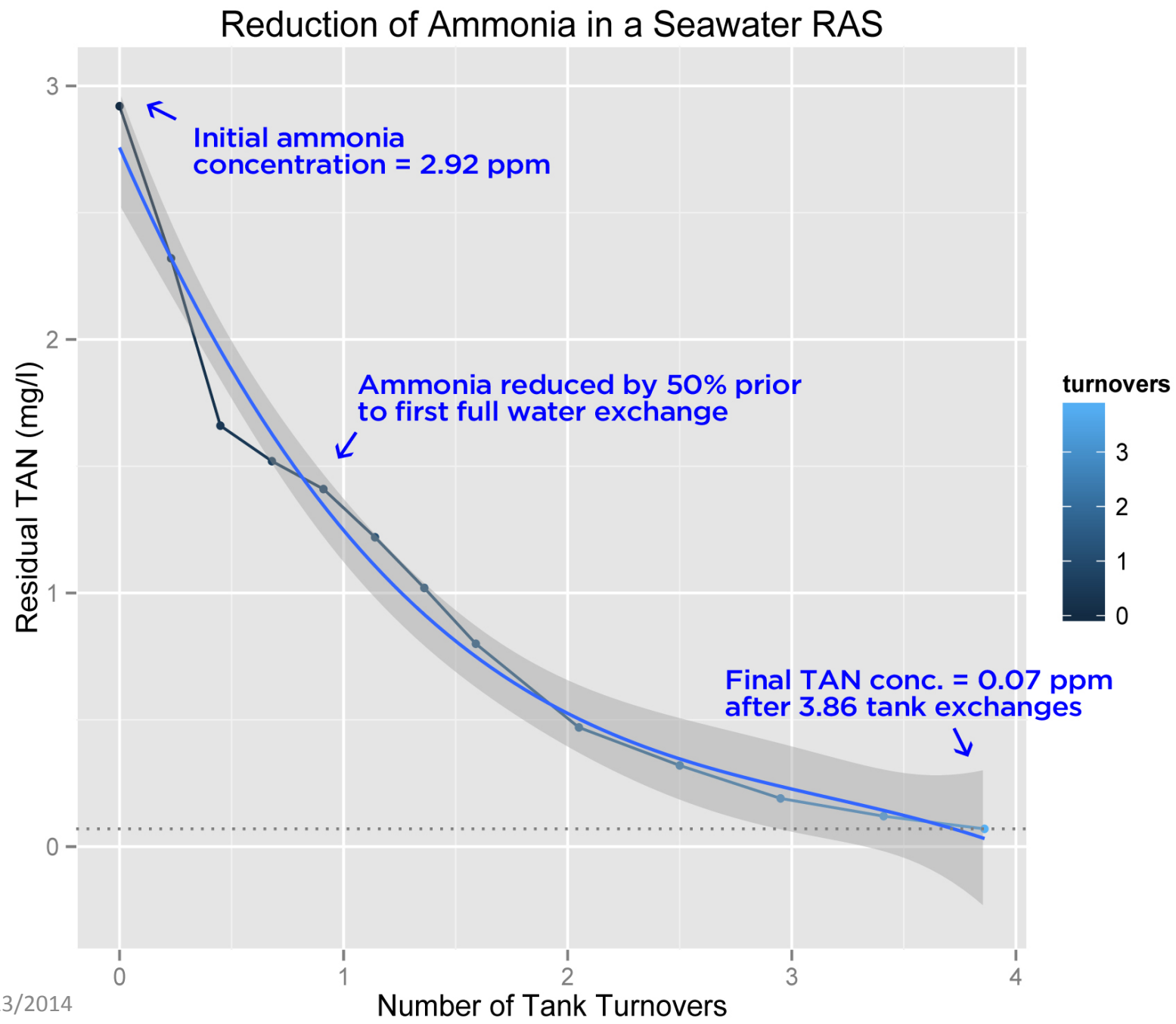
$3Cl_2 + NH_4^+ \rightarrow NCl_3 + 3Cl^- + 4H^+$

Near cathode area

$NCl_3 + NHCl_2 + 3OH^- \rightarrow$

$N_2 + 2OCl^- + 3Cl^- + H_2O$




Reduction of Ammonia in a Seawater RAS
Initial ammonia concentration = 2.92 ppm
Ammonia reduced by 50% prior to first full water exchange
Final TAN conc. = 0.07 ppm after 3.86 tank exchanges
Residual TAN (mg/l)
Number of Tank Turnovers
turnovers
0
1
2
3
4

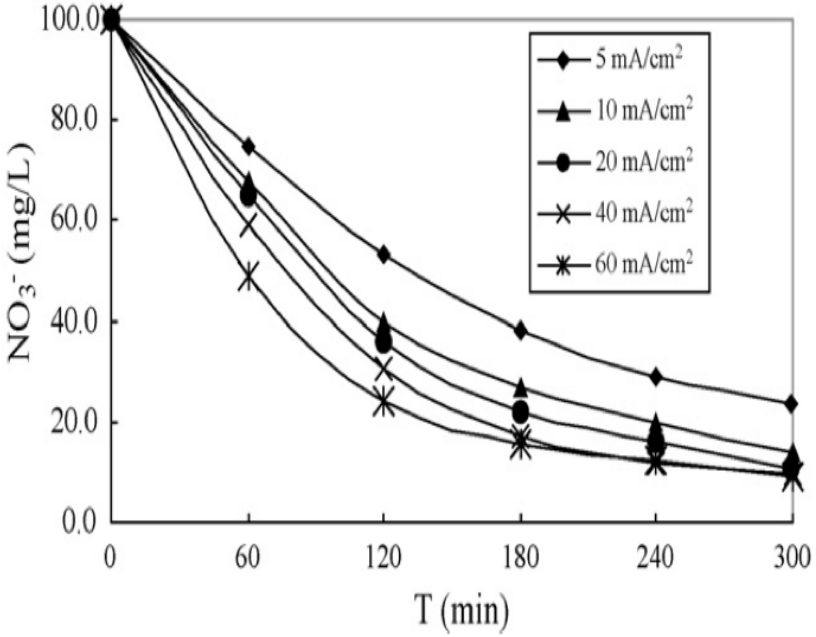


Fig. 5. Nitrate reduction with respect of time at different current density, 0.50 g/L NaCl.

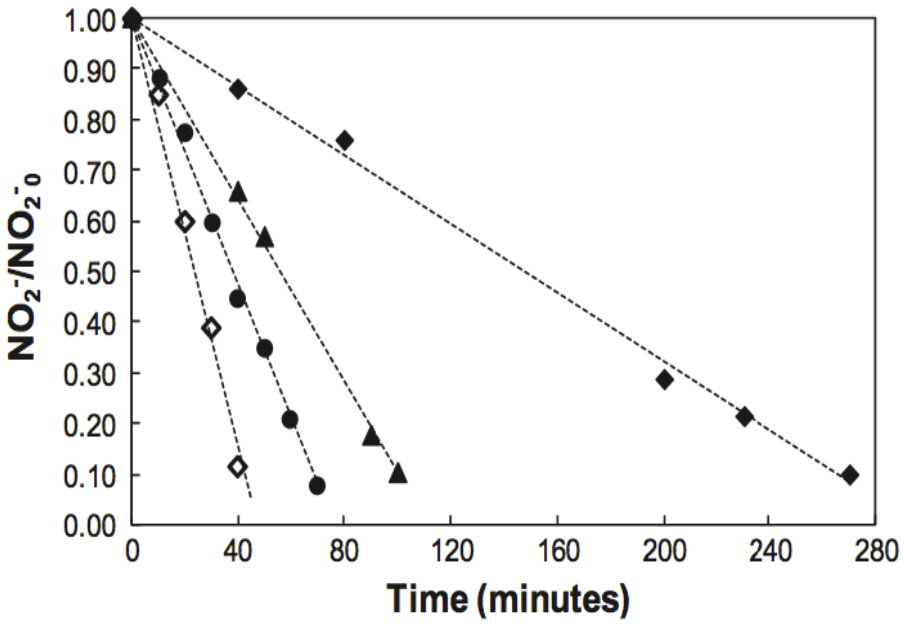
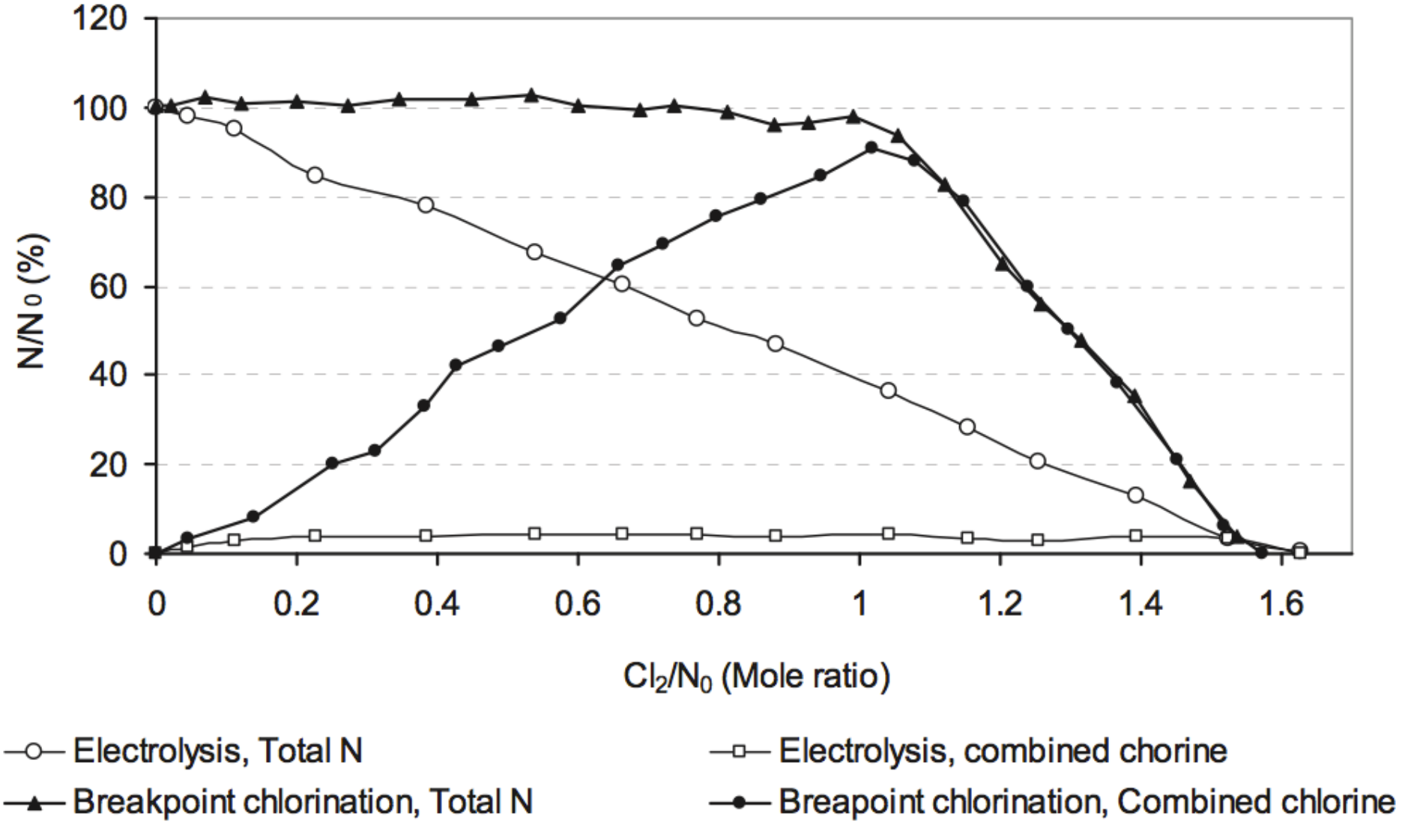


Fig. 4 – Influence of the applied current density (◆ $J = 5$ A m^{-2}; ▲ $J = 20$ A m^{-2}; ● $J = 30$ A m^{-2}; ◇ $J = 50$ A m^{-2}) on the evolution of $[NO_2^-]/[NO_2^-]_0$; $[NO_2^-] \approx 80.0$ mg/l.

Reduction of Nitrate and Nitrite: Possible, but untested



Questions?