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Wastewater treatment with electrocoagulation



The main office of Afvalzorg is located in Assendelft



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Mechanical Engineering - Delft University of Technology
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Engineer Technical Services at Afvalzorg



Company profile

- Public waste processing company
- Shareholders: Provincie Noord-Holland (90%) & Flevoland (10%)

Mission:

- Creating secondary resources and building materials from “waste material” (~1,0 Mt/a)
- Safety net for waste disposal industry (~0,4 Mt/a)
- Providing and minimalizing after-care
- Functional and safe landscapes from landfills and rehabilitation locations
- Revenue ~30M€/a, 13 locations, ~100 colleagues, own R&D and Civil Engineering department



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Location Afvalzorg Nauerna



Wastewater from landfill Nauerna

- Leachate (COD, TKN)
- Metal-containing rainwater
- Metal-containing wastewater from bottom ash washing



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Wastewater treatment plant Nauerna



- Change in waste material, more metal and salt-containing instead of organic (waste)streams.
- More metals present than standard 8 metals Hg, Pb, Zn, Ni, Cr, Cu, As and Cd

Biological treatment is not best available technique (BAT) for treatment of metal-containing wastewater



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Explorations and choices for metal removal installation

Requirement water quality control:

Use environment-friendly design, use of chemicals should be minimal.

Considered techniques:

- Ion exchange (not cost-effective, a lot of polluting substances)
- Reverses osmoses (not cost-effective, concentrated residual stream)
- Chemical precipitation (high use of chemicals)
- Electrocoagulation (environmental-friendly, cost-effective and fits to Afvalzorg' philosophy of a circular economy)

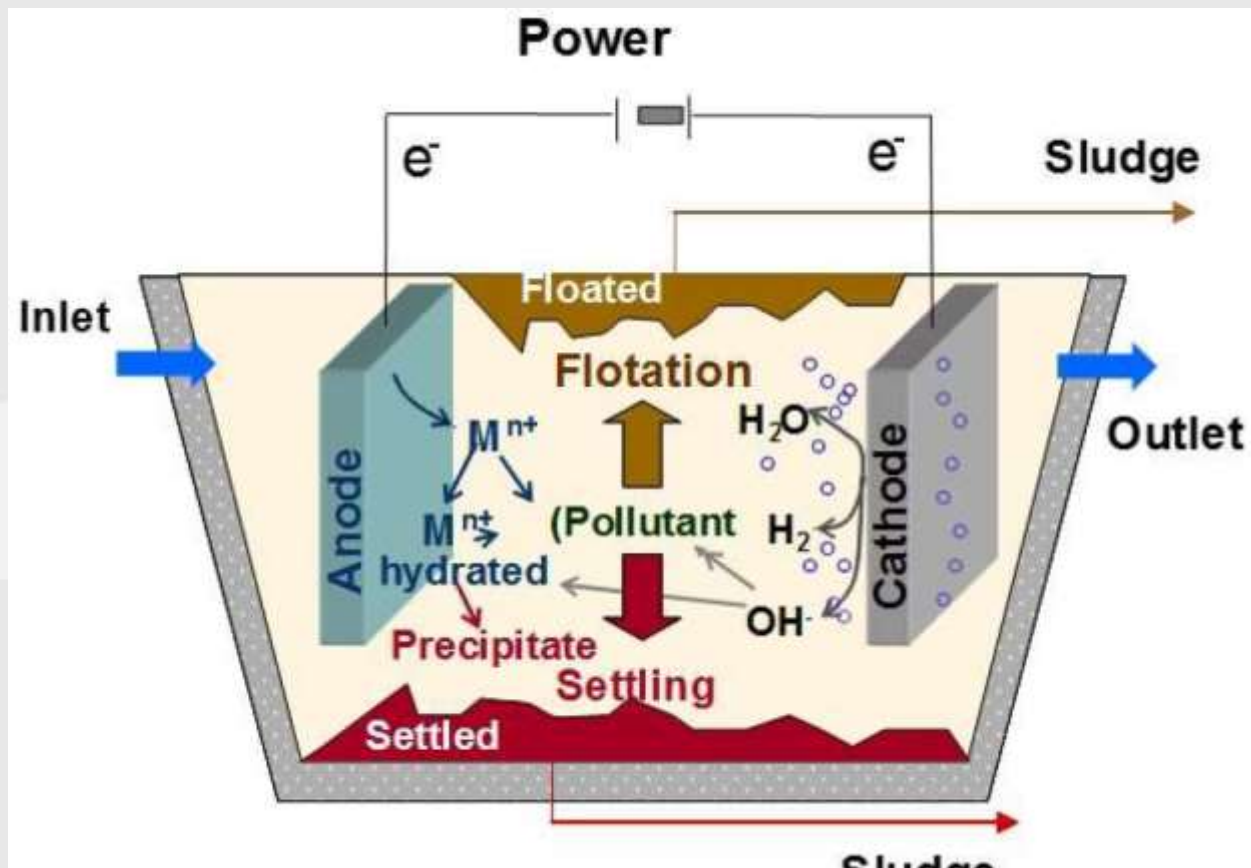
Metals that should be removed according to discharge permits:

Arsenic	Cadmium	Chromium
Copper	Mercury	Nickel
Zinc	Lead	Antimony
Cobalt	Molybdenum	Vanadium

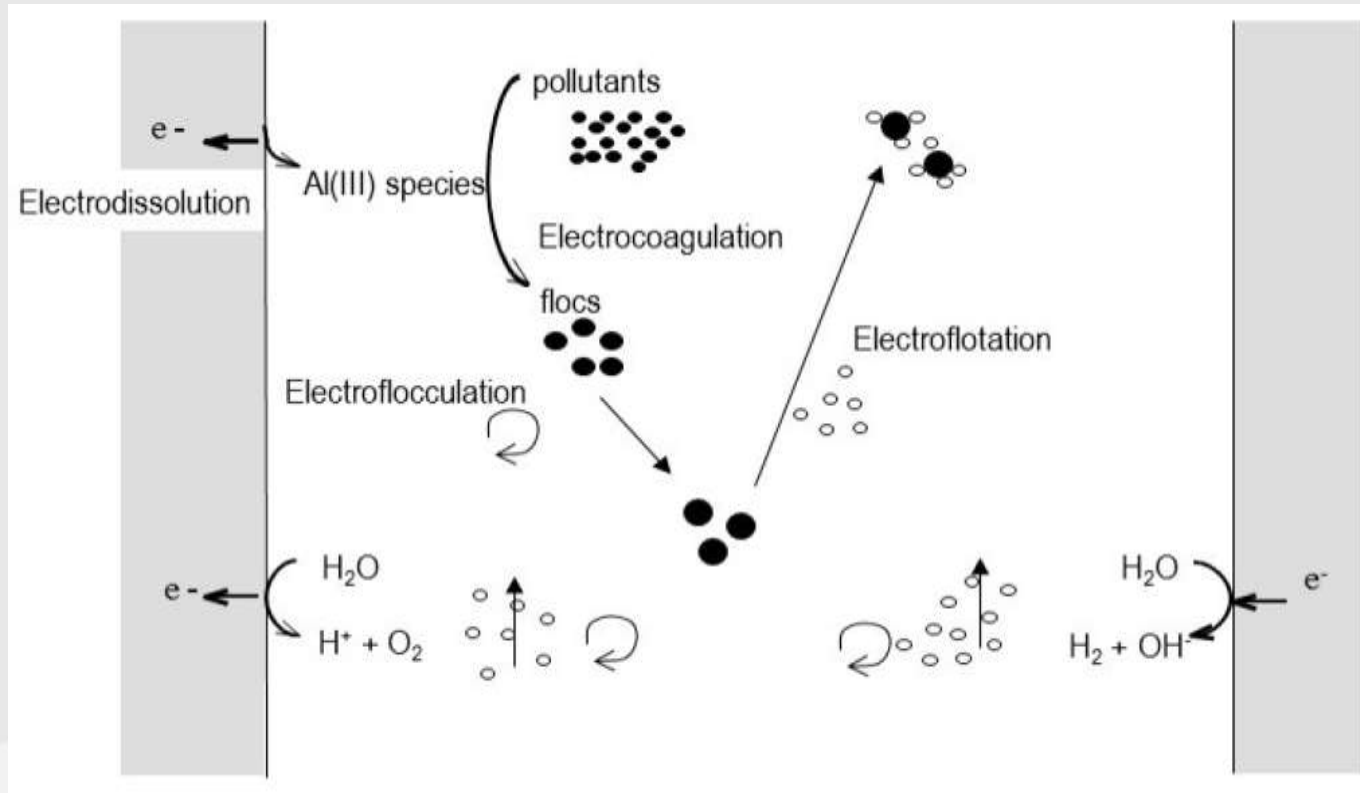


Basic principle of electrocoagulation

- Two metal plates, Anode and Cathode
- Salinity
- Fe^{3+} ions and OH^- are formed
- Due to their polarity they bind to pollutants
- Most bonds are not soluble and settle



Basic reactions EC coagulation



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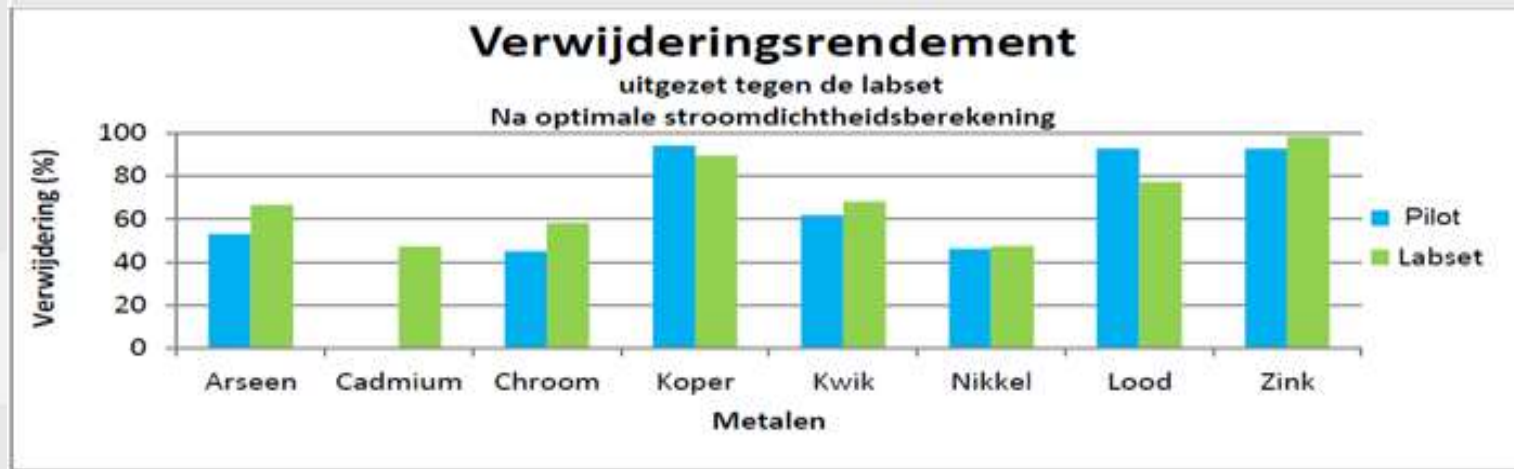
Pilot installation electrocoagulation

Pilot installation 10m³/h:

- EC Reactor
- Coagulation chamber
- Clarifier
- Sludge disposal



Results:



- Molybdenum 85%
- Vanadium 50%
- Antimony 70%



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Important parameters for electrochemical treatment of leachate and bottom ash wash water

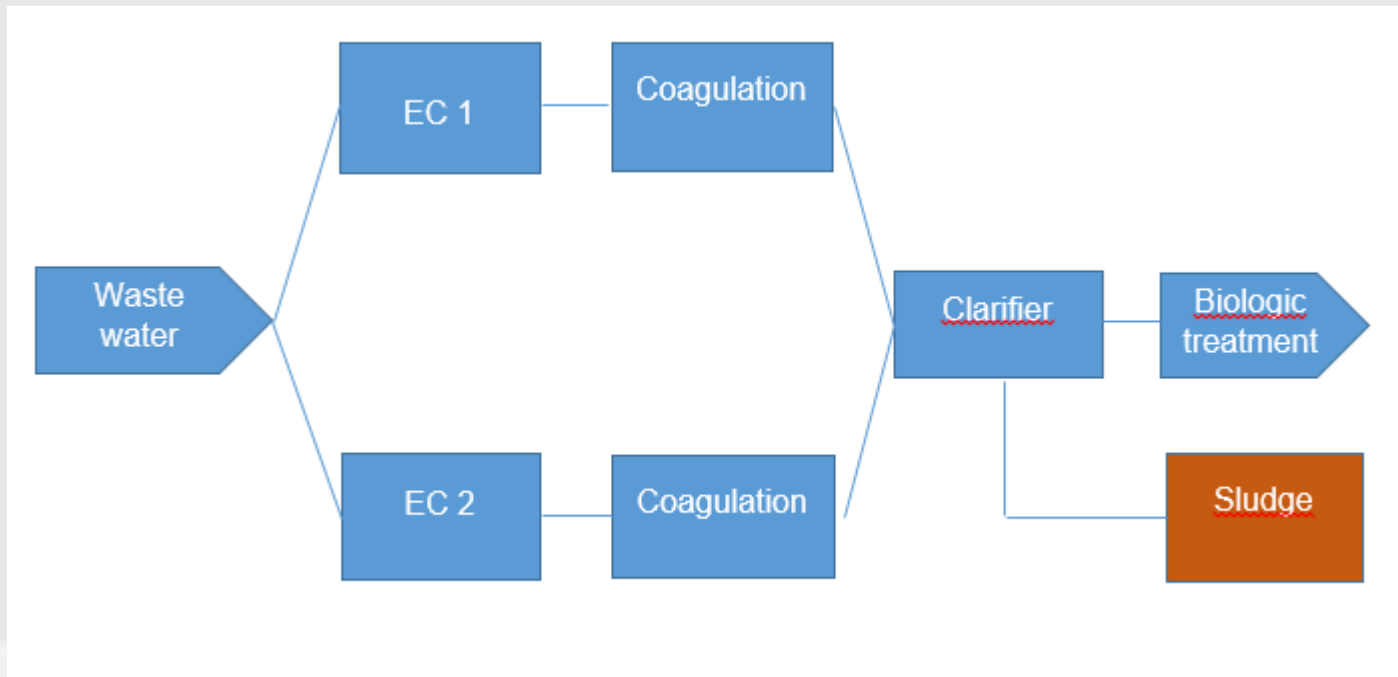
- Amount of plates inside reactor
- Plate distance
- Residence time
- Salinity
- Current intensity and current density
- pH value

Observations pilot EC compared to chemical precipitation

- Complex bonds can be broken with EC
- Efficiency increases with increase in pollution
- No chemicals necessary, energy efficient
- Lower cost €/m³ to treat wastewater compared to chemical precipitation



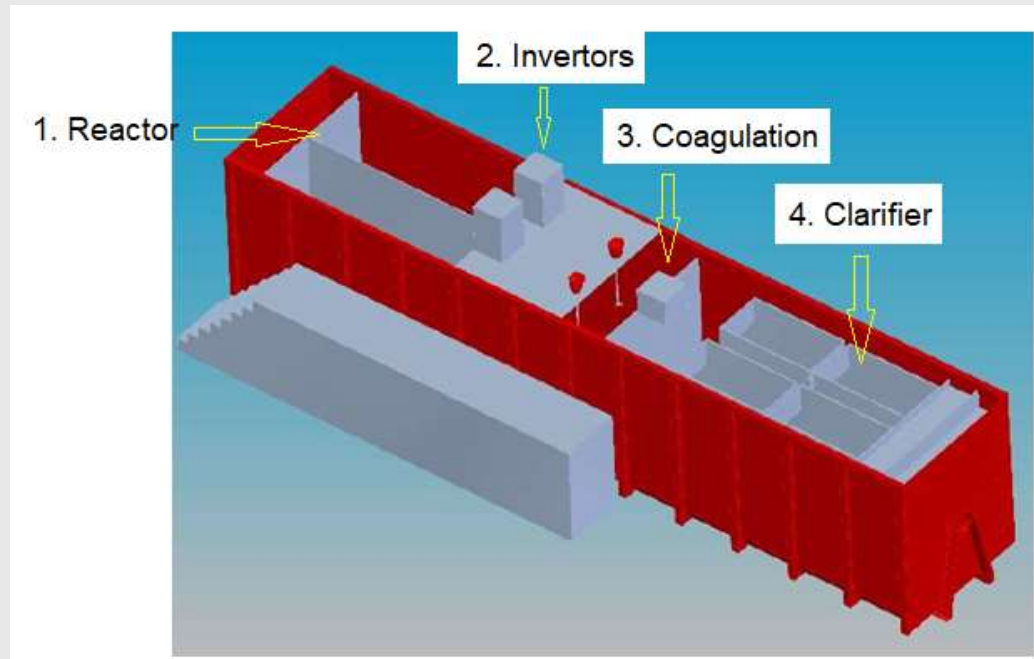
Full scale Electrocoagulation treatment scheme



- Continues treatment of 12,5m³/h or 25m³/h
- Two separate treatments of wastewater



Visualization EC coagulation installation (25m³/h)



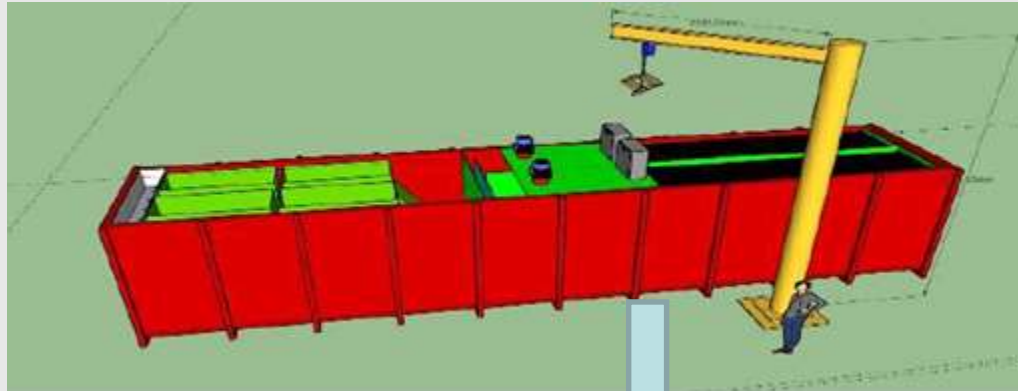
Distribution of waste water over two separate reactors with salt-containing waste water insertion

1. Reactors with metal anode- and cathode plates
2. Invertors
3. Coagulation reactors
4. Clarifier



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New plant operational in June 2019



New challenge!?

- Selective recovery of metal (mining??)

