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EC NORWAY

Wastewater from bio-waste treatment; some issues and solutions

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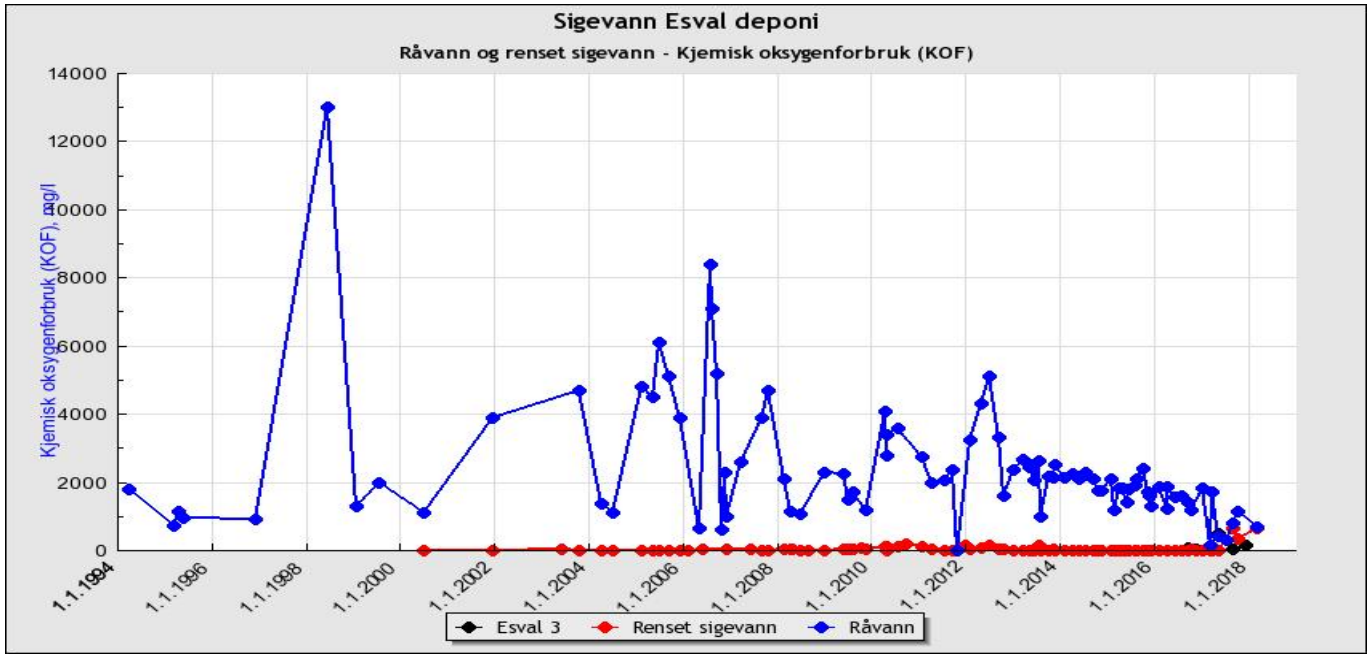
Topic:

- ”Bio”wastewaters; from biogas (biosolids), from waste incinerators, biowaste sorting stations (washwater)
- The removal of nutrients and dewatering
- Electrocoagulation of the wastewater
- Precipitation with zeolites



Total landfilled t/yr

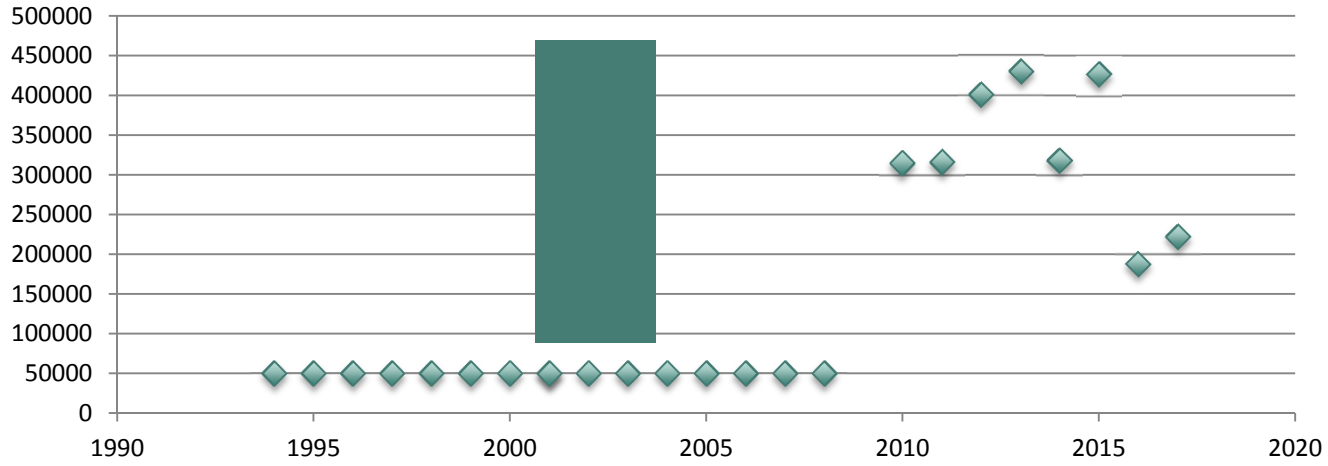


Table 1. Organic waste in Norway (in tonnes, 2013). SSB, 2017.

Category	Material recycling	Biogas	Compost	Incineration	Landfill	Other	Total	% Biogas
Food waste/wet organic waste	1207	73944	94446	4190		148	173935	43
Park, garden	4129	674	179936	5205		4507	194453	0.3
Wood	41		6484	248093		114		0
Total	**5377**	**74618**	**280866**	**257488**	**0**	**4769**	**368388**	**20**
Sewage sludge							120000	?
Manure							5680000	
WW from pulp							?	
Aquaculture							90000	?

Table 2. Wastewater (ww) characteristics*

	NH_4-N	TOT-S	pH	El	Vol
Biogas ww	2720		7.93	18362	
Incin ww 1	170				1-2
Incin ww 2	154	302	9.2	25600	5

*mg/l, μS/cm and m^3/hour

Biogas wastewater = biosolids
The pH in unadjusted Incinerator wastewater: 0.4

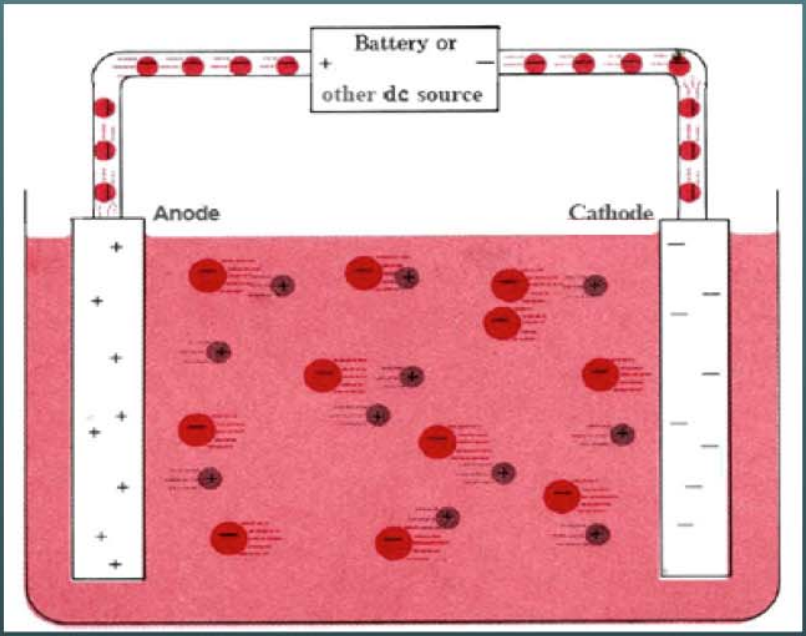
Due to HSO4 and CO2

Bio- or circular economy

- Reuse
- Recirculate
- Reduce emissions
- Reduce pollution
- What about the economy?

What is electrocoagulation?

Direct electrical current is introduced into wastewater using metal electrodes, causing various non-spontaneous reactions.



The anode is sacrificial – the current causes the anode to dissolve and release **metal cations** typically used up as seeding for new chemical entities

Electrocoagulation – the Process

Principle:

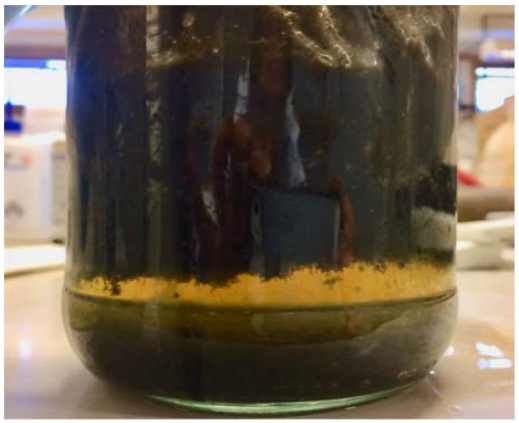
– Coagulation of pollutants - caused by the effect of **direct current** passing through wastewater

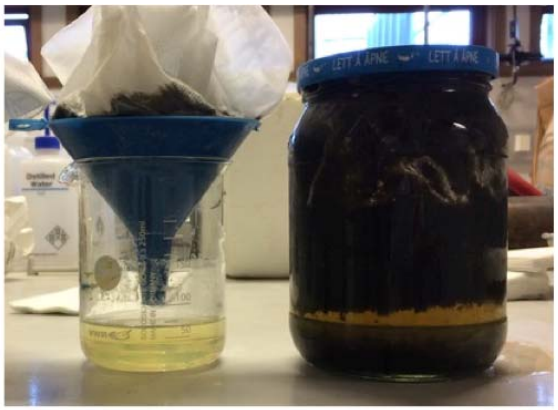
- **Various chemical and physical processes** occur during coagulation as a result of the redistribution of charges
- **"Seeding"** effect of slow dissolving of the sacrificial electrodes

Zeolites

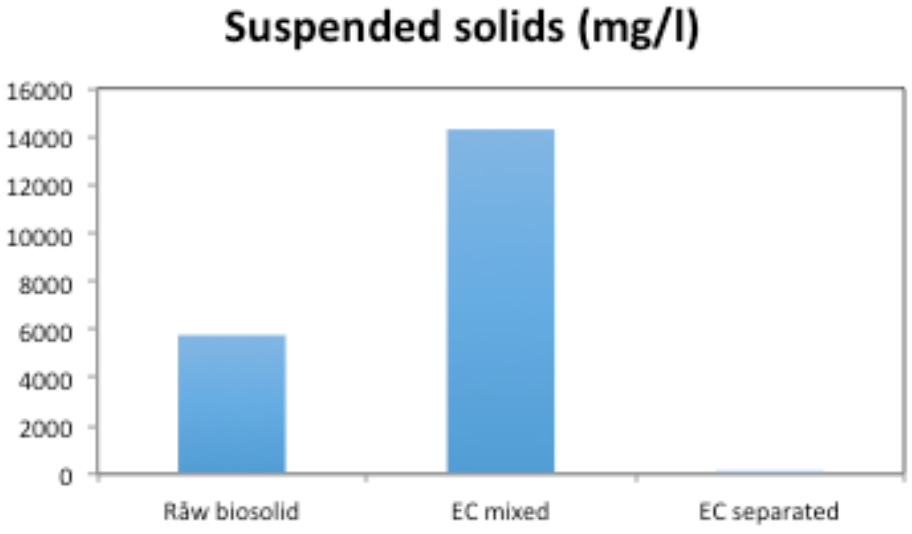
Zeolites are hydrated aluminosilicate, they're solids with a relatively open, three-dimensional crystal structure built from the elements aluminum, oxygen, and silicon, with alkali or alkaline-Earth metals (such as sodium, potassium, and magnesium) plus water molecules trapped in the gaps between them.
There are about 40 naturally occurring zeolites, forming in both volcanic and sedimentary rocks; according to the US Geological Survey, the most commonly mined forms include chabazite, clinoptilolite, and mordenite. Dozens more artificial, synthetic zeolites (around 150) have been designed for specific purposes.

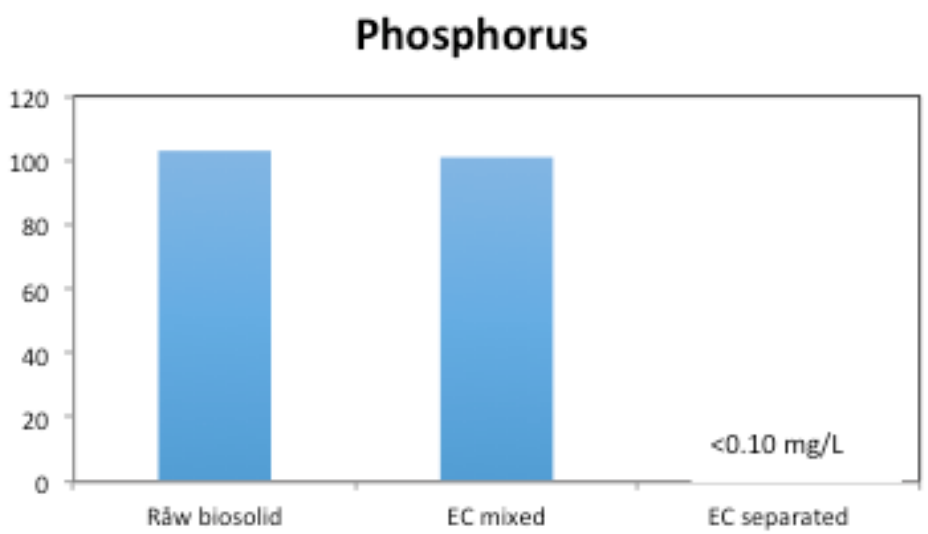
Treated biogas wastewater, separated, and EC unit & container



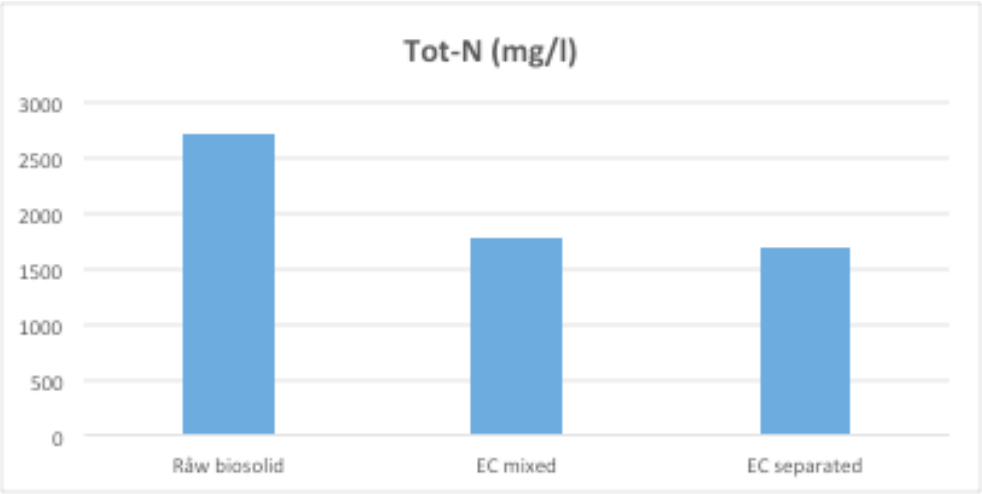


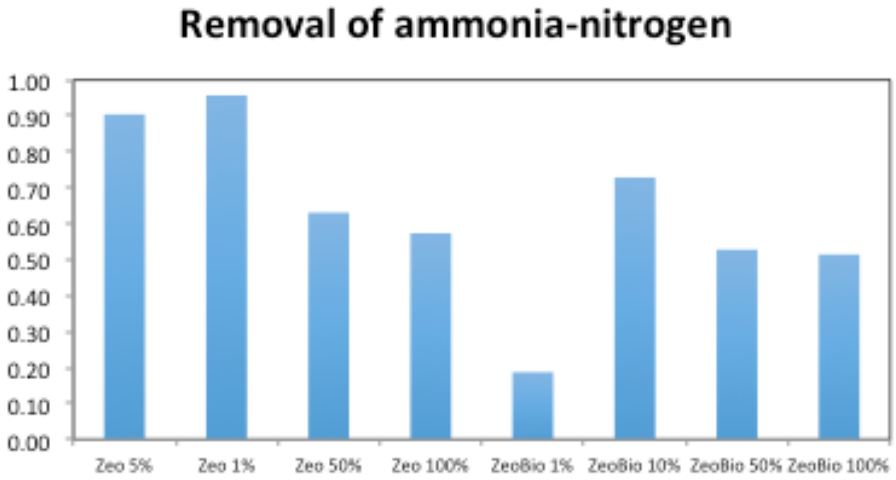
Removal of particles and Tot-P in the EC process





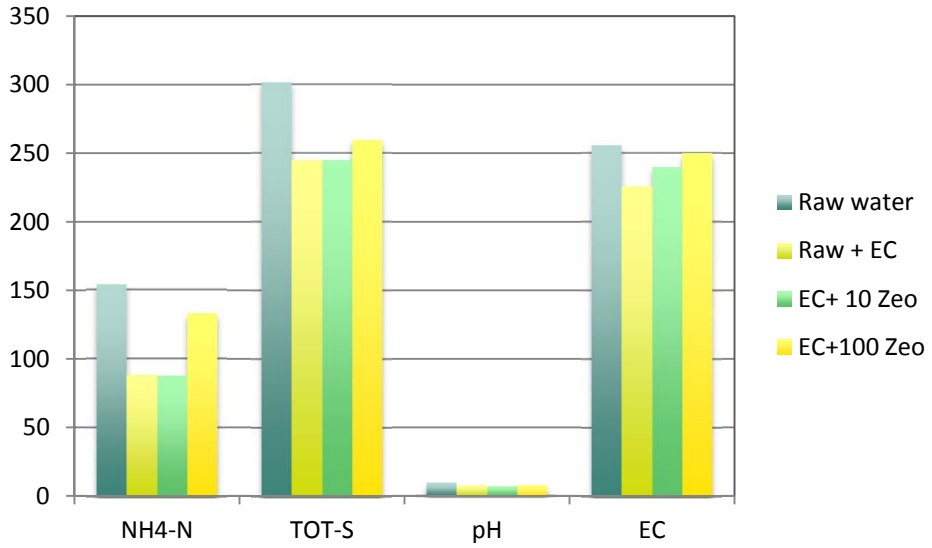
Concentration of Tot-N through the EC process (left) and of NH4-N in a batch adsorption experiment





Precipitation ($CaCO_3$)

Results gas WW



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Conclusions

- Need for better treatment systems
- EC is a promising technology for treating wastewater from biowaste treatment systems
- Design and optimization remains

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