Enhancing NOM removal

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1. Last presentation

The presence of NOM in water:

1. Decreases the efficiency of treatment steps
2. Leads to formation of biofilms and
   the uptake of copper and lead in the distribution network.

Therefore Enhanced NOM removal is required.

1. Last presentation

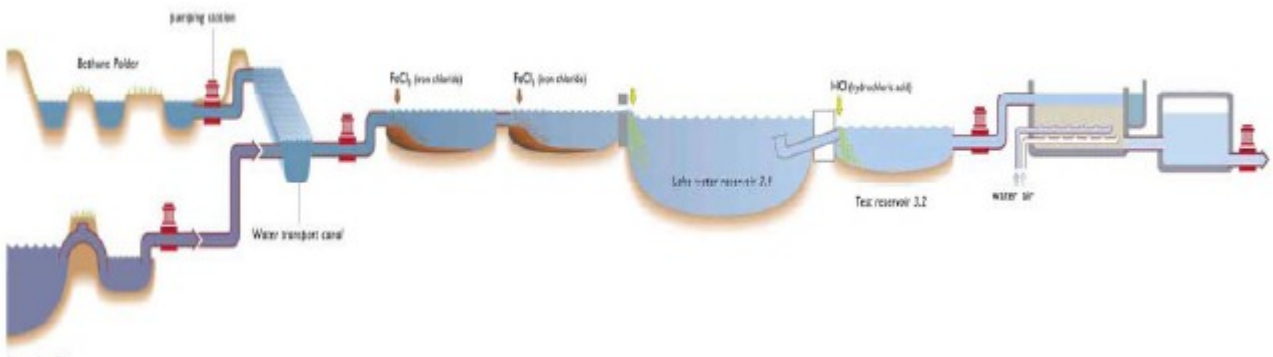
Current situation

1. Last presentation

Current situation

Process scheme Pre-treatment plant Loenderveen

Year capacity: 30 mln m³	Coagulation: 2 basins Surface area per basin: 40 x 80 m	Lake Water Reservoir Residence time: about 100 days Surface area: 123 ha Volume: 6.0 Mm³	Filters: Number: 24 filters Surface area: 48 m² per filter Max. filter loading: 6 m/h	Transport and buffering: Main: Length: 10 km Diameter: 2 x 1000 mm Buffer reservoir: Surface area: 1.12 ha Volume: 40,000 m³



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1. Last presentation

Current situation

Water quality of Treatment plant Loenderveen.

Parameter	Unit	Raw water Bethune Polder			Raw water Amsterdam Rhine Canal			After pre-treatment			After post-treatment		
		Average	Min	Max	Average	Min	Max	Average	Min	Max	Average	Min	Max
Temperature	oC	10.9	<0.5	20.5	13.9	2.5	25.2	11.9	2.3	22	12.3	2.3	22.1
pH	pH	7.36	7.17	7.72	7.93	7.49	8.19	7.62	7.45	7.79	8.06	7.84	8.44
Turbidity	FTE	35	20	85	14	3.2	37	0.2	0.12	0.27	0.12	<0.1	0.32
UVA254	1/m	30	23.9	75.5	13	6.8	28.7	14.6	13.5	15.8	4.4	3.1	6.2
DOC	mg/l C	9.2	6	17	5	2.8	9.8	6	5.4	6.6	3.3	2.5	4.2
Colour	mg/l pt	34	22	142	17	8	37	10	7	15	2	<1	5
Oxygen	mg/l O2	3.2	<1	8.6	9.5	7	12.9	-	-	-	8	5	12.8
Suspended solids	mg/l	15	8.3	23	26	16	36	<1	<1	<1	<1	<1	<1
Conductivity	mS/m	53.2	37.5	58.4	60	49.7	65.7	53.2	51.5	54.6	50.8	48.5	52.2
Chloride	mg/l cl	44	29	49	75	54	97	75	69	79	79	71	85
HCO3	mg/l HCO3	291	270	309	181	160	204	204	196	213	176	170	186
Calcium	mg/l ca	88	81	95	72	64	79	80	78	83	49	47	53
Magnesium	mg/l mg	6.6	6.2	7.2	10.4	9.3	11.6	6.5	6.1	6.8	6.4	5.6	6.8

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2. Possible solutions for NOM-removal

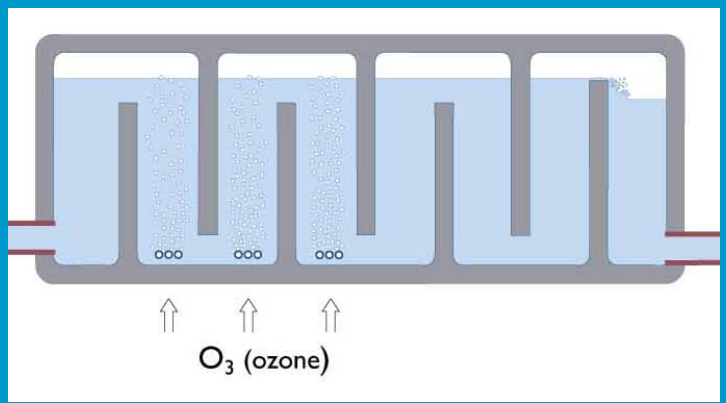
1. Oxidation of NOM with Ozone
2. Ion-exchange
3. Enhanced coagulation
4. Membrane filtration
5. Lime-Soda Softening Process Modifications for Enhanced NOM Removal

2. Possible solutions for NOM-removal

Oxidation of NOM with Ozone

Ozone reaction O_3 -----> $O_2 + O$

DOC → AOC easier biodegradable



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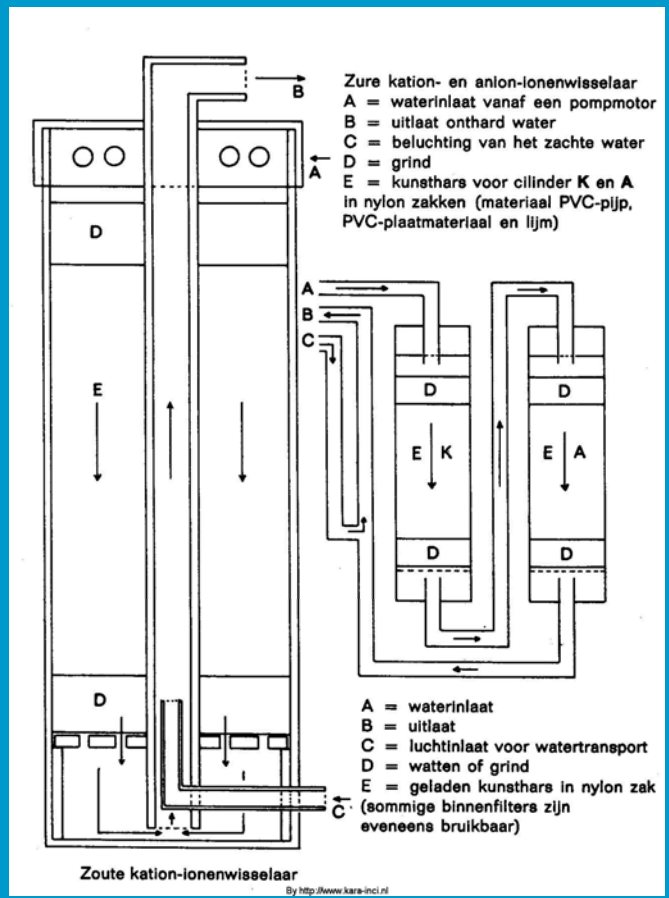
2. Possible solutions for NOM-removal

Ion-exchange

Switching charged particles from the water to the ion exchange resins

NOM can be replaced by Na^+



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2. Possible solutions for NOM-removal

Enhanced coagulation

Optimizing the conditions in the coagulation step for maximum NOM removal

Jar tests for optimum pH raw water

Dosing other and/or more chemicals

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2. Possible solutions for NOM-removal

Membrane filtration

Water filtered through a membrane under high pressure

All NOM can be removed

2. Possible solutions for NOM-removal

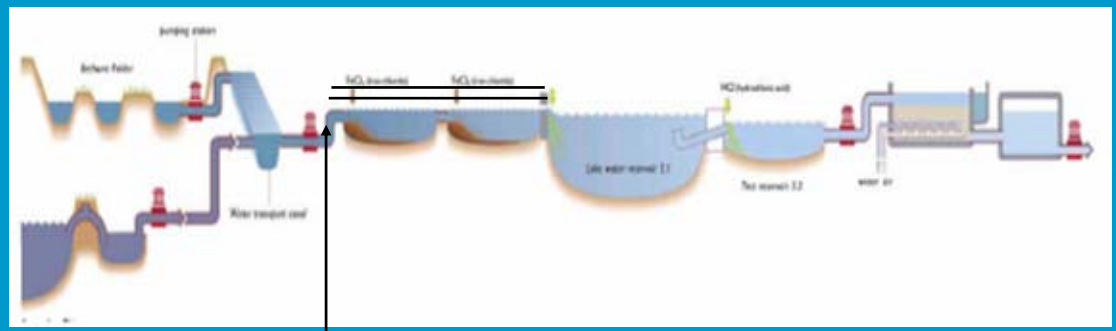
Lime-Soda Softening Process Modifications for Enhanced NOM Removal

By dosing high content Mg-lime, precipitation of

Mg(OH)2-NOM complexes will occur.

3. Applications of the solutions

Oxidation of NOM with Ozone



O_3

No hinder of algae because of roofing over the basin

No by-products at normal dosages

Operator are familiar with the use of Ozone

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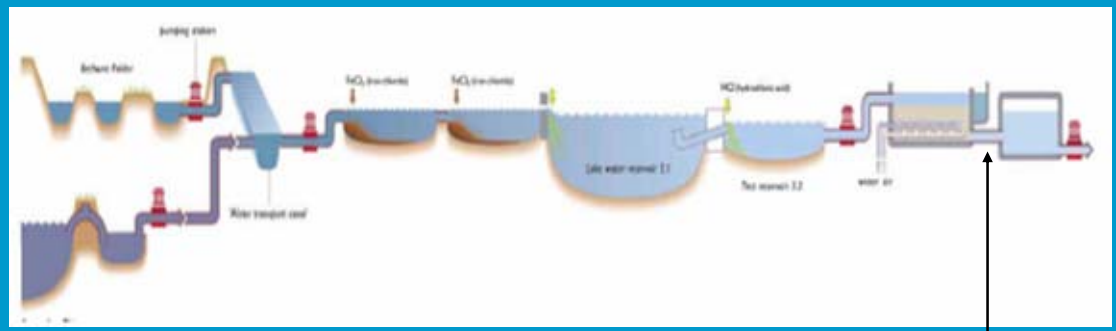
3. Applications of the solutions

Ion-exchange



Less DOC in treated water leads to higher efficiency

No chemical dosages needed, just DOC replaced with Na^+

Mix of specific resins could remove specific NOM

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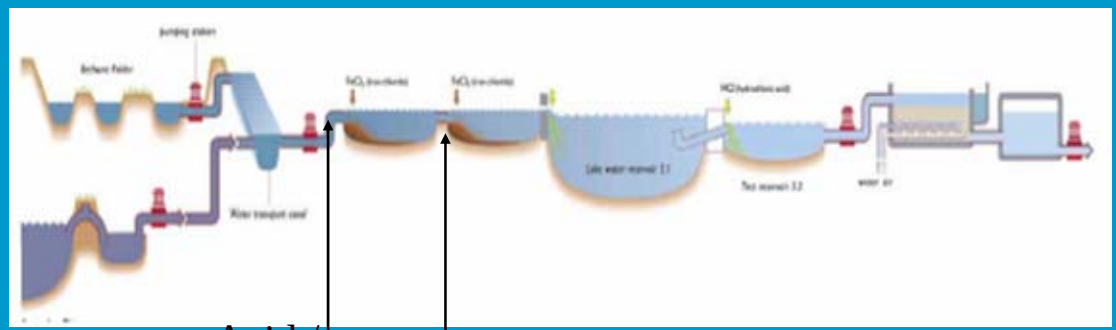
3. Applications of the solutions

Enhanced coagulation



Low cost solution, just multiple dosing installations

No hazardous chemicals dosed

Could be effective in combination with other solutions

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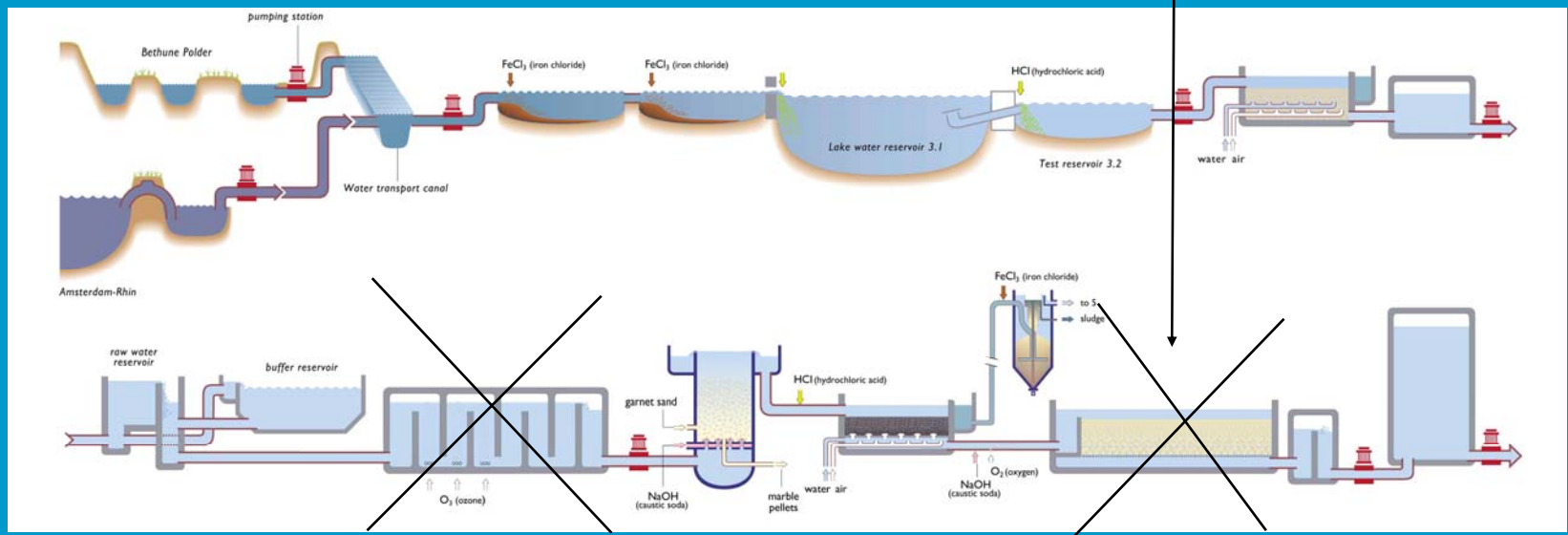
3. Applications of the solutions

Membrane filtration



Good water quality

Treatment units can be put off-line (Ozone and SSF)

Costly operation

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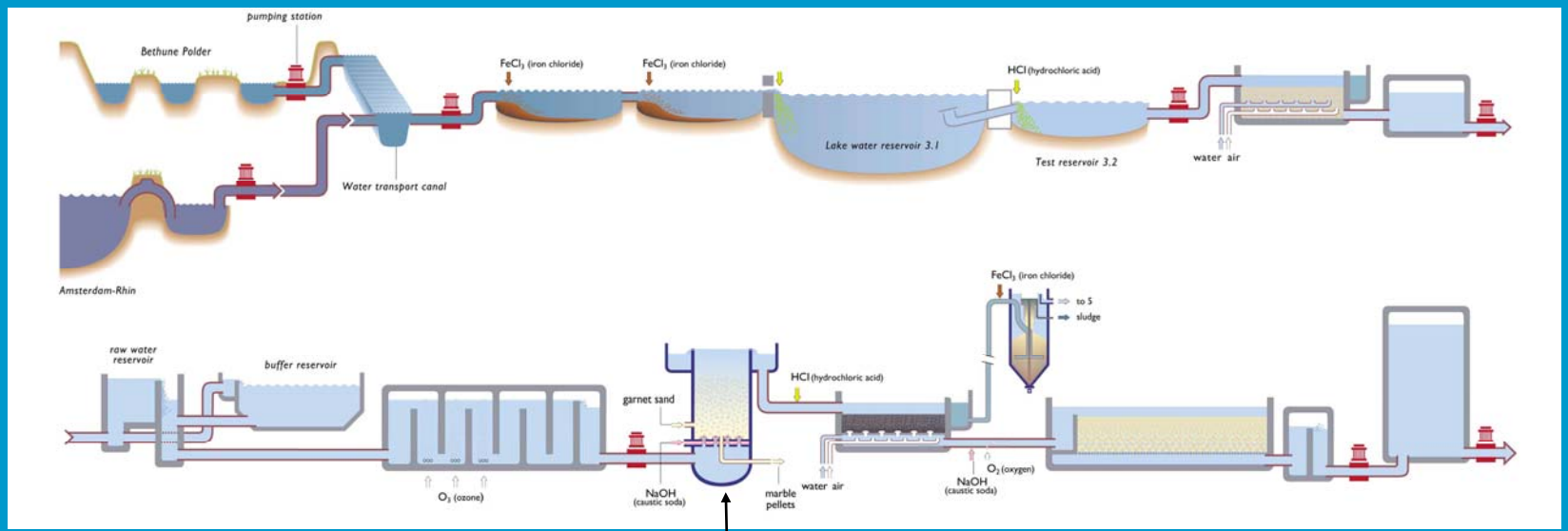
3. Applications of the solutions

Lime-Soda Softening Process Modifications for Enhanced NOM Removal



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3. Applications of the solutions

Lime-Soda Softening Process Modifications for Enhanced NOM Removal

Current problems in softening reactors would be solved

New design of softening reactors/basins

Creating lots of turbidity and waste sludge

4. The comparison

	Efficiency	Robustness	Implementation	Operational cost	Investment cost	Water quality	Total points
Ozone	4	5	4	3	3	4	23
I.E.	4	3	5	2	2	4	20
Enhanced Coa	2	5	5	5	5	2	24
Membrane	5	4	1	3	1	5	19
Softening $MgCl_2$	3	3	2	3	2	3	16

Please give us your comments

Thank you

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