



Implementation program reduction of organic micropollutants from WWTP effluent

Maarten Nederlof, Stowa Symposium Aquatech, 2021 November 3

Program Manager 'Dutch implementation program removal of pharmaceuticals at WWTP's'

Implementation of additional treatment steps for the removal of organic micropollutants from WWTP-effluent: Outline

- Recognition of the problem
- Hotspot analysis and regional confirmation
- Financial contribution of Ministry of Infrastructure and Water Management
- Selection and construction of proven technologies
- Monitoring performance and sharing experiences
- Future Challenges



Recognition of the problem

- Improved laboratory techniques (concentrations in $\mu\text{g/l}$, even ng/l)
- First RIVM report in 2016 (second in 2020)
- Broad awareness in water sector
- Dutch Chain Approach, >2016 (health care and water sector!)
- Lot of questions left

Where is it a problem (all the WWTP's?)

What are standards,

Guidelines for pharmaceuticals?

Source approach or end of pipe?

What technologies are available?

When (<2027 WFD)?

Costs?



Presence of Pharmaceuticals in water (examples, µg/l)

Pharmaceutical	Diclofenac	Metformine	Clarithromycine
Waste water	0,33-0,59	64-100	0,1-0,7
WWTP effluent	0,19-0,40	0,4-1,7	0,04-0,19
Surface water up	0,013-0,076	0,25-0,68	<0,01-0,04
Surface water down	0,06-0,22	0,30-1,04	0,01-0,13
Maas	0,04 (max)	< 0,5 (0,83 max)	0,12
Drinking water	< 0,01	0,3 (max)	< 0,01 (?)

Diclofenac: PNEC = 0,05 µg/l

Metformine: PNEC = 780 µg/l

Clarithromycine: PNEC = 0,04 µg/l

Not relevant for human toxicity !?

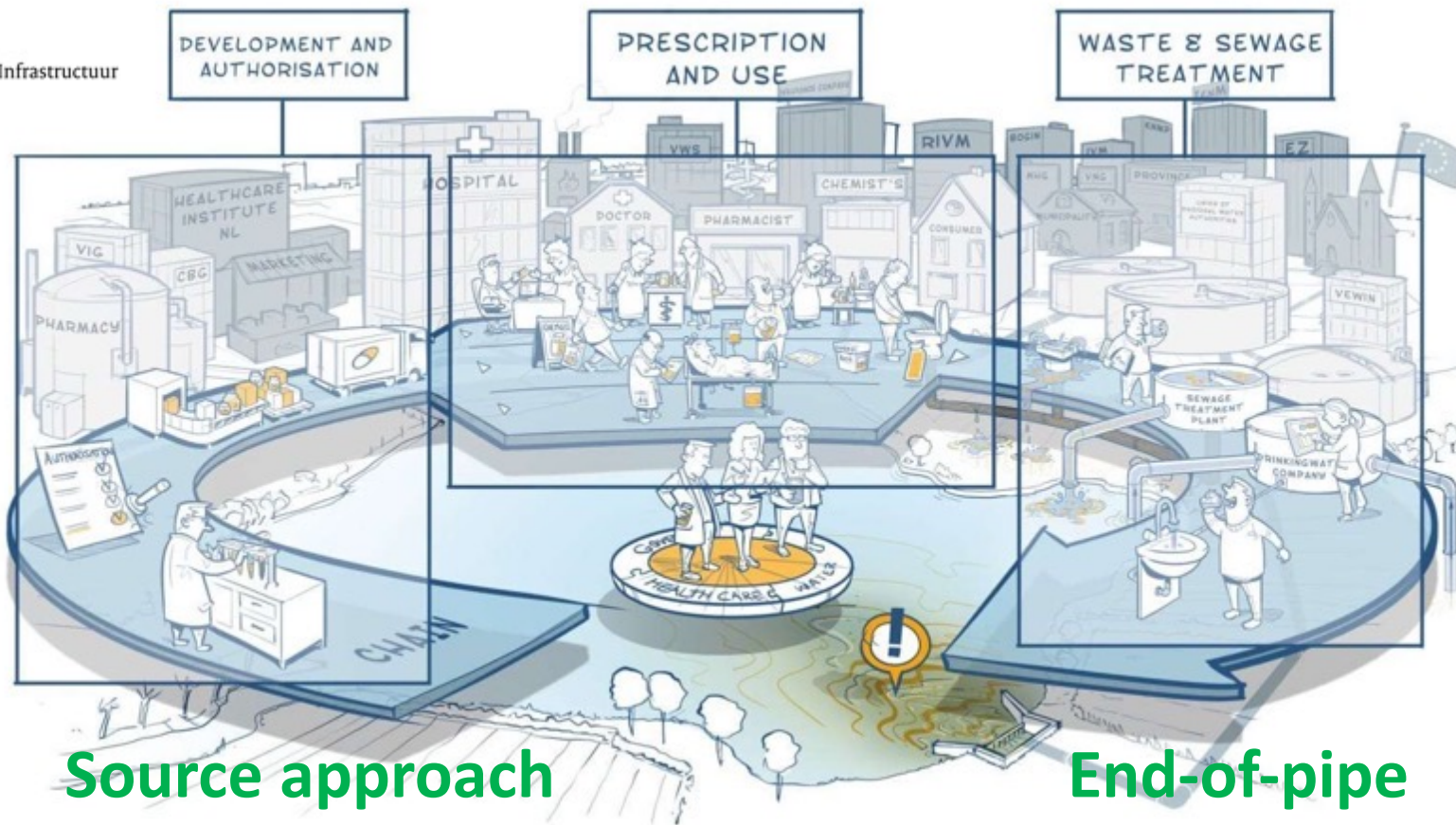
European River Memorandum: < 0,1 µg/l

Indicator parameter drinking water directive: 1 µg/l

The Dutch Approach (Chain approach pharmaceuticals in water)



Ministerie van Infrastructuur
en Waterstaat



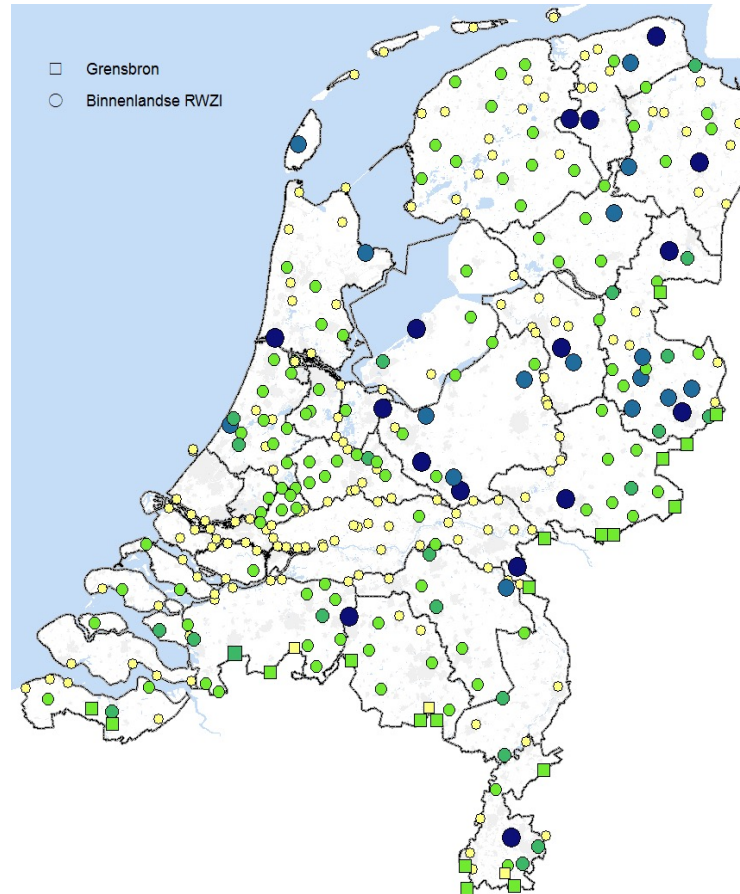
Stowa national hotspot analysis WWTP's (model calculation)

Criterion: Concentration increase receiving surface water

Conclusion: about 150
of 314 WWTP's
no significant effect

Assumption: below
1 µg/l no effect
aquatic ecosystem

About 100 hotspots



Second criterion:
Drinking water source

Regional validation: River basin approach, example River Maas

Additional
water quality
measurements..

Sources of
contaminants?

Functions of the
river Maas?



Effect on aquatic
ecosystem?

Effect on drinking
water sources?

Area of Aa en Maas (3-4 WWTP's out of 7)



Financial contribution of Ministry of Infrastructure and Water Management

- 60 M€ available to stimulate additional treatment steps
- On a voluntarily basis (still no regulation or standards)
- Water boards make their own decisions on where, when and what..
- National cooperation between Ministry and Waste water Sector
- Two tranches (2020-2023 and 2024-2027)
 - > 10 years in operation
 - > 70% removal of indicator substances (7 best out of 11)
(benzotrizole, carbamazepine, diclofenac, gabapentin, metoprolol, hydrochlorothiazide, irbesartan, 4-/5-methylbenzotriazole, sotalol, trimethoprim, venlafaxine)
 - > 50% reduction in ecotoxicity (based on bio-assays)
- First tranche: 12 waterboards, 14 WWTP's
- Second tranche: 20-25 WWTP's expected
- > 2027: 65 wwtp's left?!

Overview (proven) technologies (Stowa report 2017-36)

technology	removal	costs	Energy, GER	By-products
Powdered Activated Carbon (PACAS)	++	++	+/-	++
Active carbon filtration	++	+/-	+/-	++
Ozone + filtration	+++	+	+	- (bromate)
UV/H2O2	+++	+	-	+/-
Membrane filtration	++(+)	+/-	-	- (concentrate)
Natural treatments	+	++	++	++



Desinfection!?

Remark: combination of PACAS and ozone might be attractive to remove a broad range of contaminants

Challenges for the near future: need for innovative, better technologies

Proven technologies	CO ₂ footprint g CO ₂ /m ³	Costs €/m ³	% removal 7 out of 11
PACAS	122	0,05	70-75
Ozone	98	0,09	80-85
Ozone + SF	128	0,17	80-85
GAC	325	0,26	80-85

National implementation program, first tranche (12 water boards, 14 wwtp's <2023)

OZONE

Wervershoof
(Hollands Noorderkwartier)

Horstermeer
(Amstel Gooi en Vecht)

Houten
Woerden
(De Stichtse Rijnlanden)

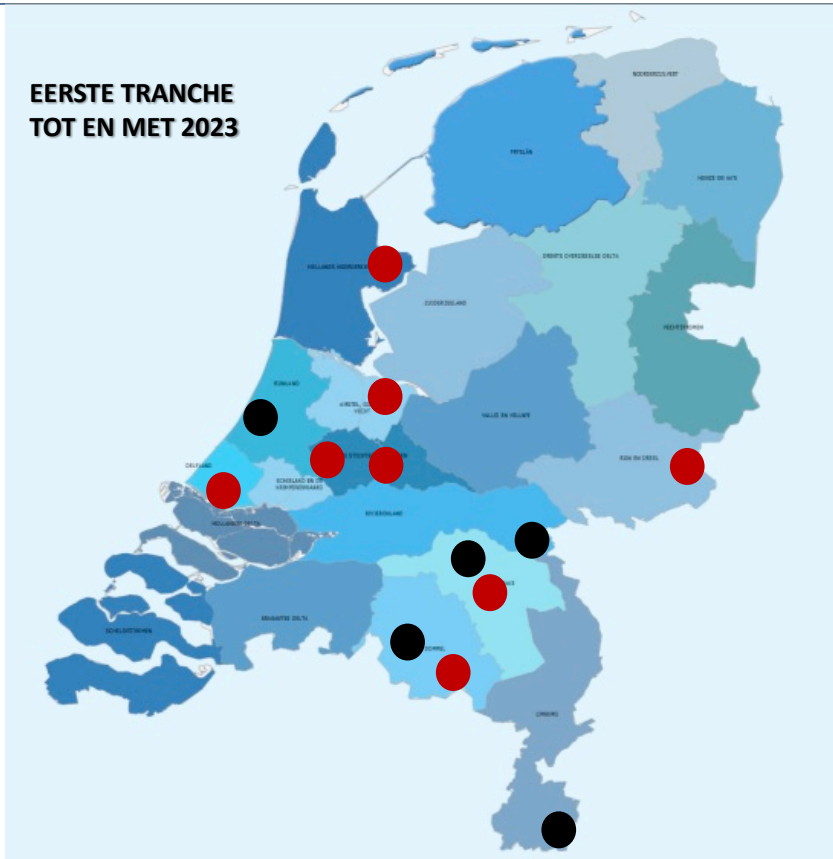
De Groote Lucht
(Delfland)

Winterswijk
(Rijn en IJssel)

Dinther
(Aa en Maas)

Soerendonk
(De Dommel)

EERSTE TRANCHE TOT EN MET 2023



PACAS

Leiden Noord
(Rijnland)

Groesbeek
(Rivierenland)

Oijen
(Aa en Maas)

Hapert
(De Dommel)

Simpelveld
(Waterschap Limburg)

First full scale PACAS installation in operation in 2021 (Water board Rijnland)!



Small footprint..



Opening, September 30,..

Monitoring and sharing experiences: learning by doing

- Extended monitoring program on effectiveness of additional treatment steps
 - Chemical analysis: Influent, effluent and surface water
 - Ecotoxicity by bio-assays: both in effluent and surface water
 - Removal of other contaminants? (nutrients, pathogens, AMR)

Lot of people involved!



- Sharing experiences in Community of Practice and User Groups
 - Activated carbon applications (design, maintenance, type of GAC/PAC)
 - Oxidation with ozone (design, modeling, bromate formation)
 - Monitoring, data analysis (chemical analysis methods, interpretation)

(Near) Future Challenges

- Upcoming water quality standard for bromate in surface water
- Upcoming European water quality standards for individual components
- Increasing number of (organic) contaminants will appear in WWTTP effluent
- Need for technologies that remove a broad(er) spectrum of contaminants
- Meet multiple goals: water quality, climate foot print, circular economy,..
- Opportunity: reuse of WWTP effluent, business case!?
- Fit for purpose treatment (and flexible towards future developments)
- Increased insight in presence and (eco)effects of contaminants in water
- Implementation of new technologies from the Innovation Program?!

Take home message: implementation depends on people..



Tell your story..

Learning by doing..

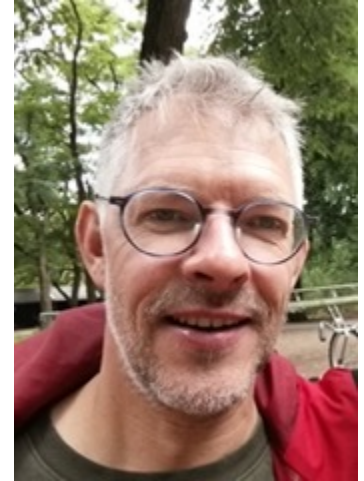


In de doseerinstallatie, onder de grote opslagsilo,



Thank you for your attention!

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stowa



Rijkswaterstaat
Ministry of Infrastructure
and Water Management

Tackling Micropollutants in Wastewater
Approaches on Implementation and Innovation in Europe and The Netherlands

November 3 and 4 2021
Aquatech Amsterdam