

Micropollutants, PAC, effluent and anaerobic digestion

Tackling Micropollutants in Wastewater

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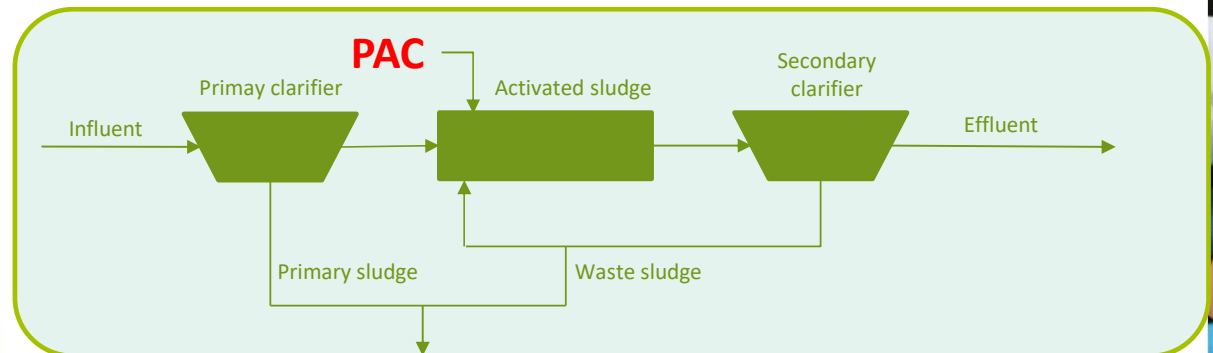
What was investigated?

1. What is the fate of adsorbed micropollutants after applying PAC to activated sludge, when waste sludge is anaerobically digested?
2. When PAC is dosed to activated sludge, how can we quantify PAC in treated effluent?

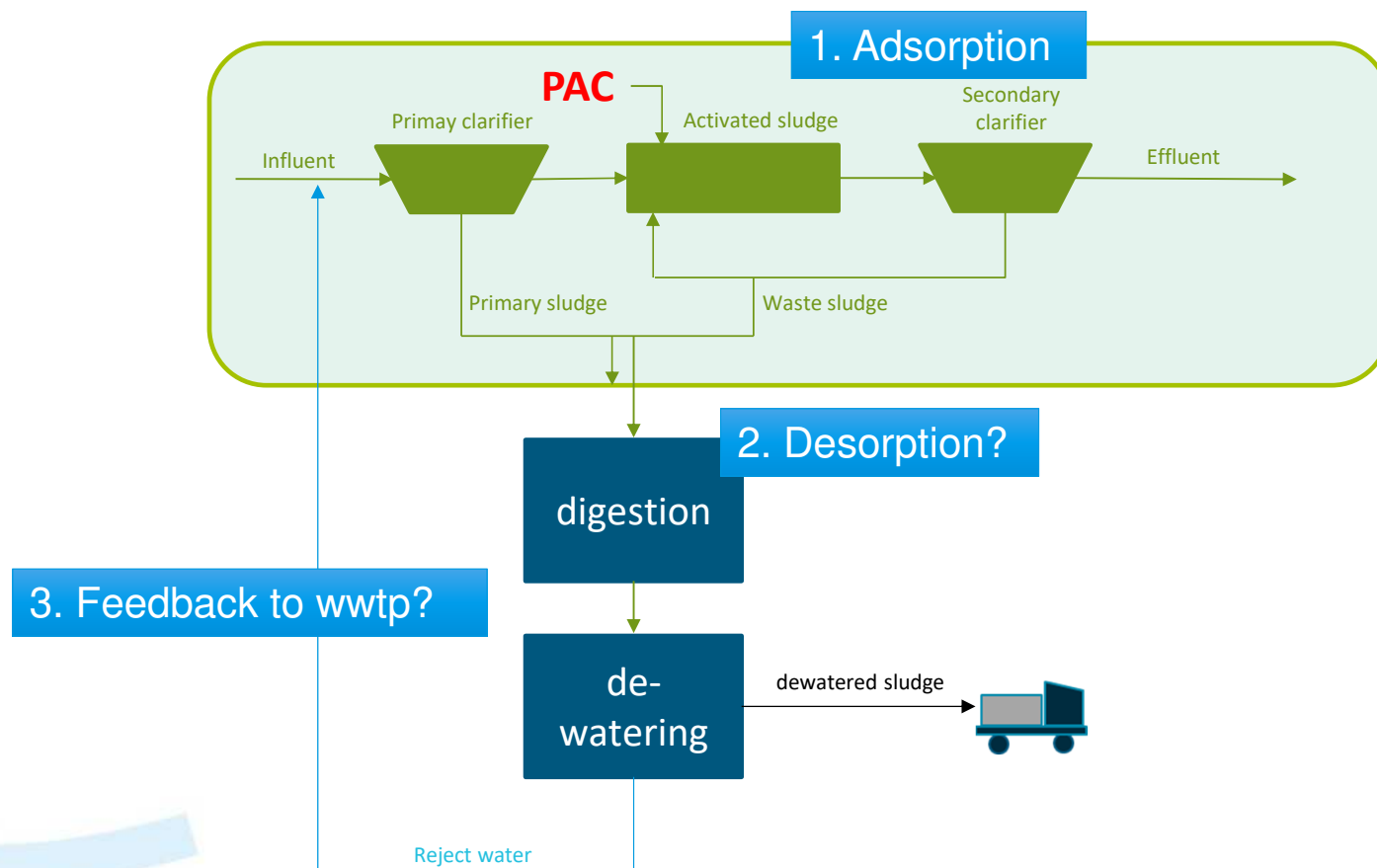


Wat happens to micropollutants at a wwtp?

- On average 30-40% is removed
 - Primarily by adsorption and biological conversion
- Adding PAC to activated sludge reactor may increase removal to $> 70\%$
- By: adsorption



What was investigated?



What was investigated?

Could desorption processes be
a show stopper
for application of PAC at wwtps?



How did we approach the question?

- Literature review
 - Fate of micro pollutants in digestion
 - German and Dutch experiments
 - Lab test thermal pressure hydrolysis
- Modeling
 - mass balance based on literature
 - centralised and 'stand alone' digester
- Interviews with experts from Kompetenz Zentrum Baden Württemberg (D) and EAWAG (CH)



What did we find?

- Application of PAC in water line leads to negligible amounts of micro pollutants in internal feed back via reject water
- Also without PAC dosing, there is 'desorption' in digester
 - all reference substances
 - 0,1 to 1,4 % of influent load
- No correlation found between substance properties and desorption processes



What did we find?

- Addition of PAC will for some substances increase internal feedback, for others it will decrease.

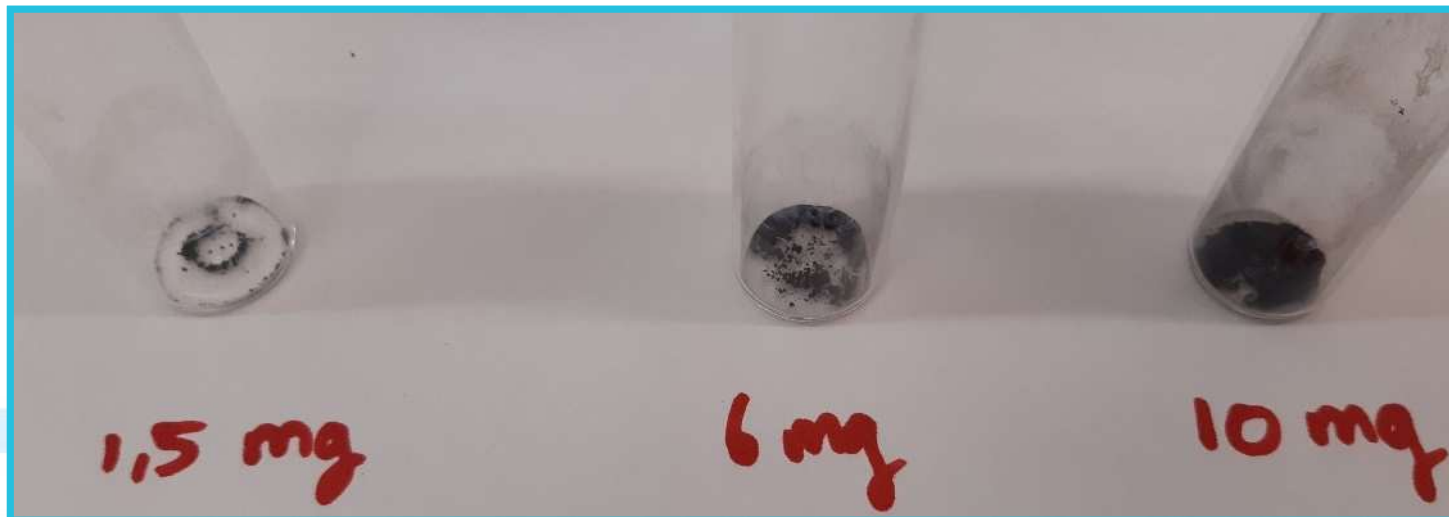
After adding PAC	# substances with increase of internal feedback	# substances with decrease of internal feedback
Thermofilic	4	11
Mesofilic	3	10

- Based on model calculations internal feedback is max 3% of influent load



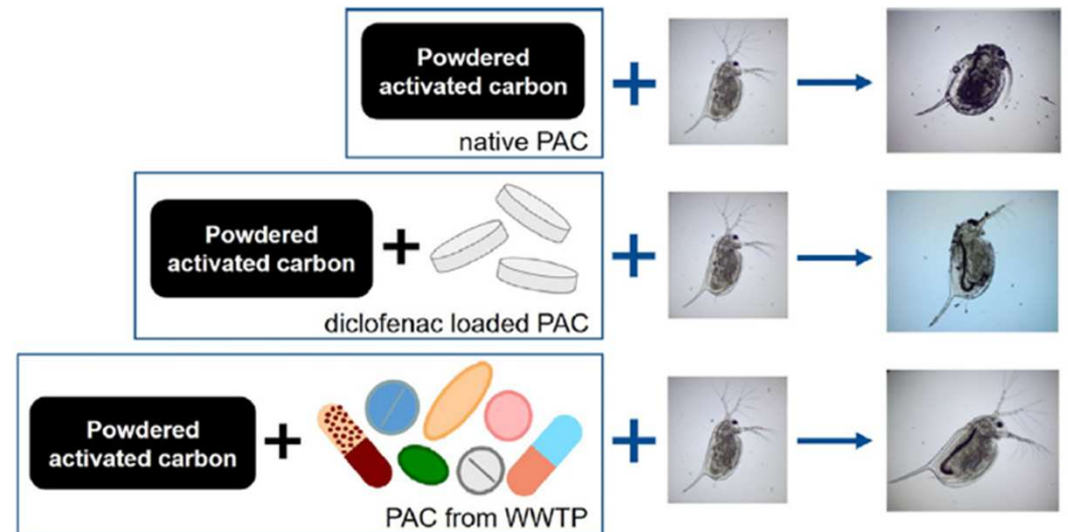
2. PAC in effluent

When PAC is dosed to activated sludge, how can we quantify PAC in treated effluent?



Effects of PAC in effluent

- Research in receiving water body
 - Toxicity of discharge decreases
 - The effluent could not be identified as such, with ecological assessment
- Research with daphnia
 - No chronic effects after exposure to waste PAC from wwtp



Quantifying PAC in effluent

- 4 possible options
- Not selected:
 - MLSS (at 105 Celsius)
 - Ash content
 - Light microscopy
 - Particle counting
 - DOC and TOC
 - Carbon dating

1. Schwarzgradbestimmung

Color change of filter after filtration

2. Turbidity

Light scattering in sample

3. Thermogravimetric analysis (TGA)

Change of mass during temperature increase

4. Density

Measuring density of all constituents in suspended solids



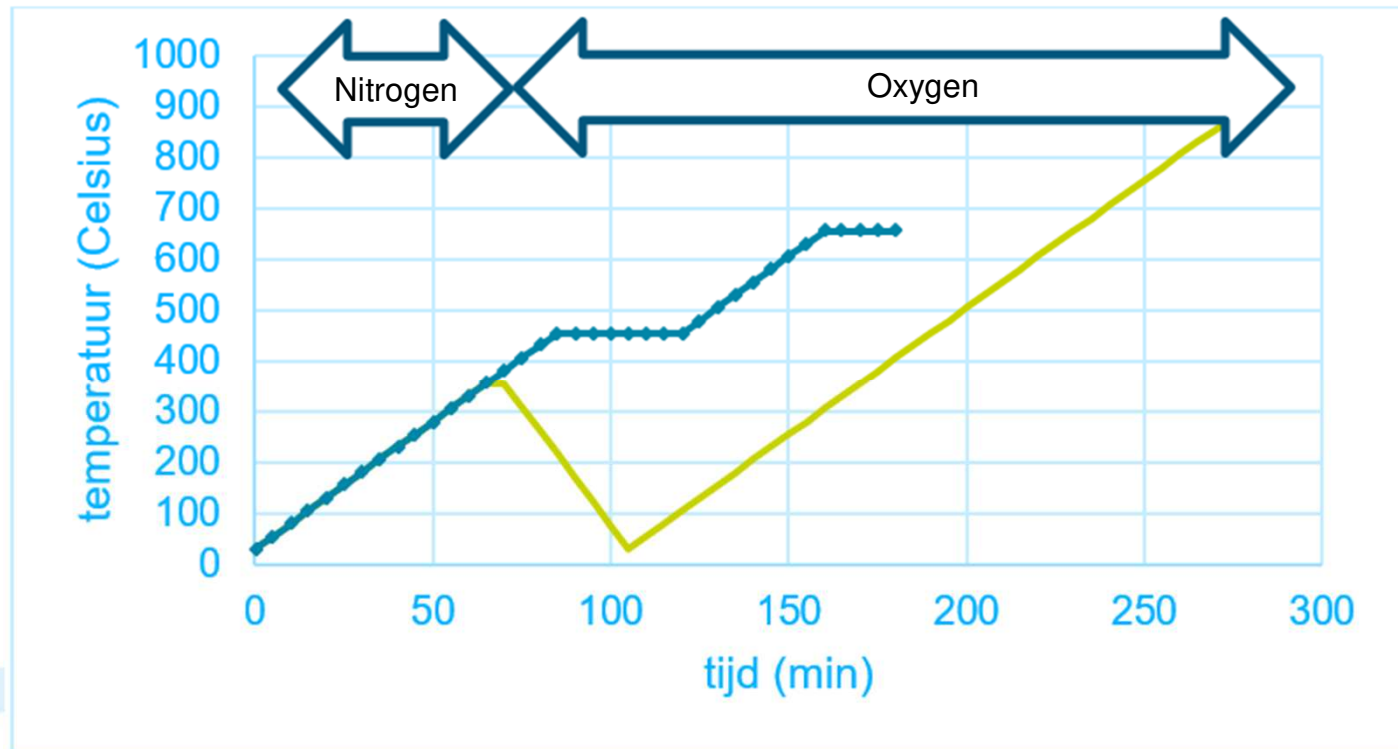
Schwarzgradbestimmung

- Color change (blackening) of filter paper
- Visual assessment by comparing to calibration series



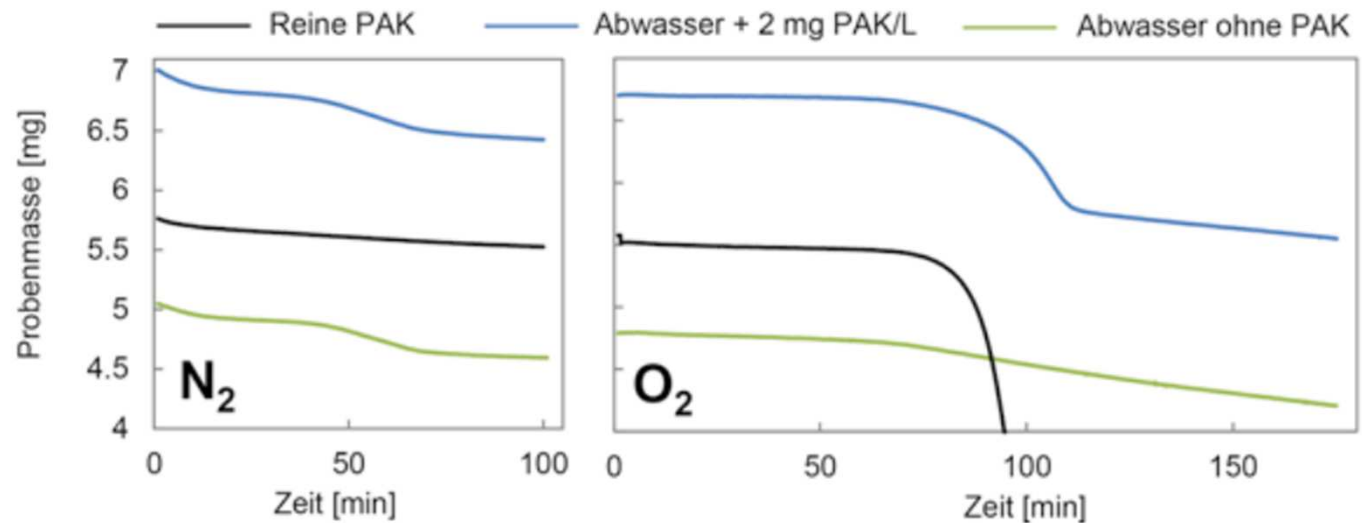
Thermogravimetric analysis

- Temperatuur range
- Different atmospheres



Thermogravimetric analysis

- Mass loss at specific temperature
- Needs large starting mass



Useful for NL wwtp ?

- PAC demonstrable from 0.5 mg/l
- Fits to current practice at wwtp
- Limited sample preparation
- Sample volume
- Cost and operational effort
- Needs reference (without PAK)
- Interpreting results



Conclusions and recommendation Schwarzgradbestimmung

- Schwarzgradbestimmung is useful method to get an indication how much PAC is in effluent. Points of attention:
 - Calibration line before start of dosing PAC
 - Challenge of changing background color
- Is will be tested at Simpelveld en Leiden-Noord wwtp

Recommendations

- Standardising decoloring of sample
- Investigate digitisation of interpretation via image analysis



Conclusion and recommendation

Thermogravimetric analysis (TGA)

- TGA can quantify PAC in effluent
 - Requires specialist knowledge and sample preparation
 - Has high accuracy

Recommendation

- Gain experience with the method, aiming at:
 - Reducing sample volume
 - Simplify sample preparation
 - Standardising/automate interpretation





Thank you for your attention!

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Tackling Micropollutants in Wastewater
Results of the Dutch Innovation and Implementation Program



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