



Water Research Centre

Adsorption and biodegradation of T&O in GAC and BAC

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Introduction: Taste and odour

Geosmin, 2-MIB and hundreds of • others.

• Cyanobacteria, algae, benthic organisms.

• Defence mechanism?

Extremely low human odour threshold • (< 10ng/L).



Introduction: T&O treatment













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Introduction: GAC & BAC





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Objectives

• Understand the effect of carbon characteristics on adsorption.

• Understand the effect of carbon characteristics on biofilm formation and biofiltration.

• Asses the impact of seasonality on the removability of T&O.

• Investigate changes in the biofilm due to exposure to T&O.





Methodology

Characterisation & Adsorption monitoring



log Equilibrium concentration (ng/L)

Biofilm & adsorption evolution

Biofilm characterisation









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Adsorption

• Micropore volume.

• BET as fallback option.

• Oxygen content has little influence: conflicting bonds

First order k	0.71	0.93	0.47	0.34	-0.62	-0.8	-0.071	0.32	-0.42	-0.43	-0.089
Second order k	0.61	0.98	0.48	0.45	-0.66	-0.71	-0.18	0.4	-0.42	-0.45	-0.042
Removal after 3h contact	0.53	0.94	0.41	0.44	-0.69	-0.73	-0.29	0.34	-0.42	-0.46	-0.082
Removal after 8h contact	0.67	0.95	0.46	0.4	-0.65	-0.76	-0.14	0.27	-0.49	-0.51	-0.16
Removal after 7d contact	0.78	0.87	0.52	0.25	-0.52	-0.84	0.0066	0.28	-0.36	-0.35	-0.072
n	0.64	0.92	0.55	0.47	-0.55	-0.68	-0.026	0.46	-0.37	-0.26	0.024
Kf	0.25	0.14	-0.1	-0.0093	-0.18	-0.21	0.082	-0.37	-0.3	-0.53	-0.4
nds	BET	Micropore volume	Volume < 10nm	Average pore diameter	Mesopore volume	Macropore volume	Effective particle size	01sA	01sB	Si2p	O1sA+B

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- 0.75

- 0.50

- 0.25

- 0.00

- -0.25

-0.50

- -0.75



Adsorption evolution

• Steady T&O removal.

Rapid decline in DOC removal.
Not a good indicator

 Similar kinetic and isothermal removability.









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Biofilm growth





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Biofilm properties



Surface area







Biofilm V







(A)

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The microbiome









Microbiome changes with age and pre-exposure



Conclusions

- Adsorption is controlled by micropore volume (< 2 nm).
- Carbon characteristics have little impact on biofilm growth, but still play a major role on biofiltration performance.
- Kinetics and isothermal experiments suggest adsorption is primary mechanism.
- Biofilm is complex, diverse, and quickly colonises the granules, increasing in thickness as time goes on.
- Alpha diversity does not change much with age, but beta does.
- Pre-exposure to T&O has little to no effect on the microbiome or on the removability.







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