

Water treatment for T&O. Challenges, gaps and perspectives.

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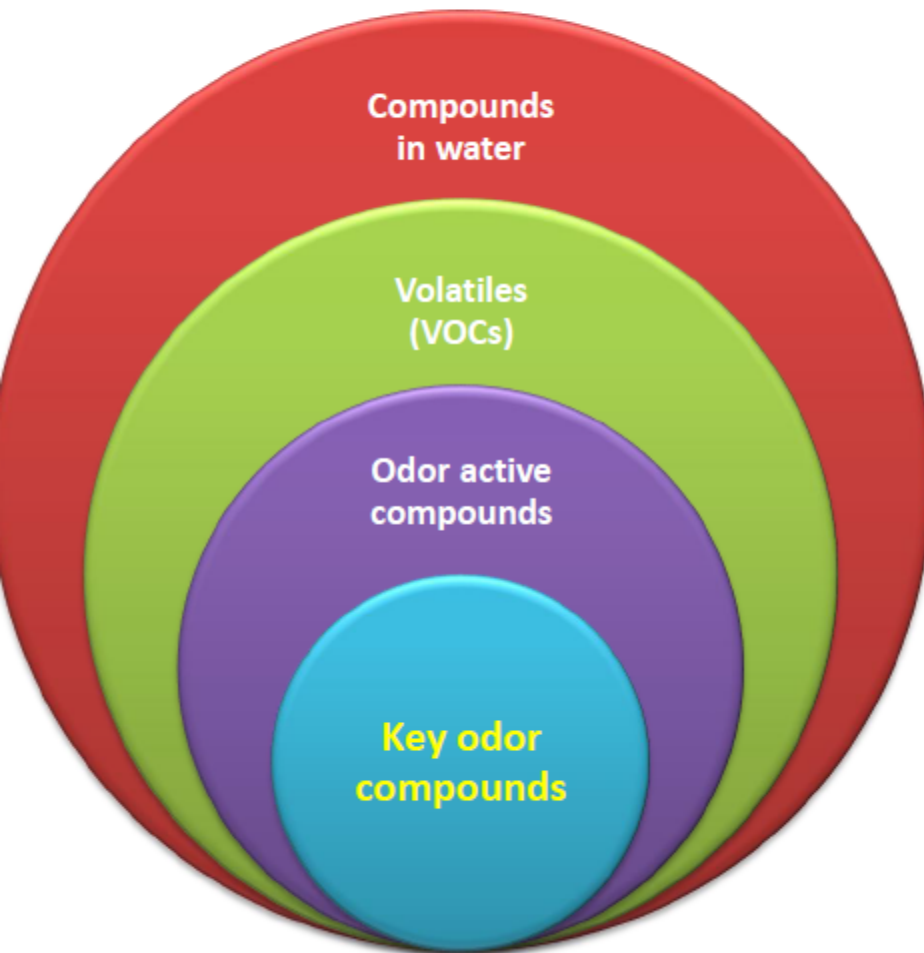
NCSR Demokritos, Greece

WaterTOP Editorial Meeting, 27-30 September 2021, Nafplio, Greece



Water Taste and Odor Compounds (T&O)

Water volatiles vs T&O



Water odors and odor thresholds

Compound	Mean Odor Threshold in water ($\mu\text{g/L}$)	Descriptor
geosmin	0,004	earthy
2-MIB	0,015	musty
2-Isobutyl-3-methoxypyrazine	0,0001	stale, musty
2,4,6 TCA	0,0009	musty, earthy
naphthalene	6	mothballs
chloroform	30000	chemical, antiseptic
B-cyclocitral	19	tobacco, woody
Dimethyl trisulfide	0,010	septic
b-ionone	0,007	violets

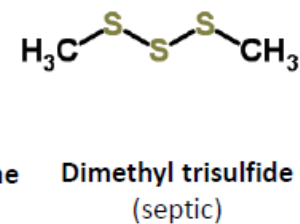
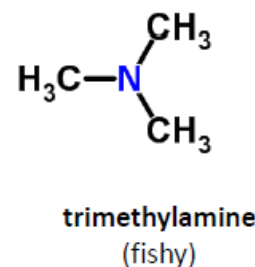
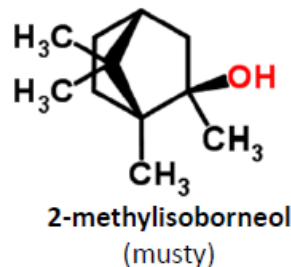
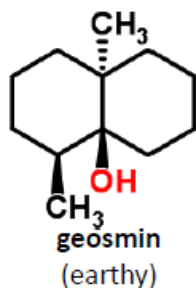
Young et al. (1996), Water Research, 30(2),331-340

Cotsaris et al. (1995), WST, 31(11), 251-258.

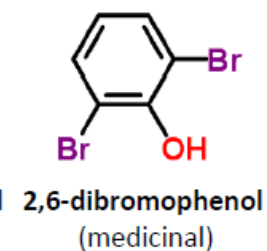
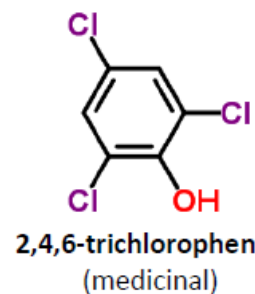
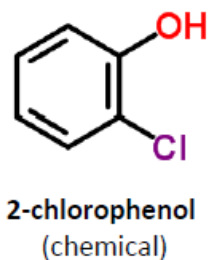
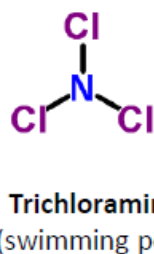
Sources of water T&O

T&O is the most frequent cause of consumer complaints

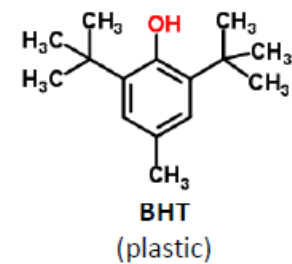
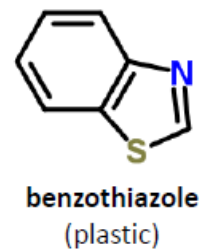
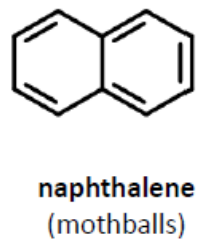
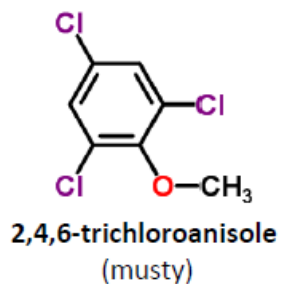
Surface Water
Reservoirs
Algal
metabolites



Water
treatment
Chlorination
products



Distribution
network
biofilm activity,
materials in
contact



Treatment of water for removal of T&O compounds

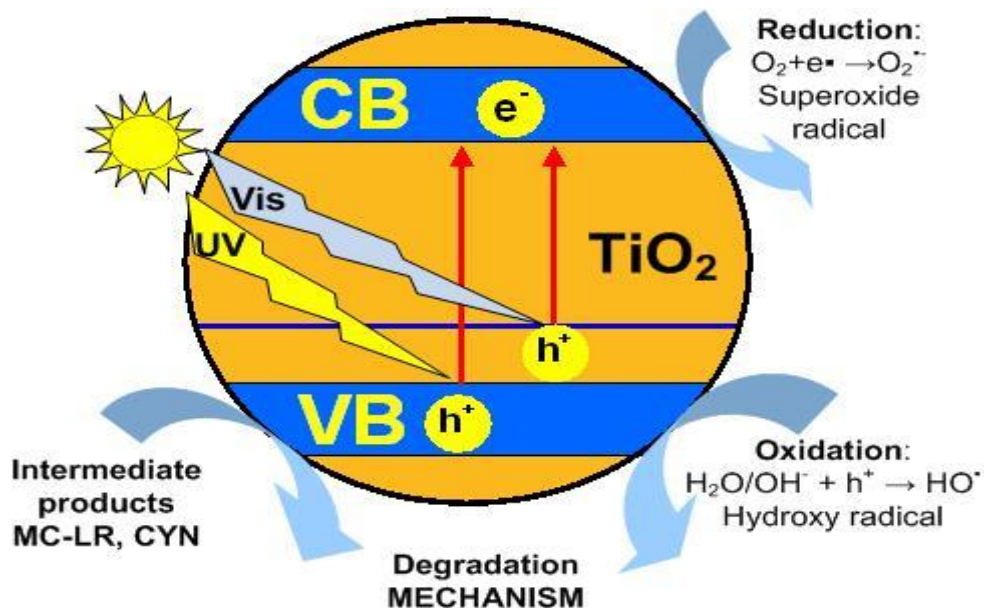
Challenges

- Due to their low odor threshold T&O compounds need to be removed from water even at the ng L^{-1} level
- Few conventional treatment methods are efficient in their removal
- Coagulation, flocculation, sedimentation and filtration are generally ineffective.
- Common disinfectants and oxidants are unable to control T&O in drinking water
- Adsorption by powdered/granular activated carbon or ozonation present better suitability with limitations
- The presence of natural organic matter can dramatically reduce treatment effectiveness

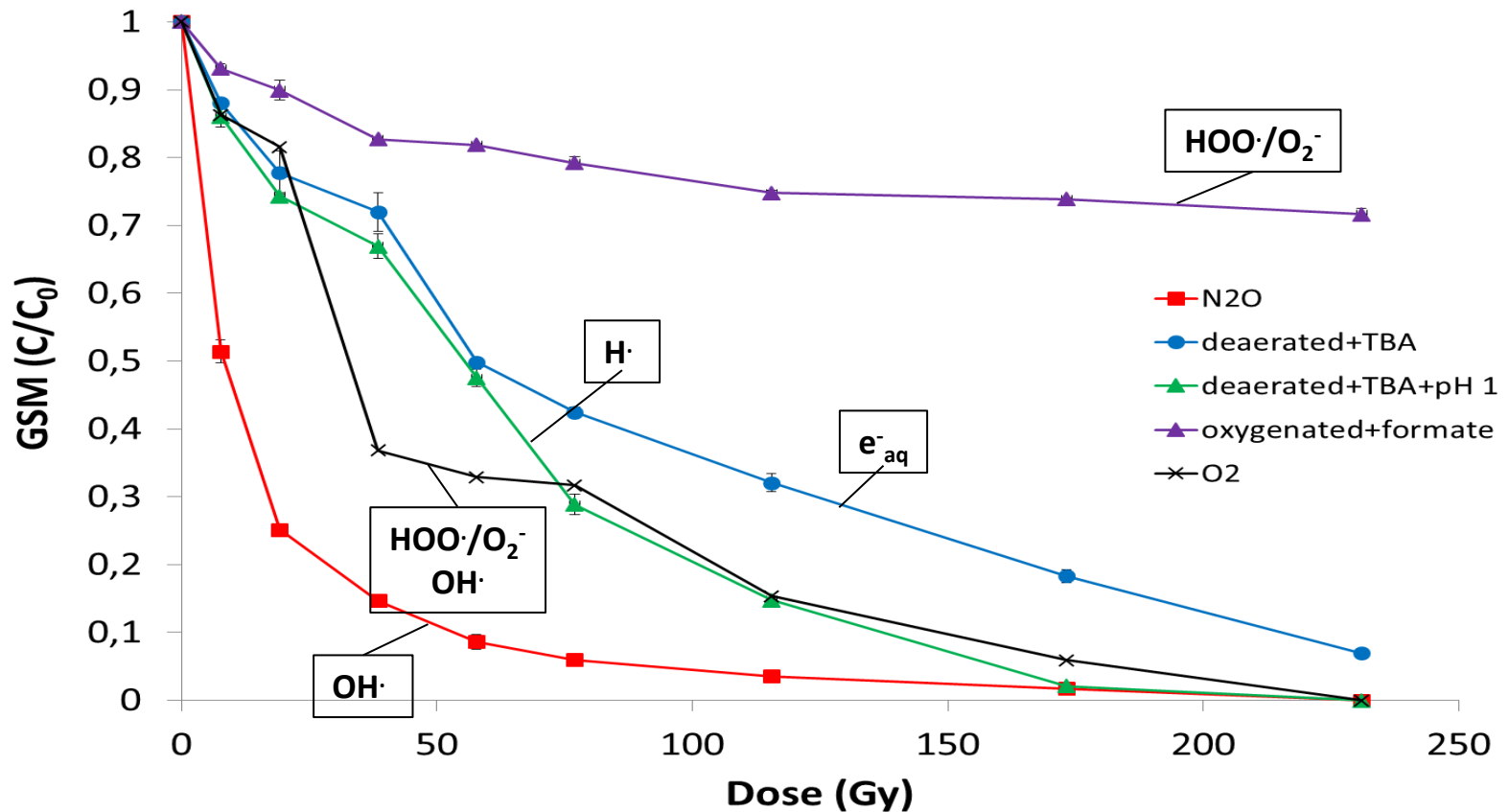
Need for alternative efficient treatment processes

Emerging water treatment technologies: Advanced Oxidation Processes (AOPs)

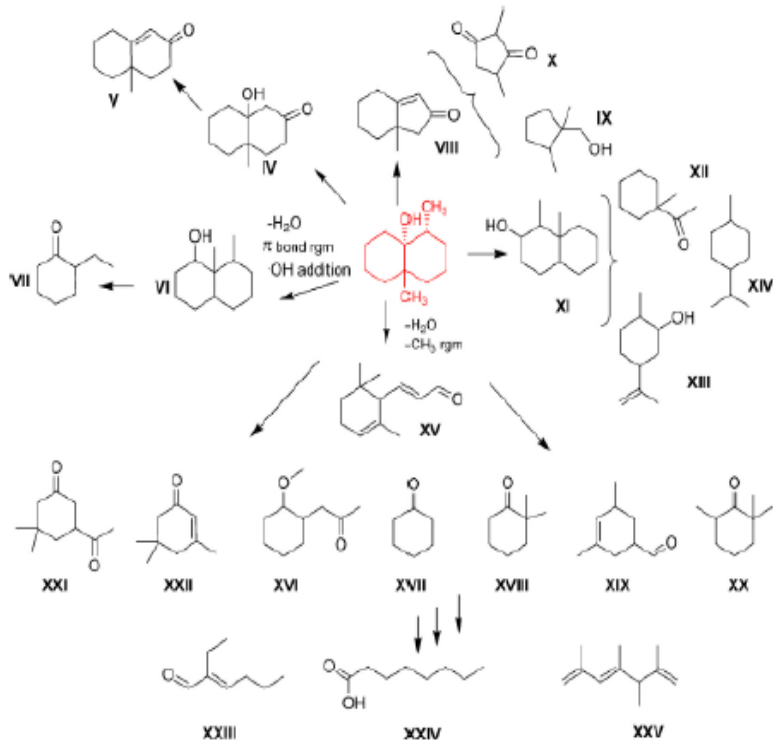
- Based on reactive oxygen species (ROS) and highly reactive radicals
- UV-Vis Photocatalysis (e.g. TiO_2 , POM) UV/ H_2O_2 , UV/ O_3 , UV/ Cl_2 , (photo-) Fenton Sonolysis, Radiolysis
- Non-selective degradation that can lead to complete mineralization to CO_2



Degradation of geosmin by different reactive species produced through γ -radiation

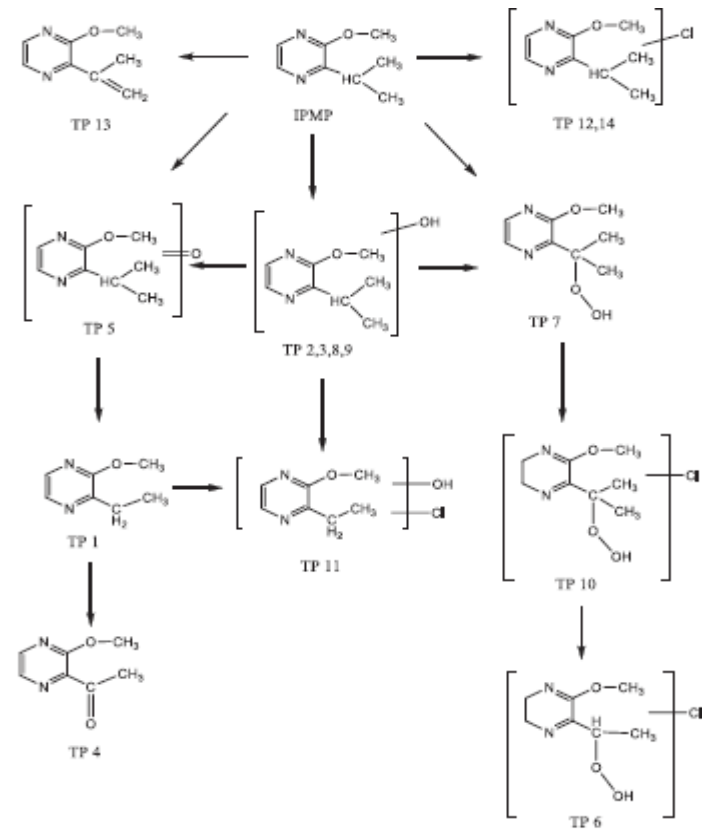


Transformation Products of T&O generated by AOPs



Transformation products of geosmin during POM and TiO₂ photocatalysis

Fotiu et al. (2014), *J. Photochem. Photobiol. A* 286, 1-9



Transformation products of 2-isopropyl-3-methoxy pyrazine during UV-A/Chlorine process

Antonopoulou et al. (2020) *Science of the Total Environment* 732 138404

Are AOPs the missing link in water treatment for T&O? Gaps to be filled

- Applicability of the process under real conditions/environmentally relevant concentrations
- Utilization of existing infrastructure of WTP
- Pilot-scale studies
- Sufficient data related to the transformation products formed
- Elucidation of reaction mechanisms for fine tuning of the processes
- Combination of processes, e.g. UV/Cl₂ , UV/O₃
- ...

To meet the objectives of WATERTOP, WG4 will contribute to the perspective paper in CEJA by discussing

- The need for additional/special water treatment
- Limitation of conventional methods
- Emerging AOPs for water T&O removal focusing on UV-based processes. Applicability, large-scale vs small scale or point-of-use...
- Presence of transformation products of T&O in the environment and during water treatment processes.
- Combination of methods for improving removal of T&O e.g. UV/Cl₂
- Further ideas...