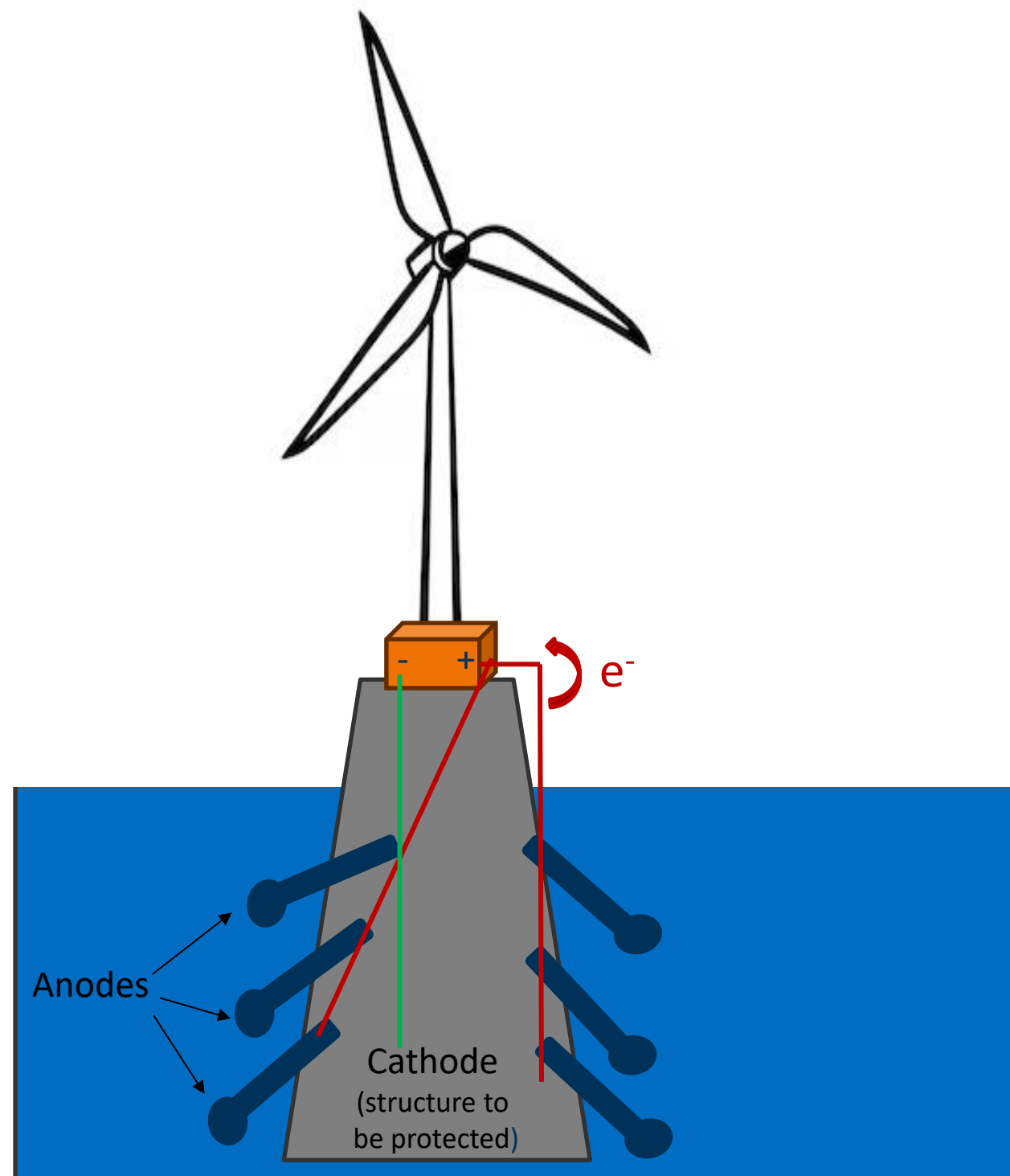


# Nature of chlorination by-products formed during ICCP

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Environmental Chemistry



## Anodic reactions:



	Current Intensity	Cl <sub>2</sub> production rate (in g per hour)	HClO/HBrO production rate (in g per hour)
Polarization phase of metallic structure (during few weeks)	53 A	1264	256
Operational phase	7.8 A	186	38

According to the Faraday's Law:

$$m = \left(\frac{Q}{F}\right) \times \left(\frac{M}{z}\right)$$

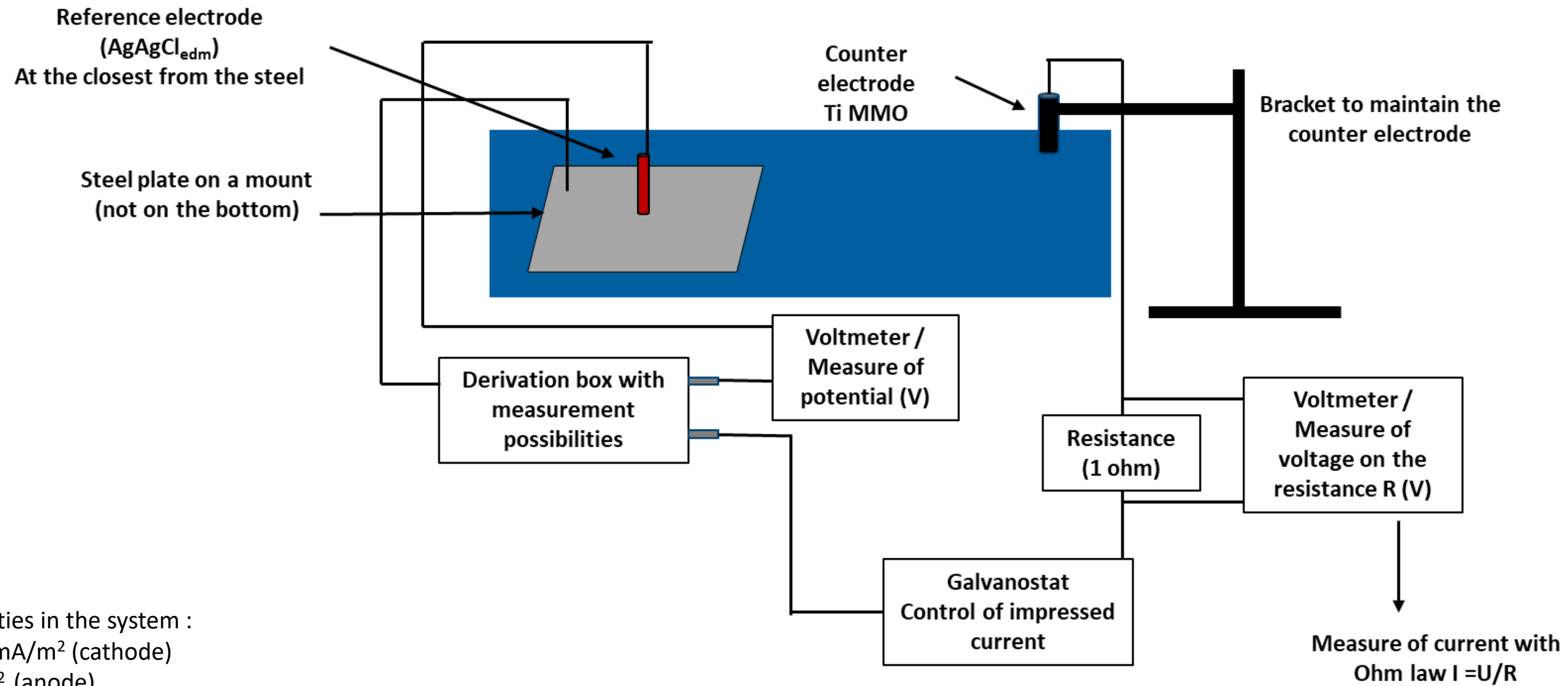
m : mass of compound released from the electrode (in grams per second) ;

Q : total electric charge (in amperes : A) ;

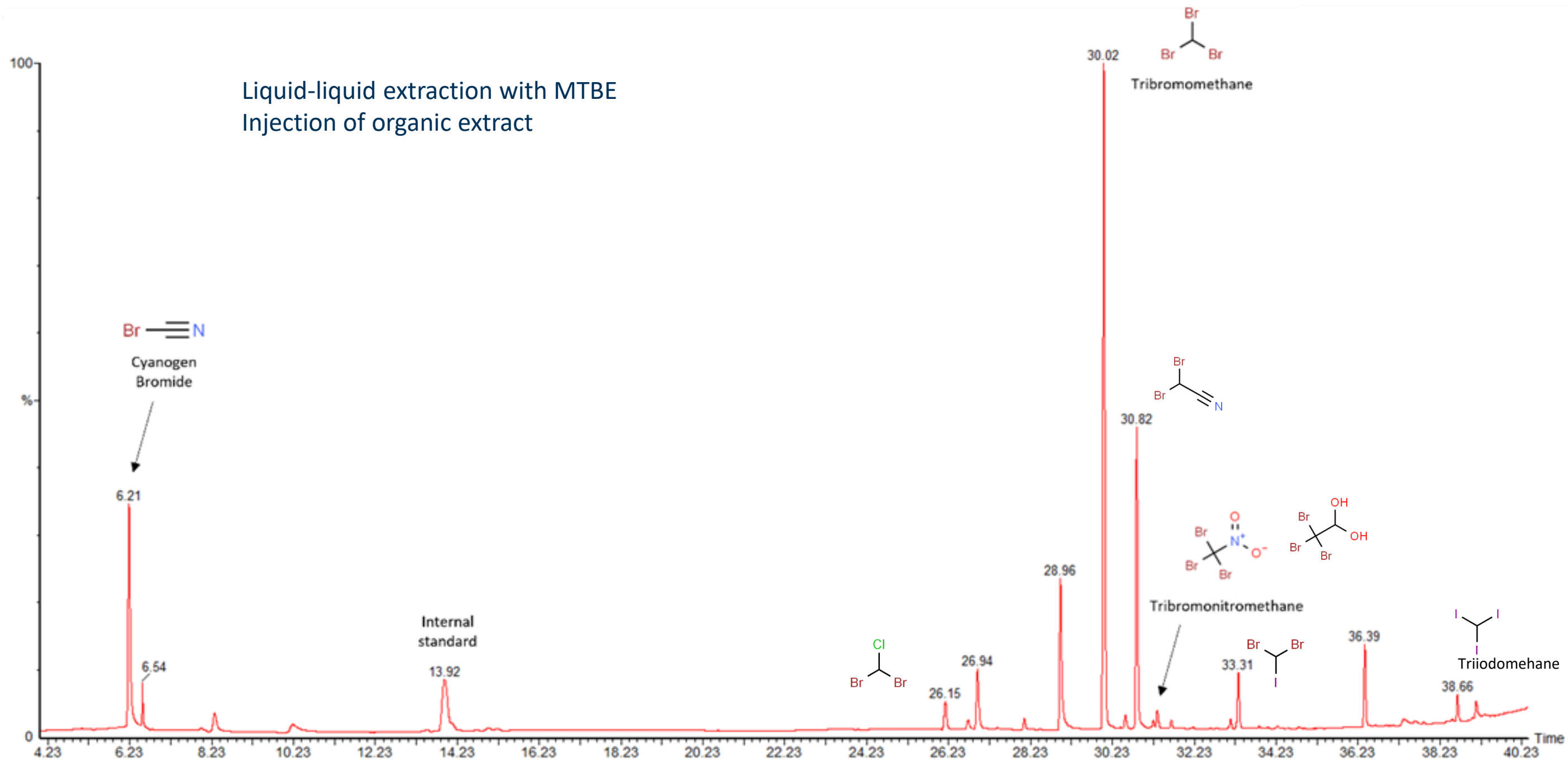
F : Faraday's constant (in Coulomb per mole = 96485 C.mol<sup>-1</sup>) ;

M : Molar mass of the compound (in grams per mol) ;

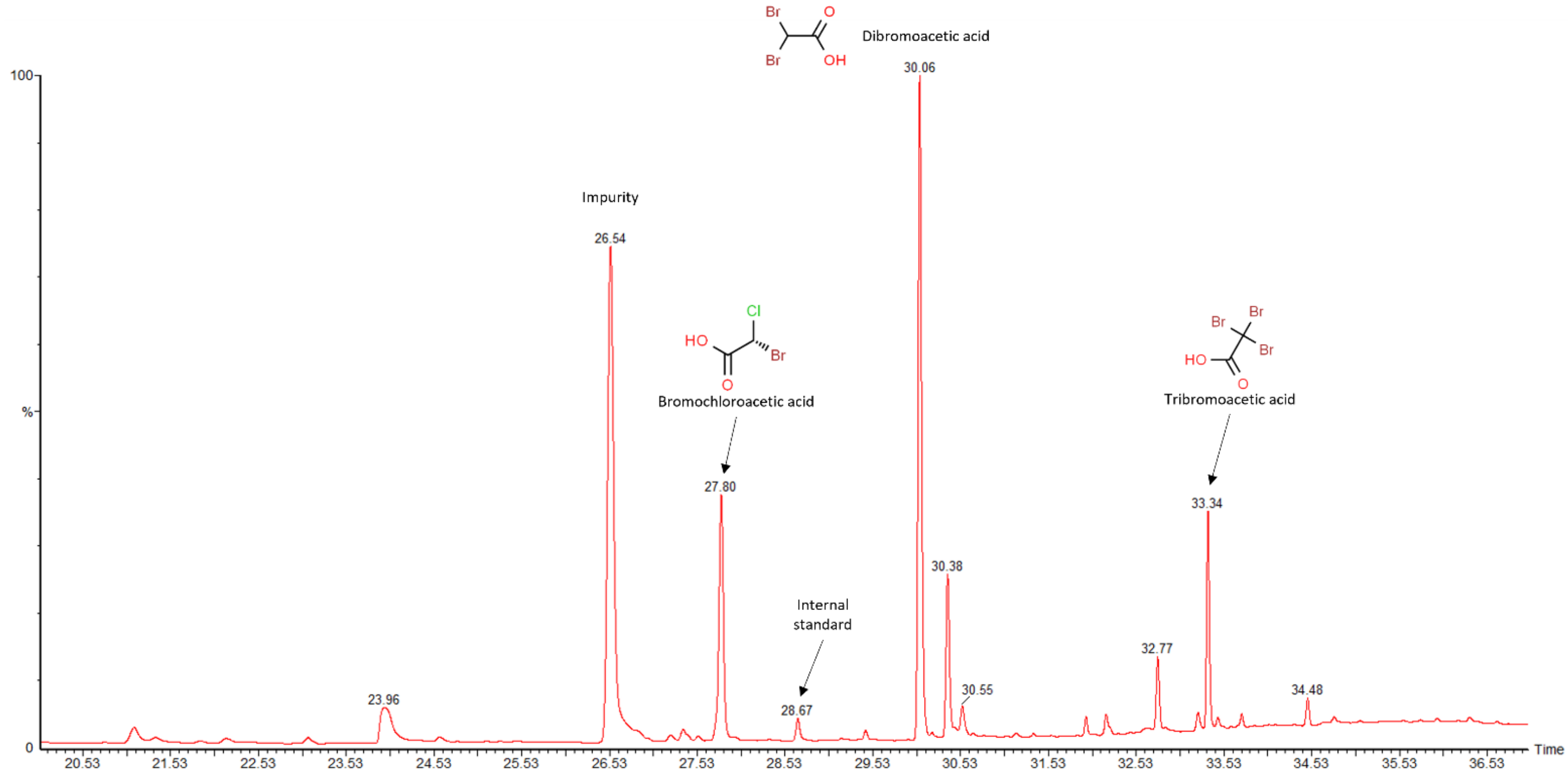
z : Valence of the compound



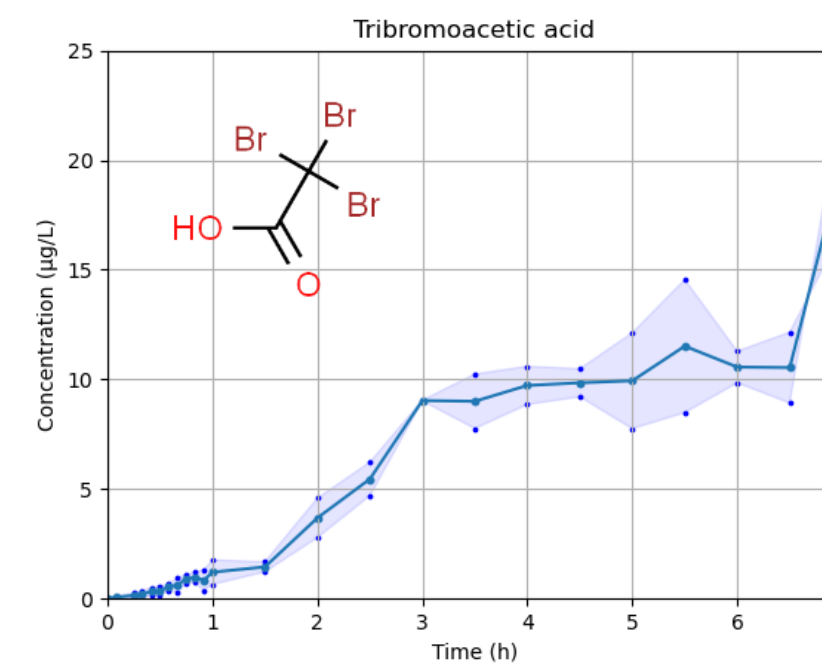
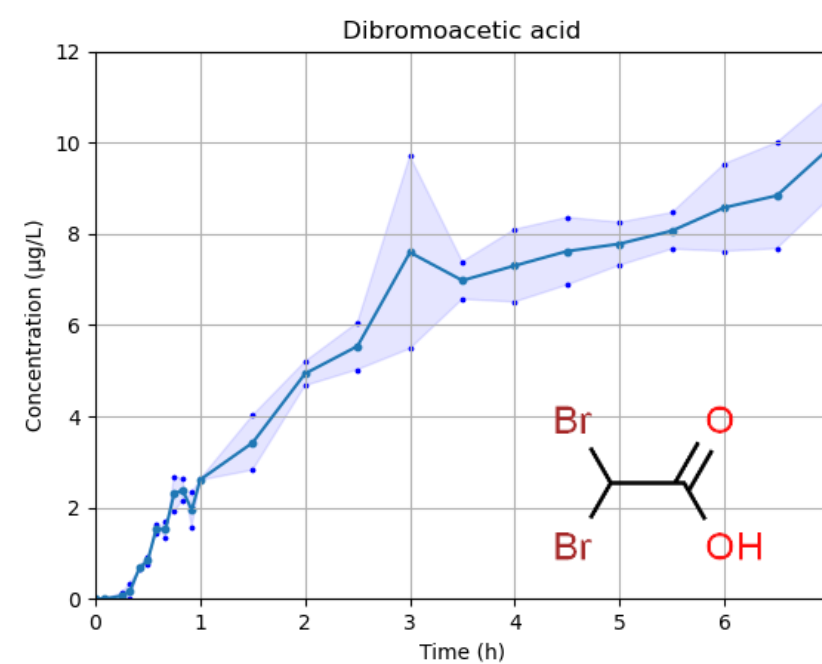
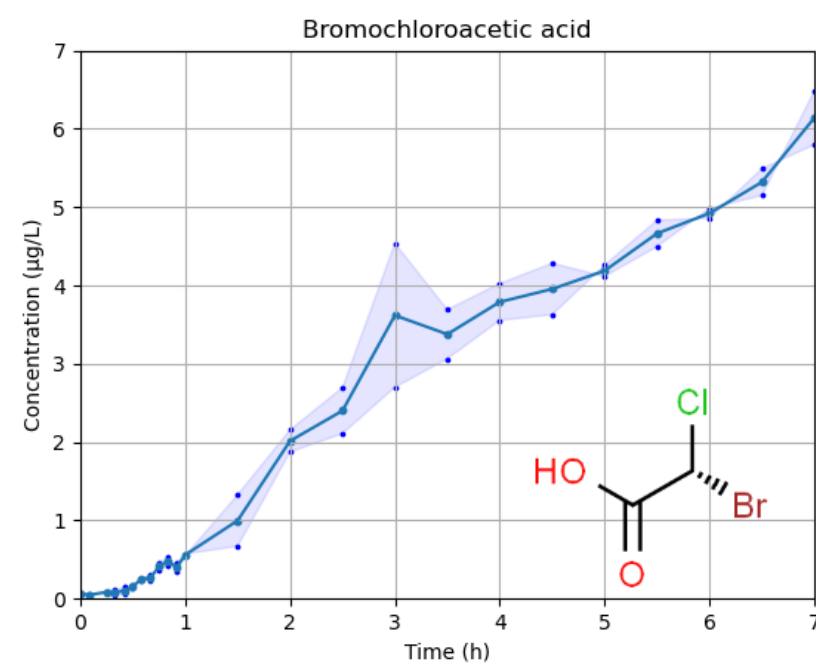
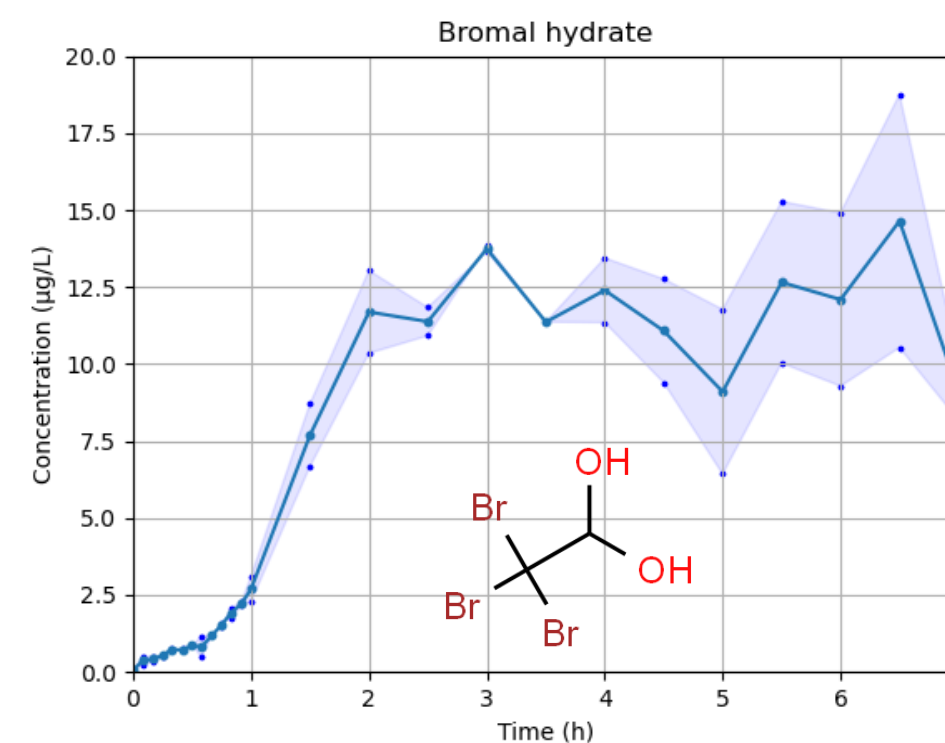
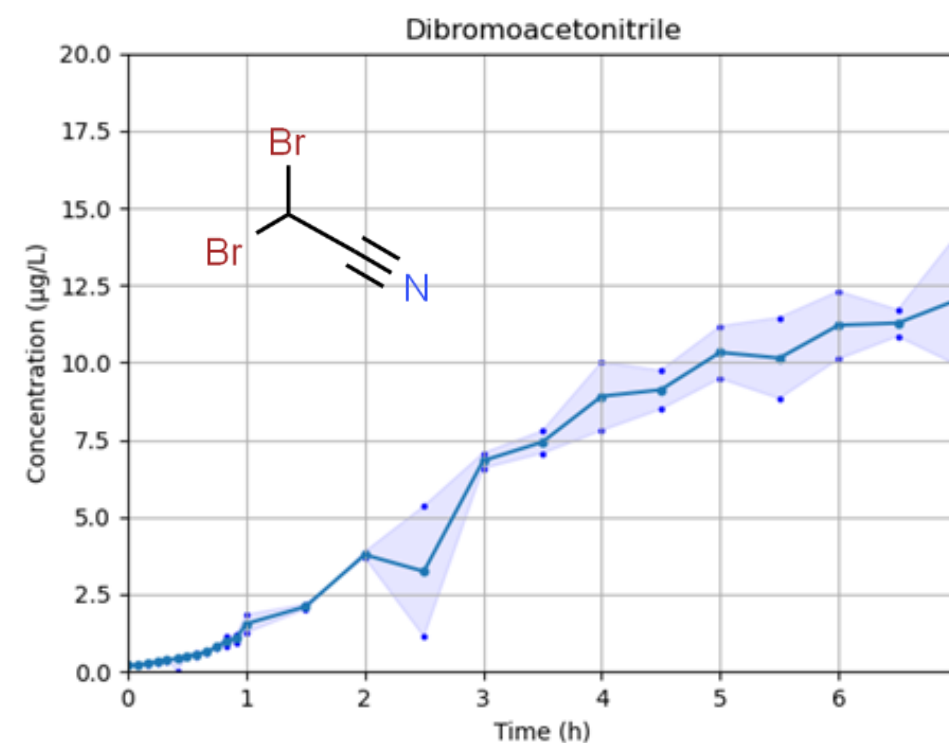
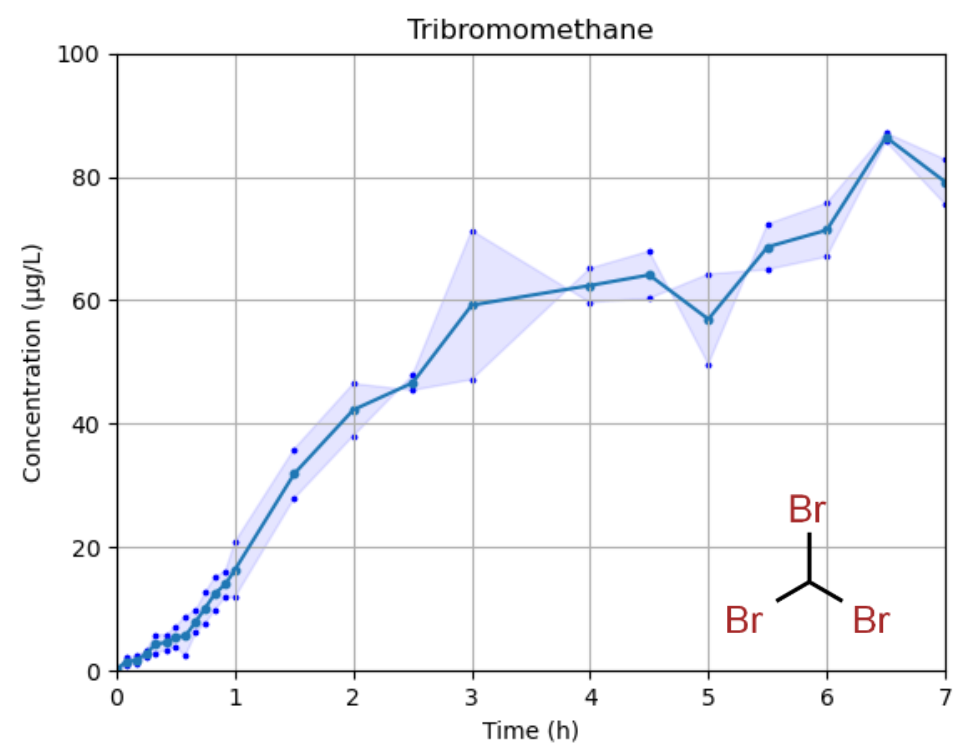
Current Densities in the system :  
187,7 to 250 mA/m<sup>2</sup> (cathode)  
5 to 6,66 A/m<sup>2</sup> (anode)



# GC-ECD analysis of haloacetic acids (HAA)

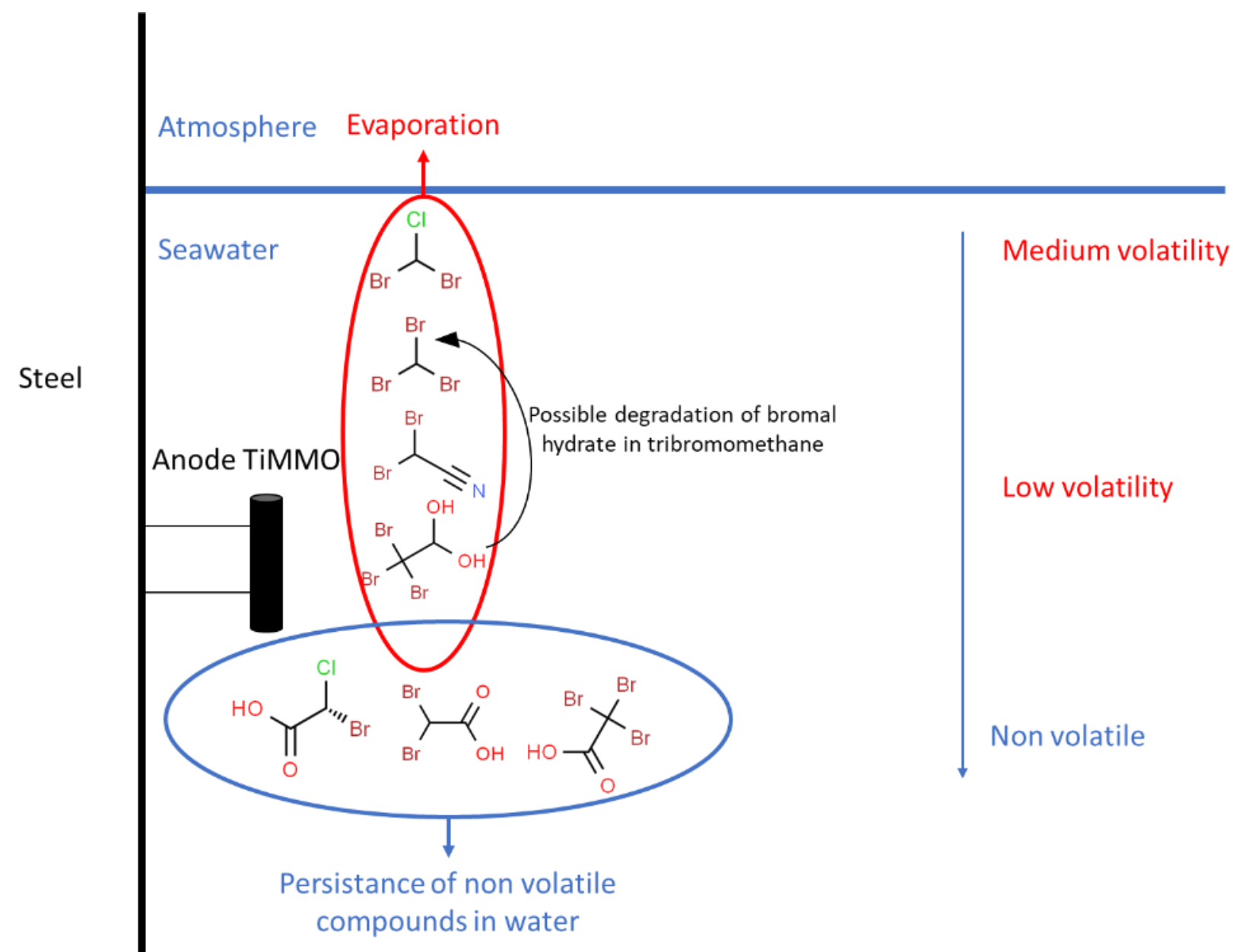


# Kinetics of formation of some CBP



# Kinetics of formation of some CBP

Family of compounds	Identified molecules	Maximum measured concentration (µg/L)	Concentration after 7 hours (µg/L)	Concentration after 26 hours (µg/L)	Vapor pressure (kPa at 20°C)	Volatility (none, low/medium, high)
	Cyanogen bromide	11.1	10.8	4.8	16.2	High
THM	Dibromochloromethane	13.2	4.2	12.2	0.74	Low/medium
	Tribromonitromethane	1.6	1.1	1.6	0.69	Low/Medium
	Tribromomethane	212.3	82.8	194.0	0.67	Low/medium
	Triiodomethane	2.7	0	0	0.0053	None
HAN	Dibromoacetonitrile	26.9	13.8	23.9	0.04	None
HK	Bromal hydrate	18.7	10.0	6.8	0	None
HAA	Bromochloroacetic acid	11.2	8.9	11.2	0.0186	None
	Dibromoacetic acid	15.2	13.3	13.1	0.0026	None
	Tribromoacetic acid	16.3	12.2	16.2	0	None



- 10 compounds belonging to 5 CBP families identifies
- 5 compounds are volatile or semi-volatile; 5 are able to be accumulated in the environment

Compounds	Maximum production rate ( $\mu\text{g}\cdot\text{m}^2/\text{A}/\text{L}/\text{h}$ )	Production with 50 $\text{A}/\text{m}^2$ of current density ( $\mu\text{g}/\text{L}/\text{h}$ )	Extrapolation with 200 $\text{A}/\text{m}^2$ of current density ( $\mu\text{g}/\text{L}/\text{h}$ )
Tribromomethane	0.828	41.4	165.6
Dibromoacetonitrile	0.0308	1.54	6.16
Dibromochloromethane	0.062	3.1	12.4
Bromochloroacetic acid	0.018	0.9	3.6
Tribromoacetic acid	0.0669	3.345	13.38

Extrapolated production rates of identified CBP as a function of current densities (50 and 200  $\text{A}/\text{m}^2$ )

## Need to sample water in real environments

Thank you for you attention

