

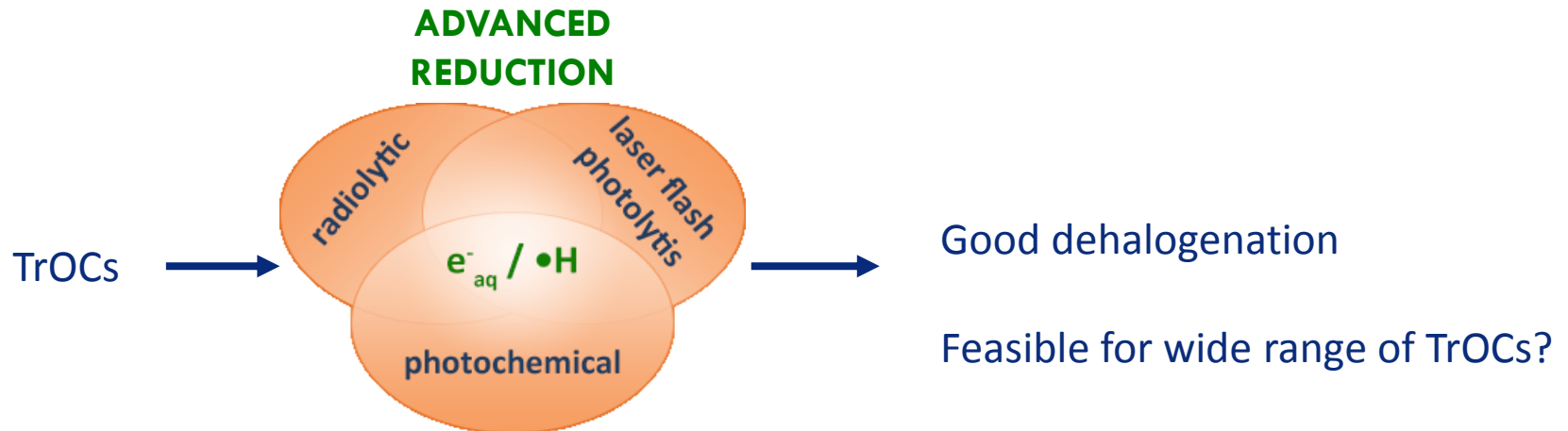
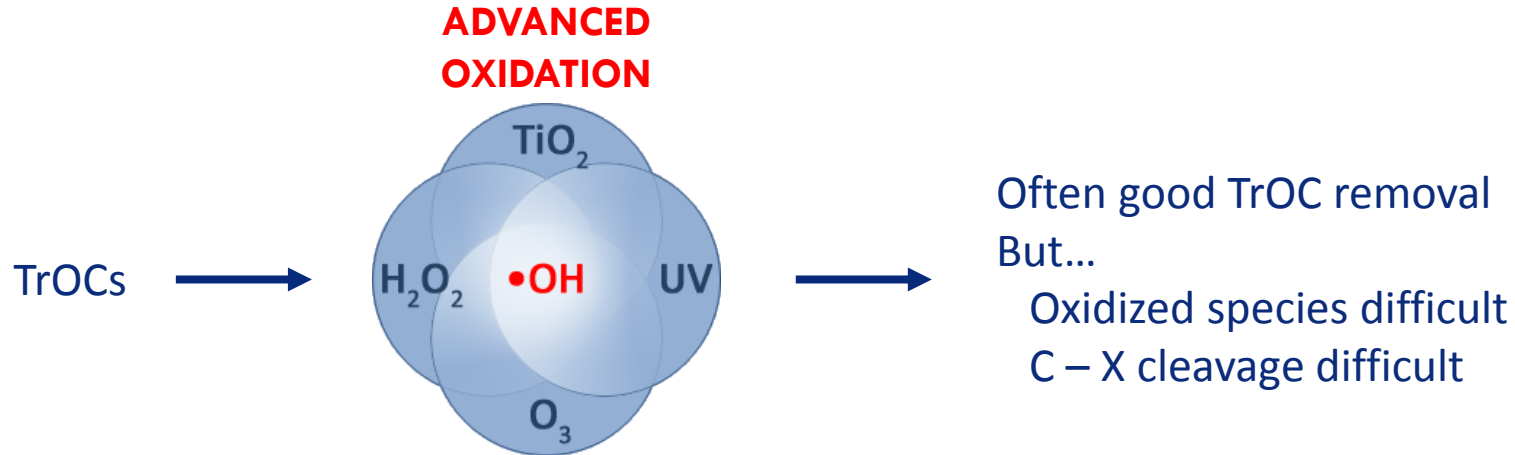
# ADVANCED REDUCTION PROCESSES FOR TRACE ORGANIC CONTAMINANT REMOVAL IN DRINKING WATER TREATMENT

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# TROCs IN DRINKING WATER



# STATE OF THE ART – ALTERNATIVE



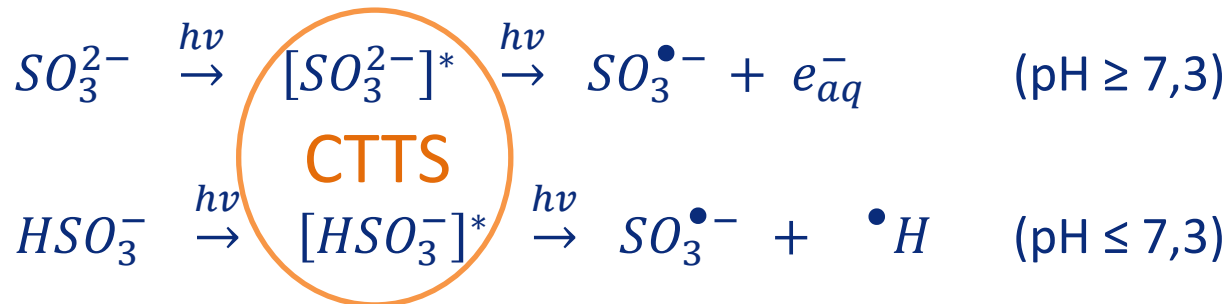
# ADVANCED REDUCTION

Goal: produce highly reactive **reducing radicals**:

- $e_{aq}^-$  (SRP: -2,9 V)
- $\bullet H$  (SRP: -2,3 V)

Production (photochemical):

- Electron donating agent (e.g. sulfite)
- Activation method (e.g. UV irradiation)



3 breakdown mechanisms:

- Reducing radicals (ARP)
- UV (photolysis)
- Electron donating agent (chemical reduction)

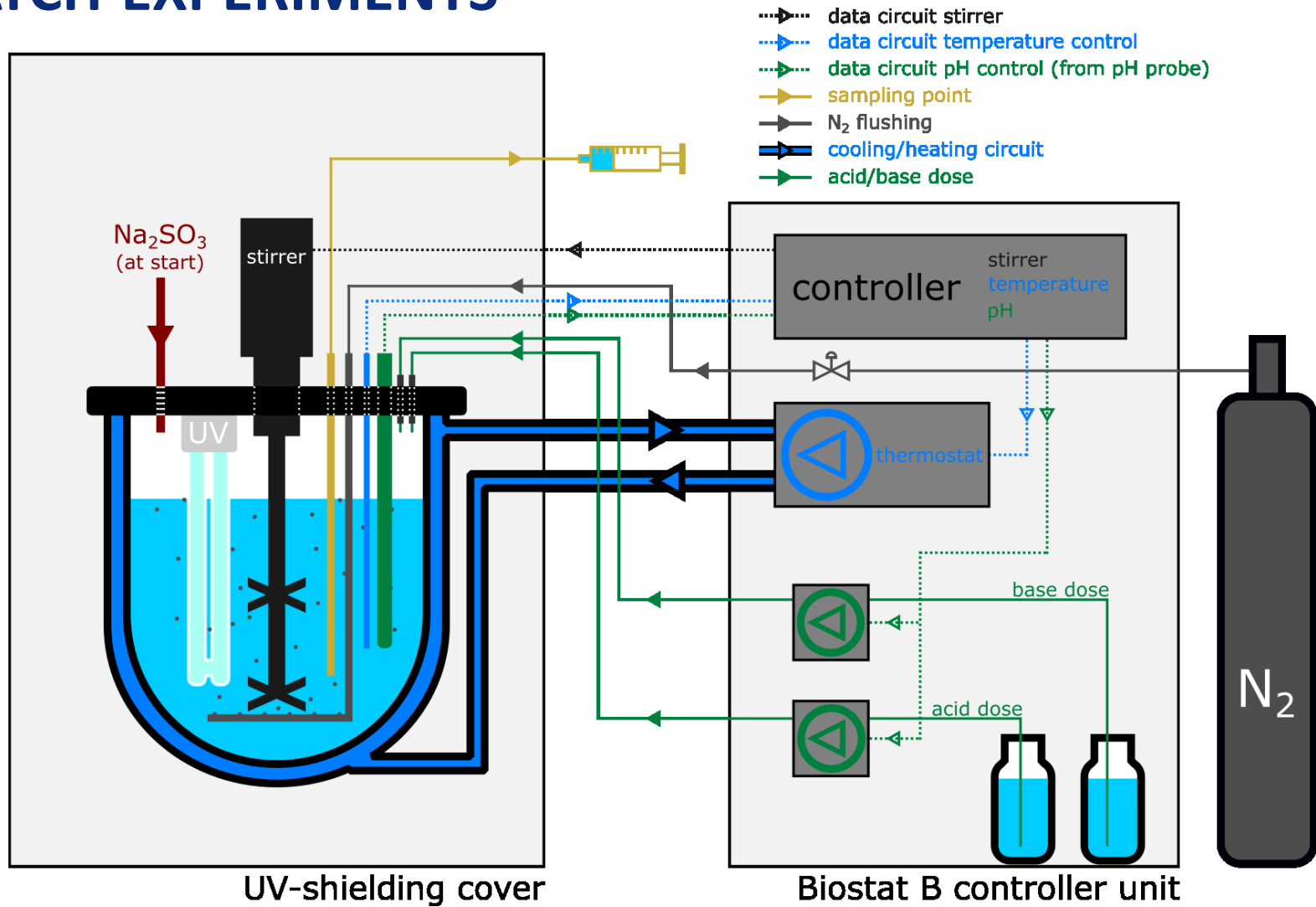
# GOAL

ARP feasible for wide range of TrOCs?  
(mixture of 27)

Influence of sulfite dose  
(0 / 0,1 / 1 / 5 mM)

Influence of pH  
(6 / 8 / 10)

# BATCH EXPERIMENTS

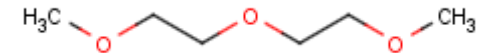


# RESULTS

Blancs: Nowhere chemical reaction with sulfite

→ Photolysis / ARP

TrOCs:  $^{26}_{/27}$  reaction –  $^1_{/27}$  recalcitrant (diglyme)



Classes:

- $^6_{/26}$  mainly photolysis
- $^{16}_{/26}$  mainly ARP
- $^4_{/26}$  indistinguishable (similar or too fast reaction)

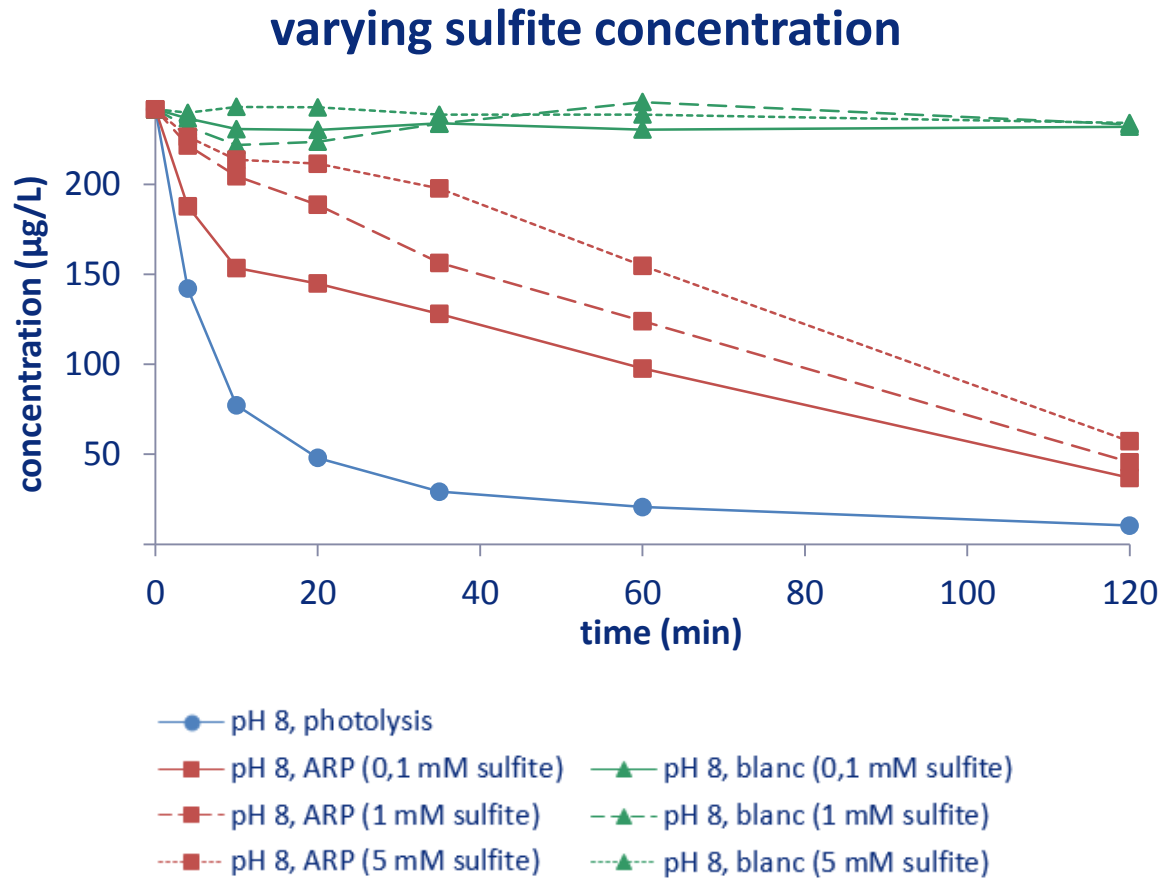
# PHOTOLYSIS – LINCOMYCIN

higher  $SO_3^{2-}$  concentration  
 =  
 slower breakdown

more  $SO_3^{2-}$

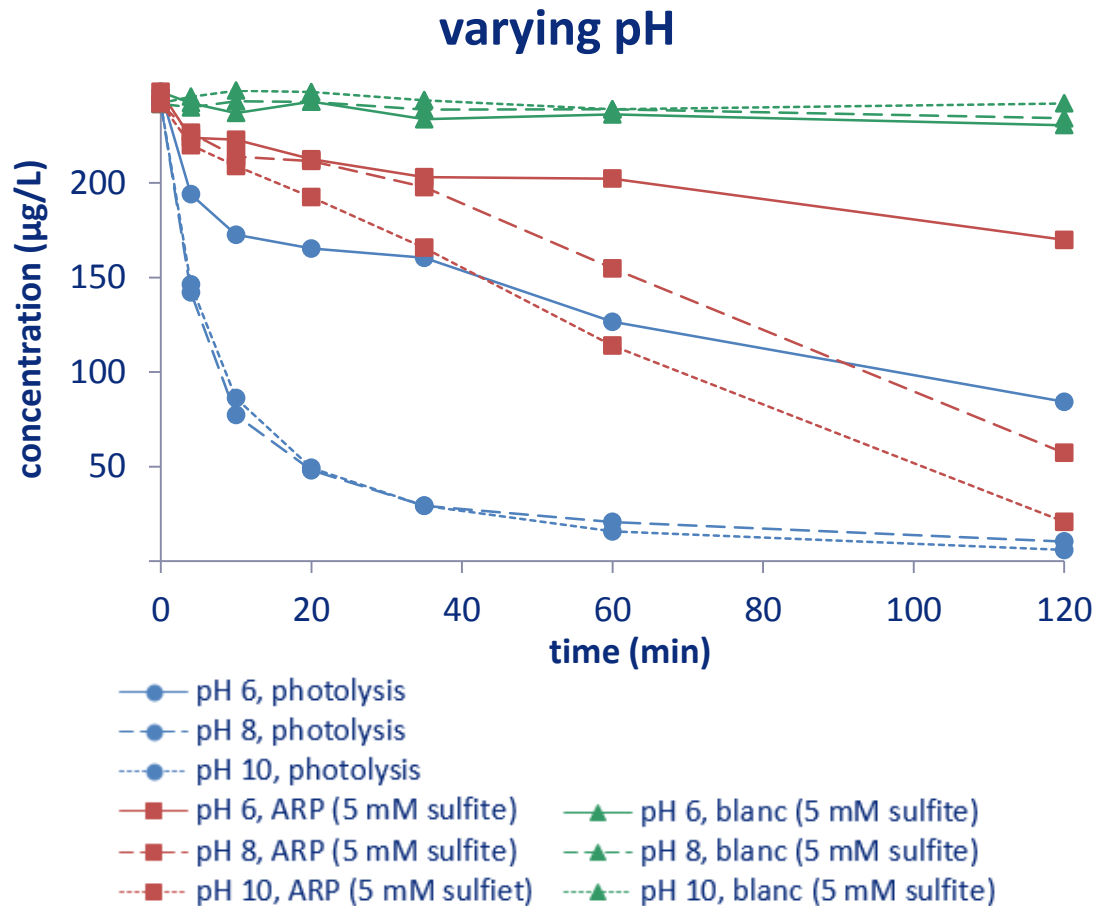
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more  $e_{aq}^-$  production  
 BUT ALSO  
 more *photon* competition

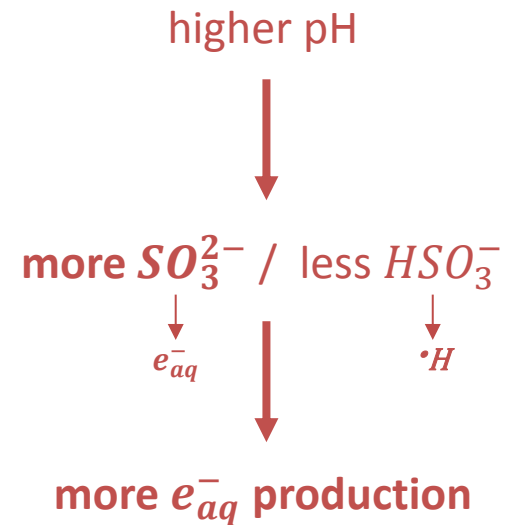




# PHOTOLYSIS – LINCOMYCIN



higher pH  
=  
faster breakdown



# ARP – CAFFEINE

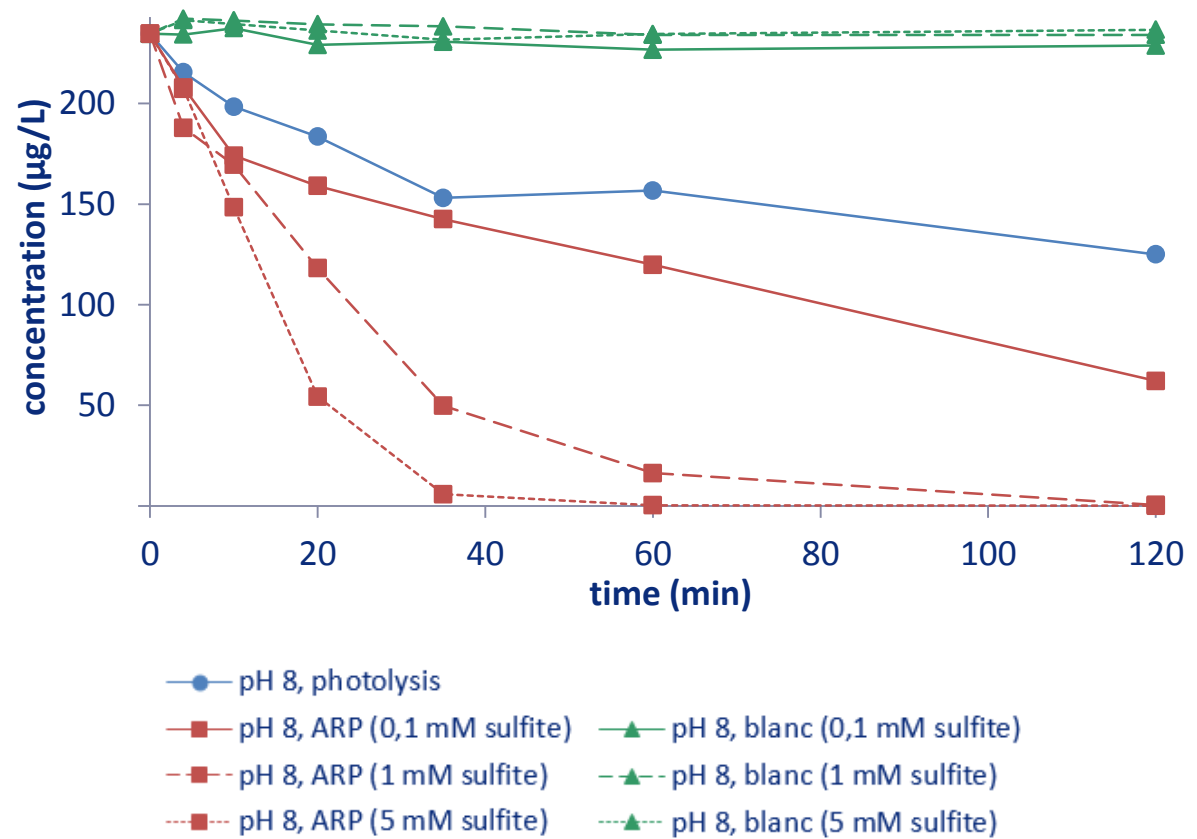
higher  $SO_3^{2-}$  concentration  
= faster breakdown

more  $SO_3^{2-}$



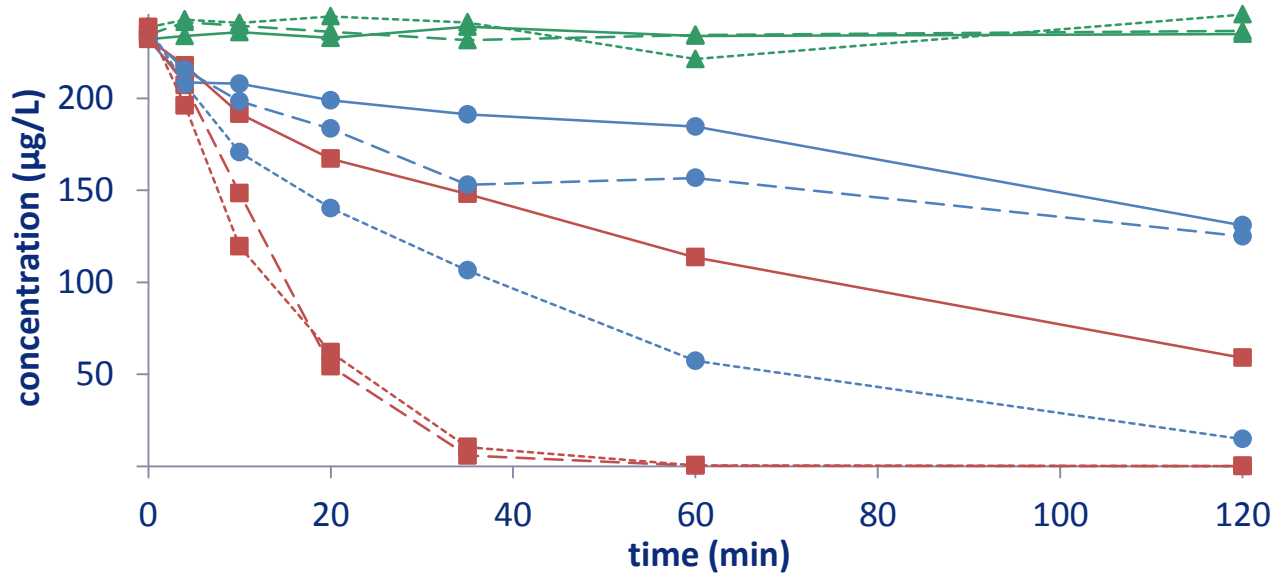
more  $e_{aq}^-$  production

varying sulfite concentration



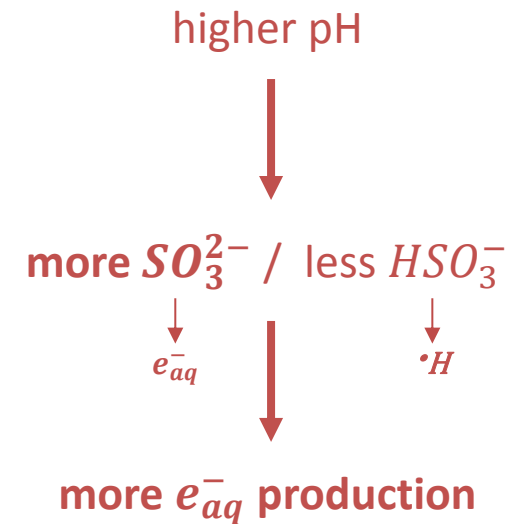
# ARP – CAFFEINE

varying pH



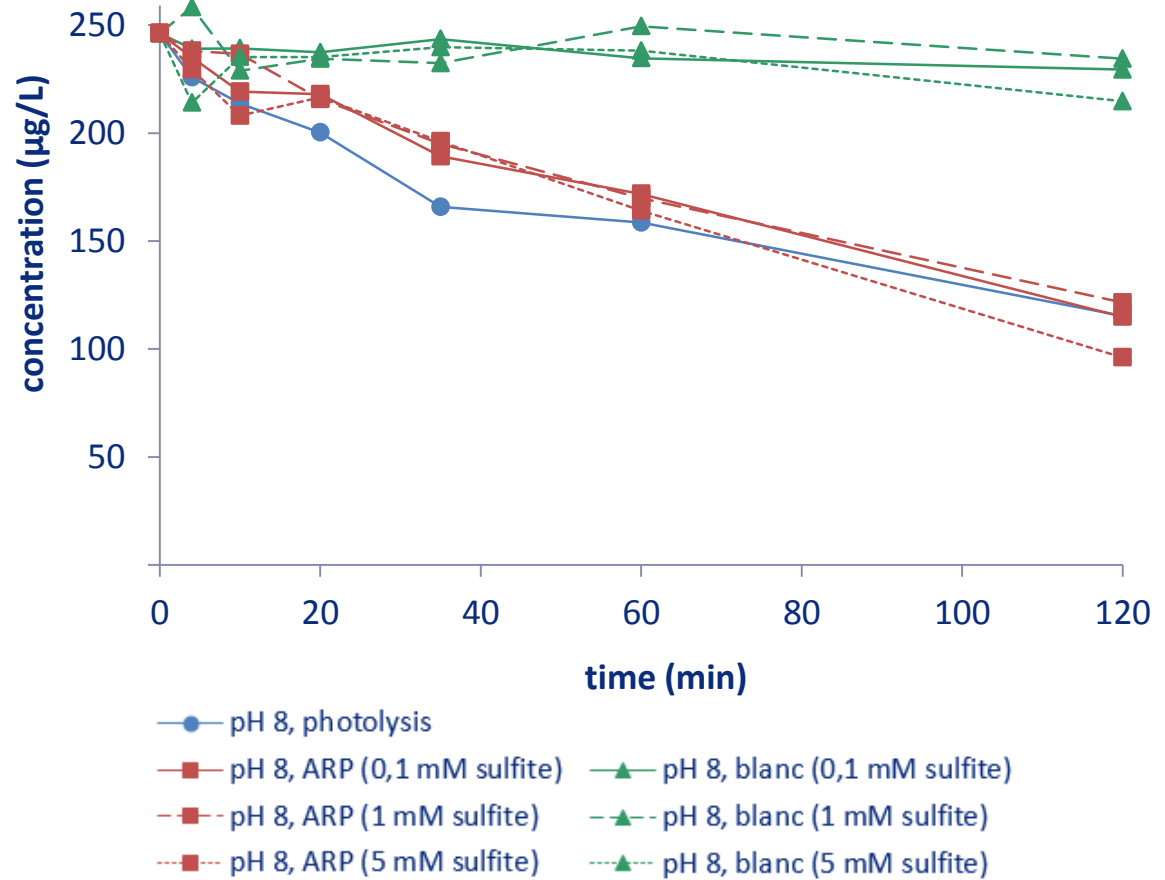
- pH 6, photolysis
- pH 8, photolysis
- pH 10, photolysis
- pH 6, ARP (5 mM sulfite)
- pH 8, ARP (5 mM sulfite)
- pH 10, ARP (5 mM sulfite)
- ▲ pH 6, blanc (5 mM sulfite)
- ▲ pH 8, blanc (5 mM sulfite)
- ▲ pH 10, blanc (5 mM sulfite)

higher pH  
=  
faster breakdown



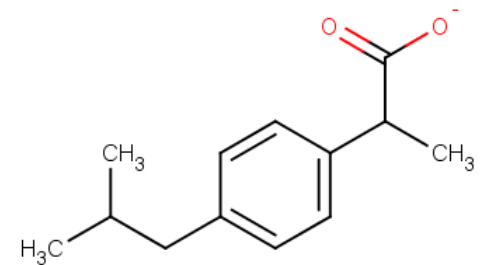
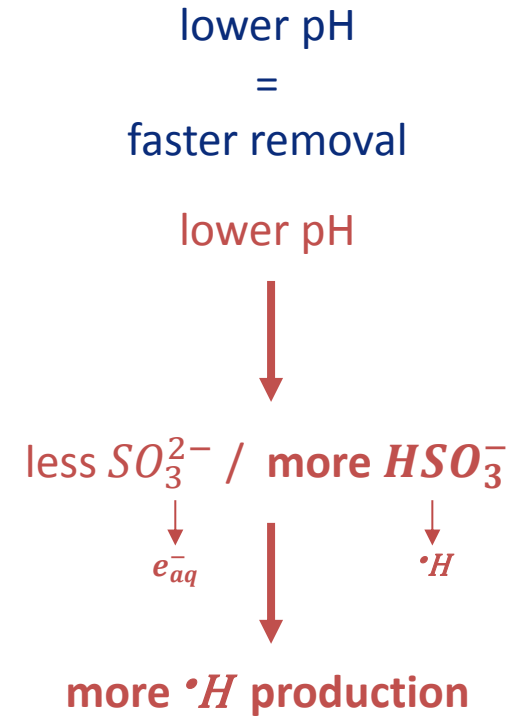
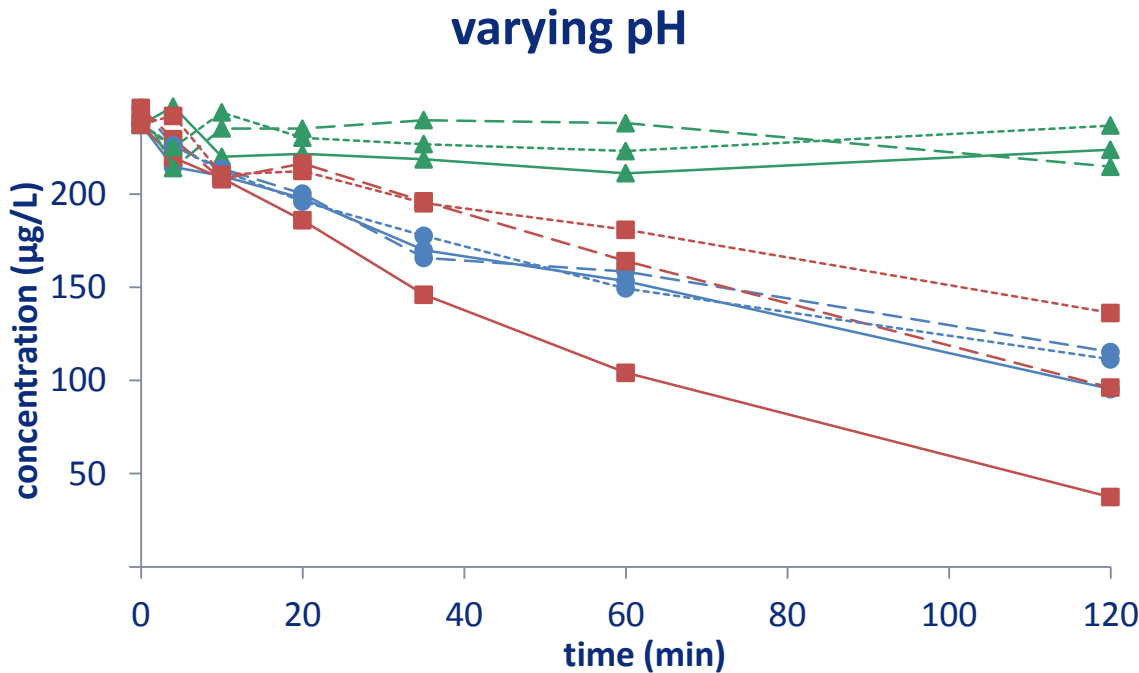
# ARP – IBUPROFEN

varying sulfite concentration



no change with varying  $SO_3^{2-}$

# ARP – IBUPROFEN



# CONCLUSIONS

- $1/_{27}$  recalcitrant
  - $6/_{27}$  mainly photolysis
  - $16/_{27}$  mainly ARP – with  $14/_{16} e_{aq}^-$  and  $2/_{16} \cdot H$
  - $4/_{27}$  indistinguishable (too fast reaction)
- **Optimal conditions are component dependent**
- **Optimal removal conditions: 97 – 100% removal  
except ibuprofen (84%) and diglyme (no removal)**
- usually: higher pH is better**
- higher sulfite dose is better**



# THANK YOU FOR YOUR ATTENTION!

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@ UGent: PalnT and EnVOC labs

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