Biological Removal of Selected Pesticides from Wastewaters

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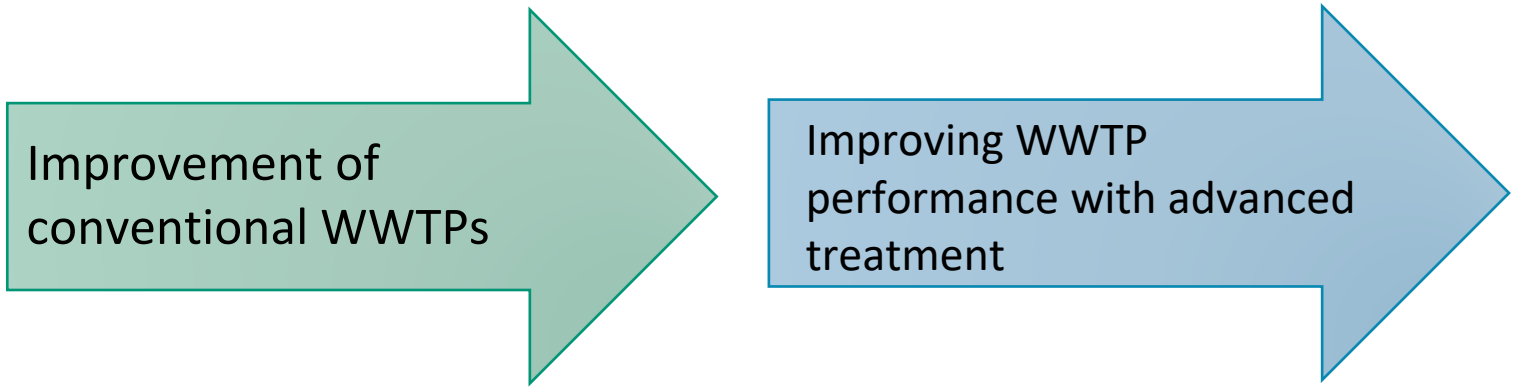
Pesticides (as Micropollutants)

- Originate from different point and diffuse sources and enter water bodies via different flow paths
- Found at very low concentrations, but increasing day by day!
- WWTPs act as primary barriers against the spread of micropollutants!
- Conventional WWTPs → not designed for their treatment
- Discharged to receiving waters!



Objective

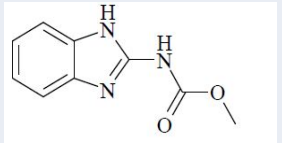
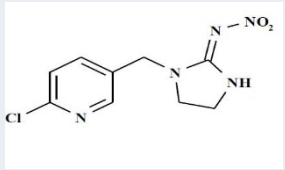
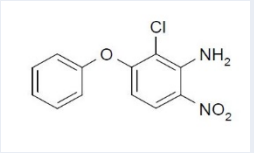
To investigate the biological treatment of selected pesticides with special emphasis on the effect of SRT on their removal in conventional biological WWTPs

To this purpose;

Lab scale biological reactors were operated with synthetic WW containing selected pesticides at different SRTs:

- ✓Effect of SRT on the removal of pesticides
- ✓Effect of pesticides on the removal of COD

Pesticides

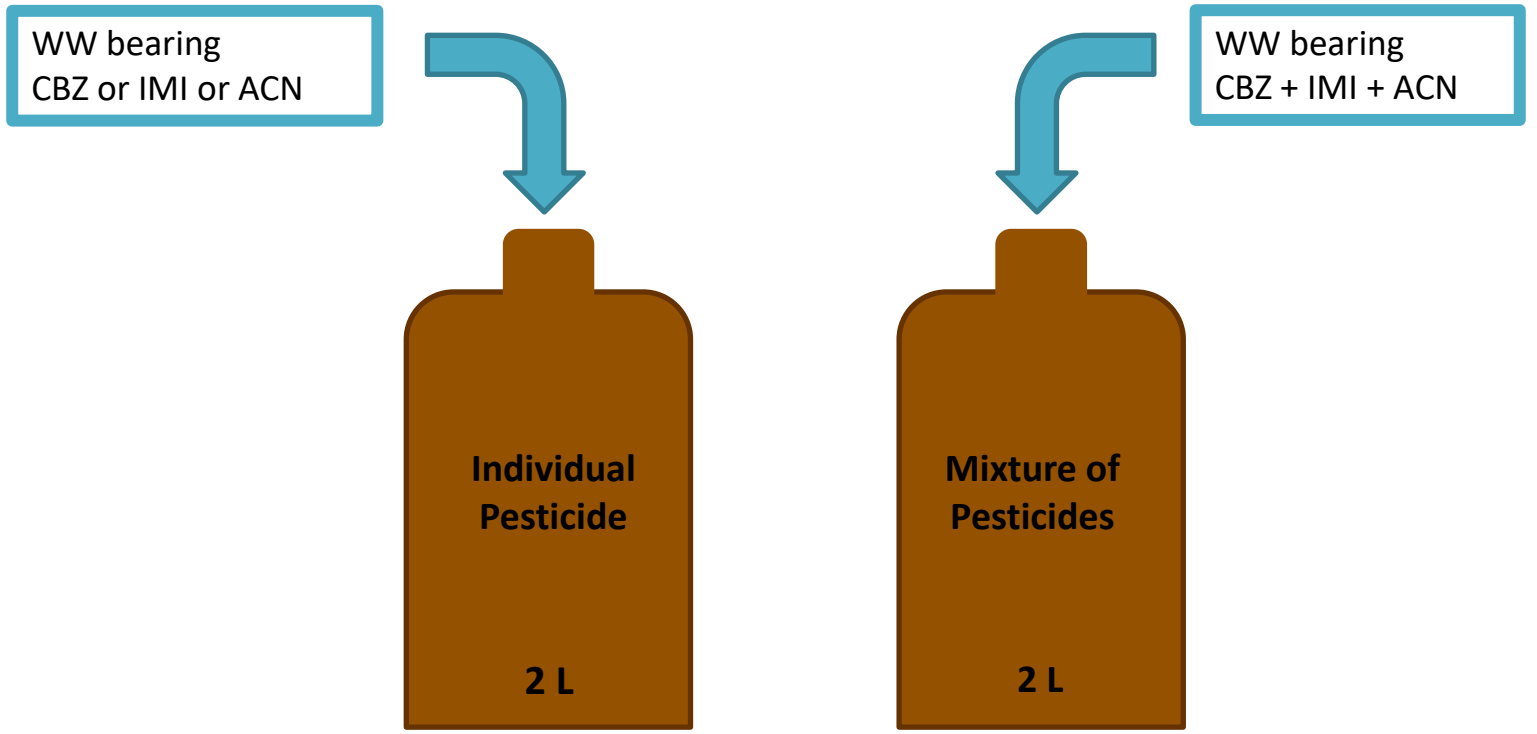
Property	Carbendazim	Imidacloprid	Aclonifen
Name	methyl benzimidazol-2-ylcarbamate	(E)-1-(6-Chloro-3-pyridinylmethyl)-N-nitroimidazolidin-2-ylideneamine	2-chloro-6-nitro-3-phenoxyaniline
Formula	$C_9H_9N_3O_2$	$C_9H_{10}C_lN_5O_2$	$C_{12}H_9C_lN_2O_3$
Mass	191.21 g/mol	255.7 g/mol	264.7 g/mol
Structure			
Melting Point	Above 302 – 307 °C	144 °C	81.2 °C
Vapor Pressure (25 °C)	1.5 x 10^{-4} Pa	4.0 X 10^{-07} mPa	0.016 mPa
Solubility in Water	30 mg/L at pH 4, 8 mg/L at pH 7 and 1.49 mg/L at pH 8 (20 °C)	610 mg/L	1.4 mg/L (20 °C) at pH 5 to pH 9

Method

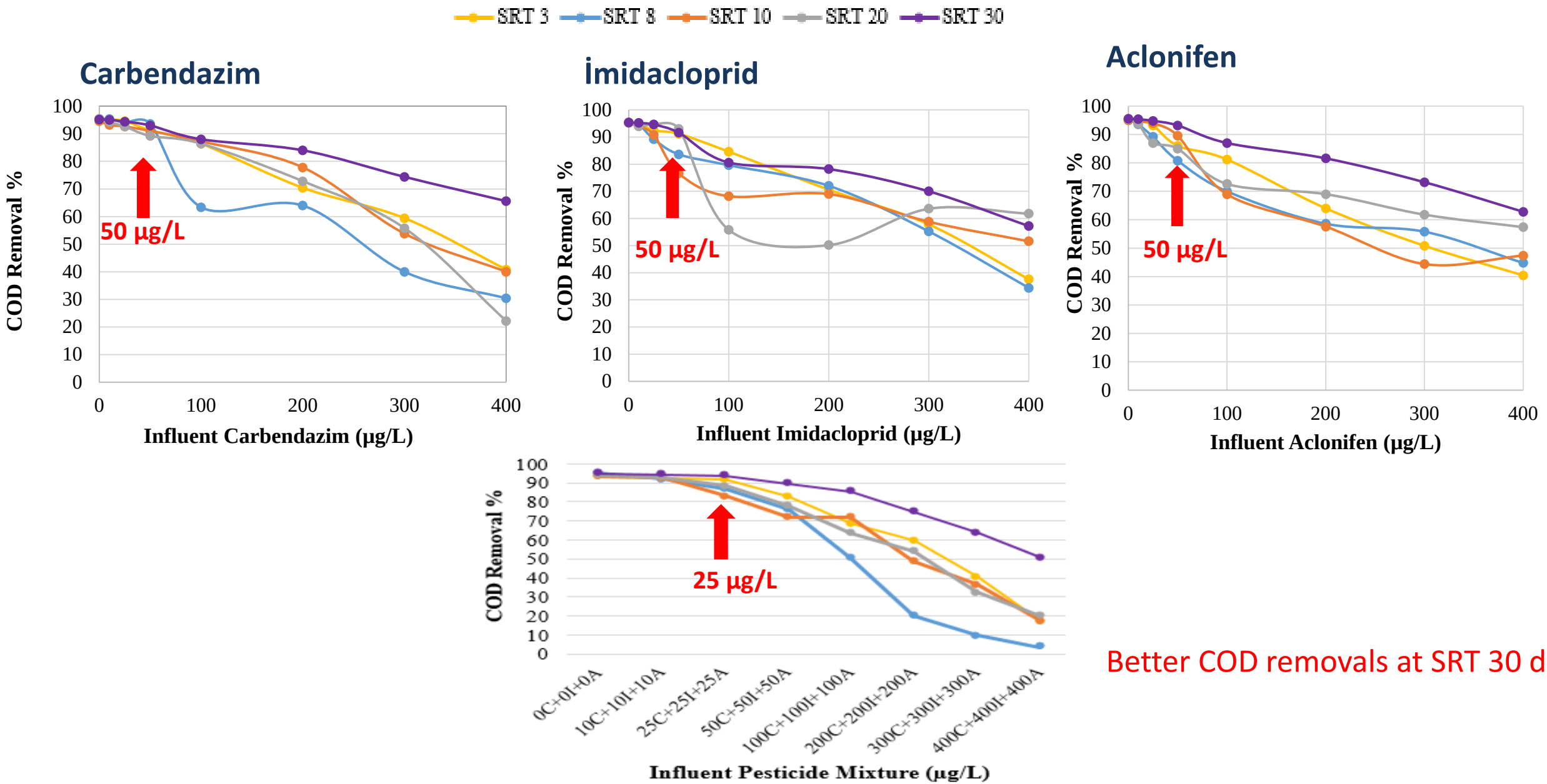
- 20 fed-batch reactors
- Synthetic wastewater
- Temperature: 25˚C
- Steady State
- Pesticides analysis → HPLC

- SRT: 3, 8, 10, 20 and 30 d
- Pesticide conc.:

0, 10, 25, 50, 100, 200, 300, 400 µg/L (individual and mixtures)



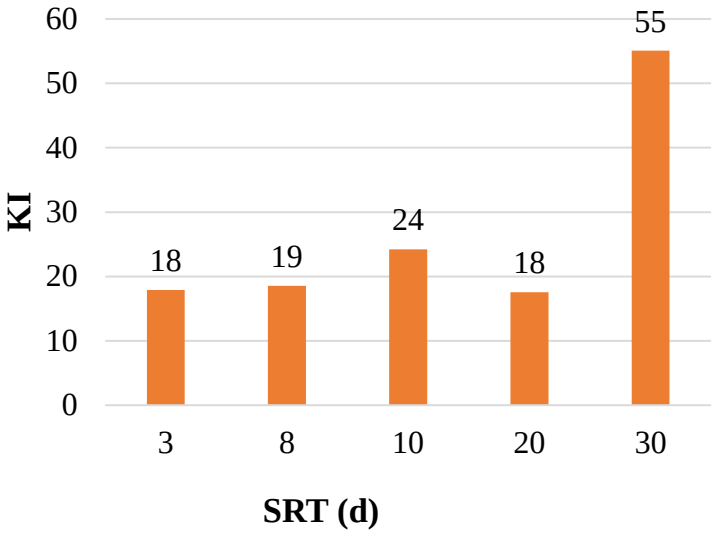
COD Removal in the Presence of Pesticides



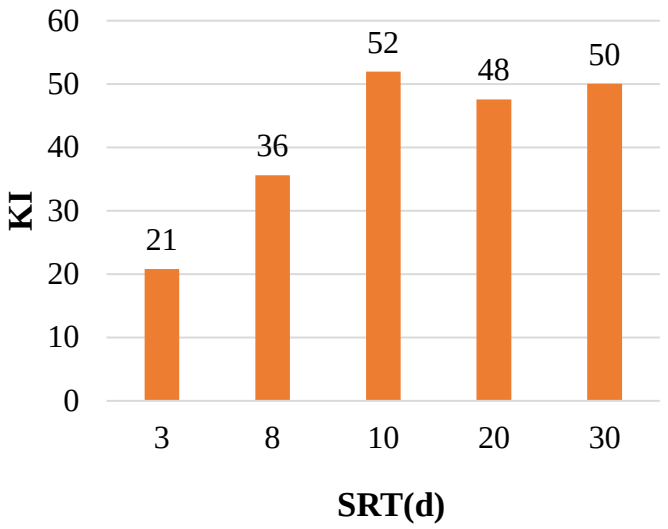
Better COD removals at SRT 30 d

Inhibition of COD Removal in the Presence of Pesticides

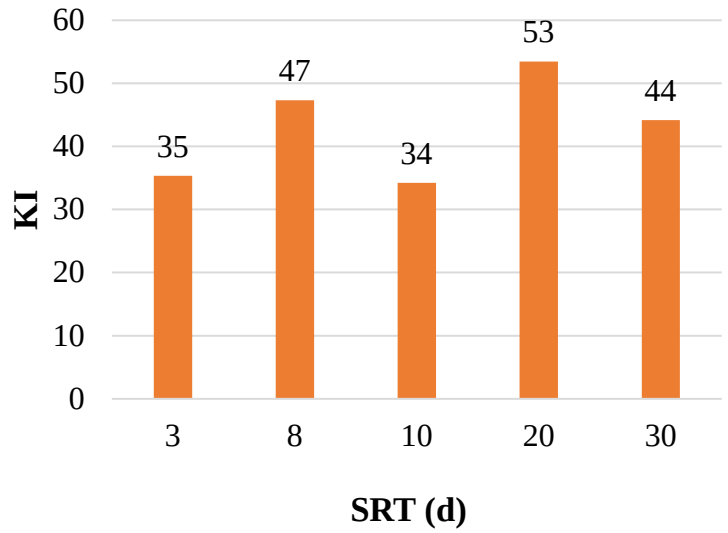
Carbendazim



İmidacloprid



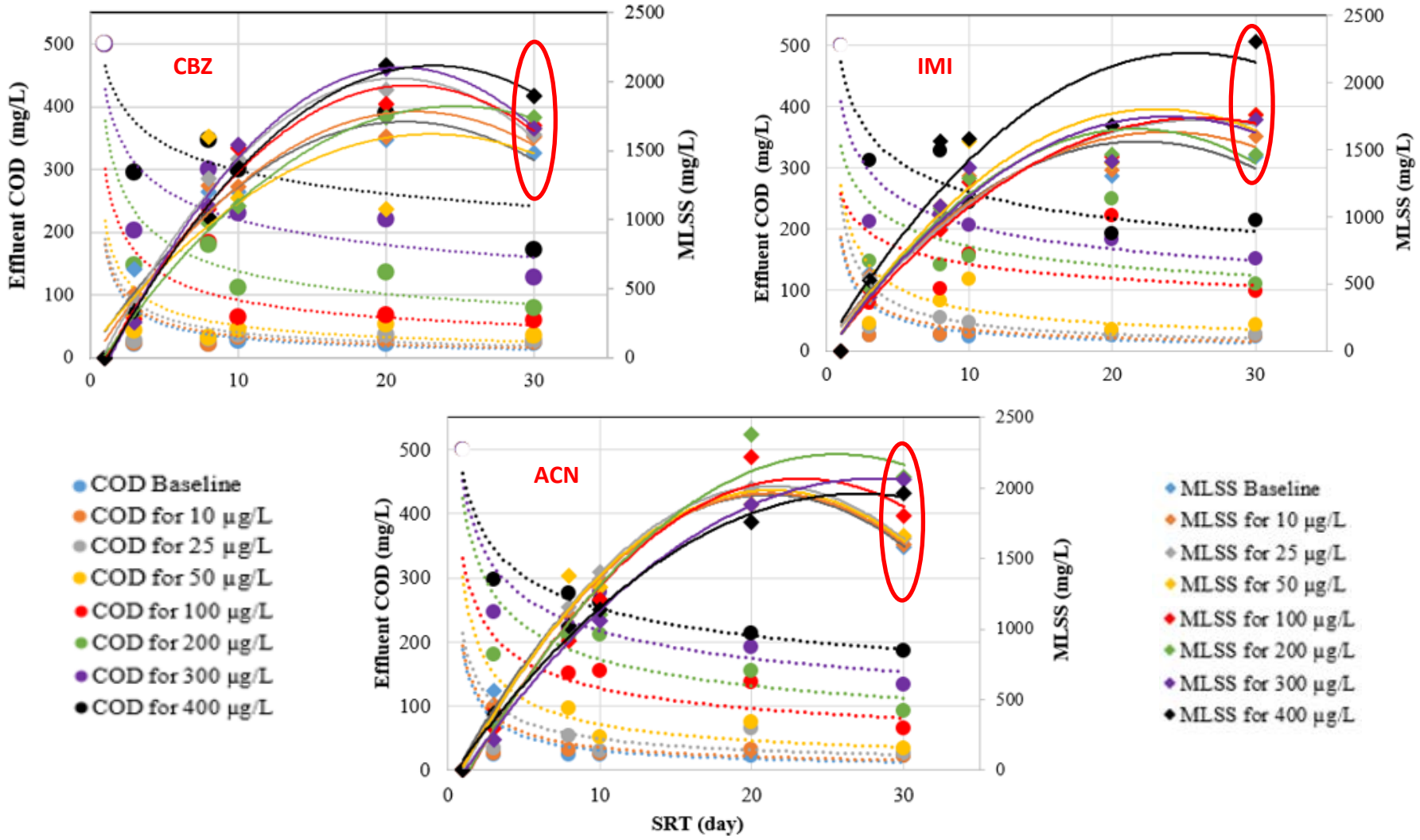
Aclonifen



The greater the K_I value, the lower the inhibition power is...

- In general, less inhibitory effect at longer SRTs; Probably due to the better acclimatization at longer contacts
- Less inhibitory effect by Aclonifen than others

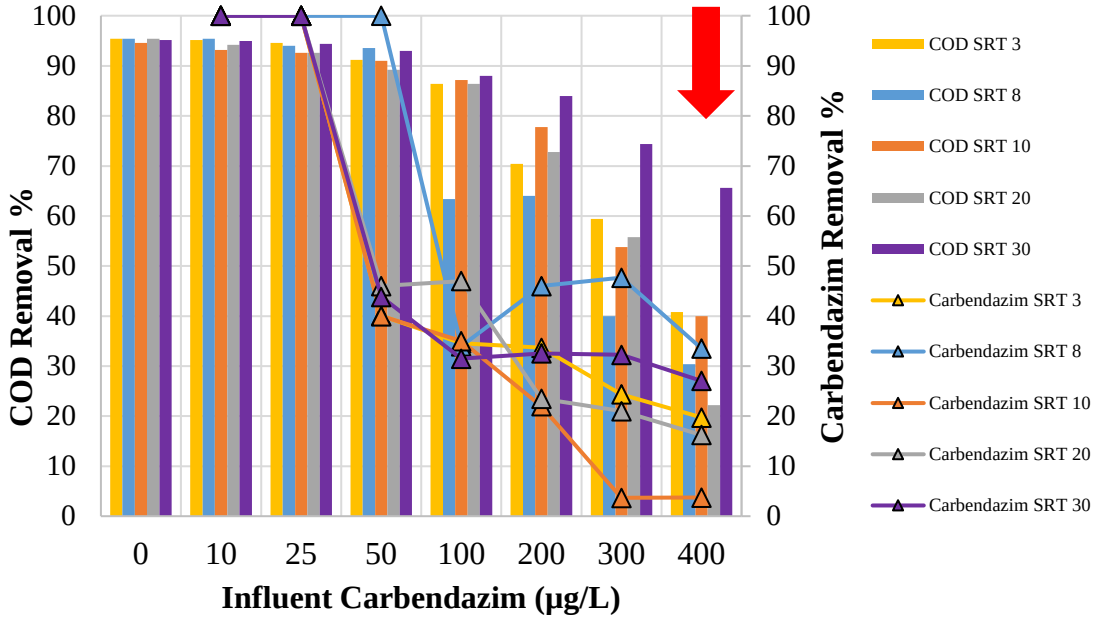
COD & MLSS vs SRT



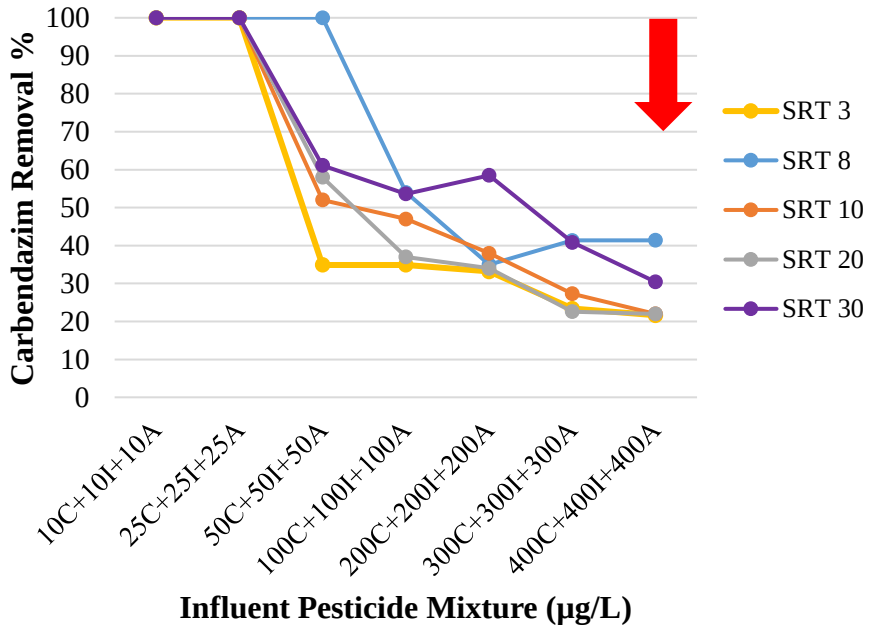
Maintenance energy requirement at SRT 30 days,
but less at higher pesticide conc. probably due to smaller pesticide/biomass ratio

Carbendazim Removal

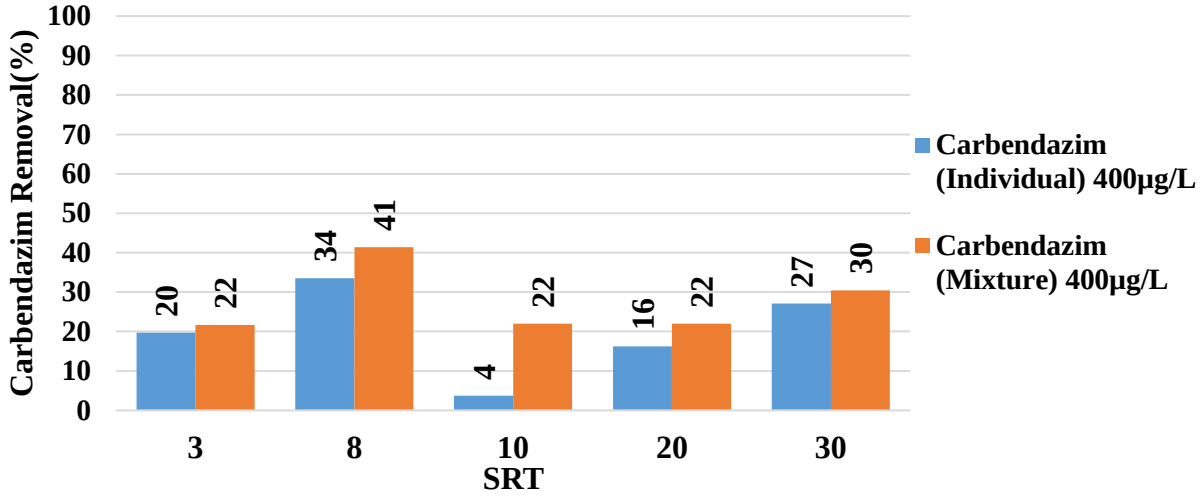
Individual



Mixture



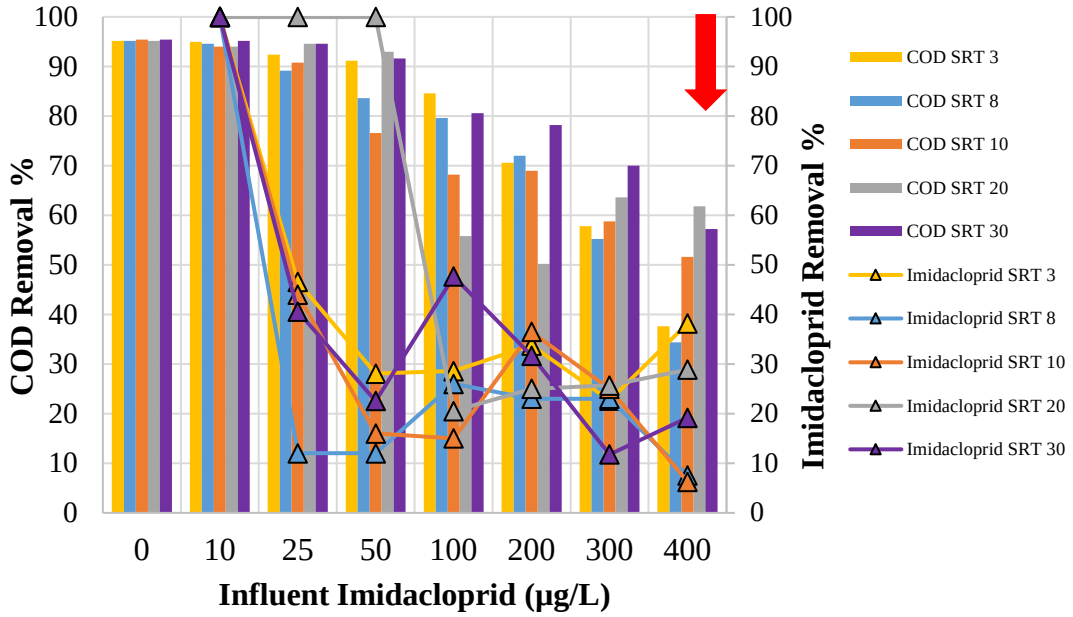
No clear correlation between carbendazim removal and SRT!



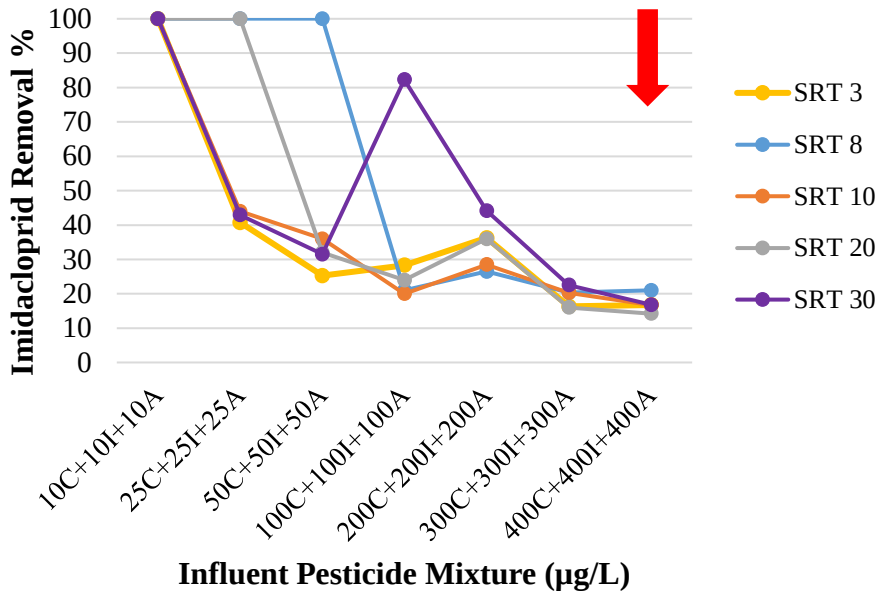
Better removal at mixtures!

Imidacloprid Removal

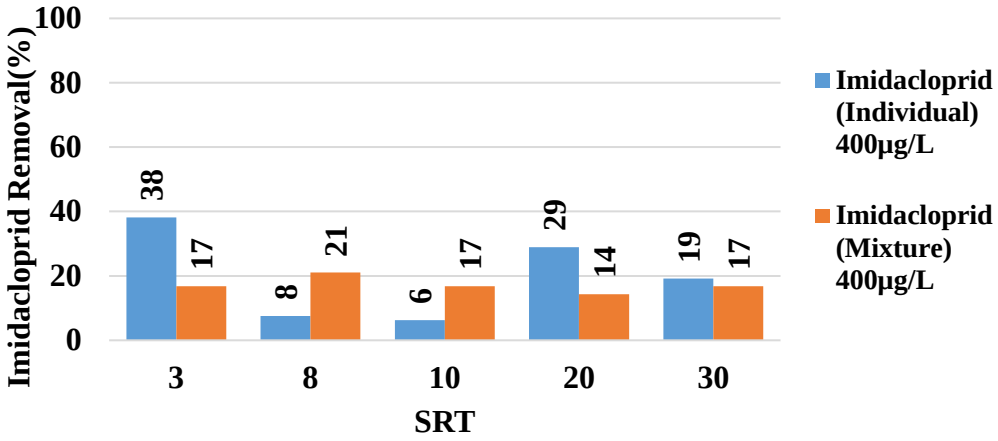
Individual



Mixture

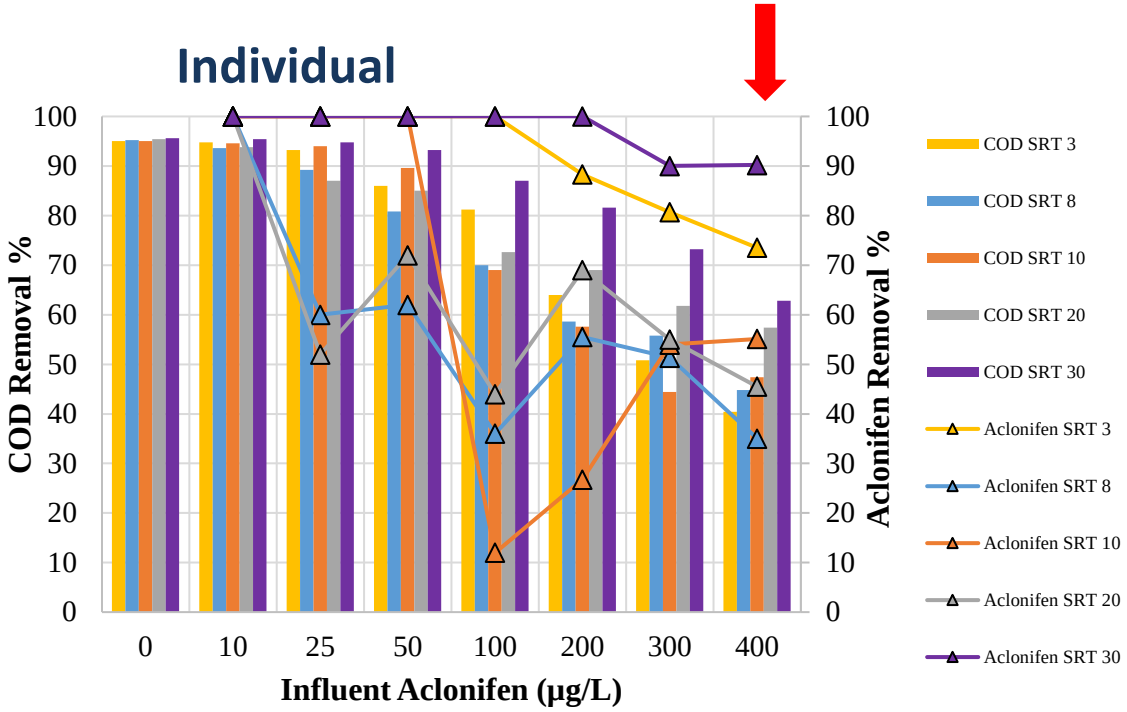


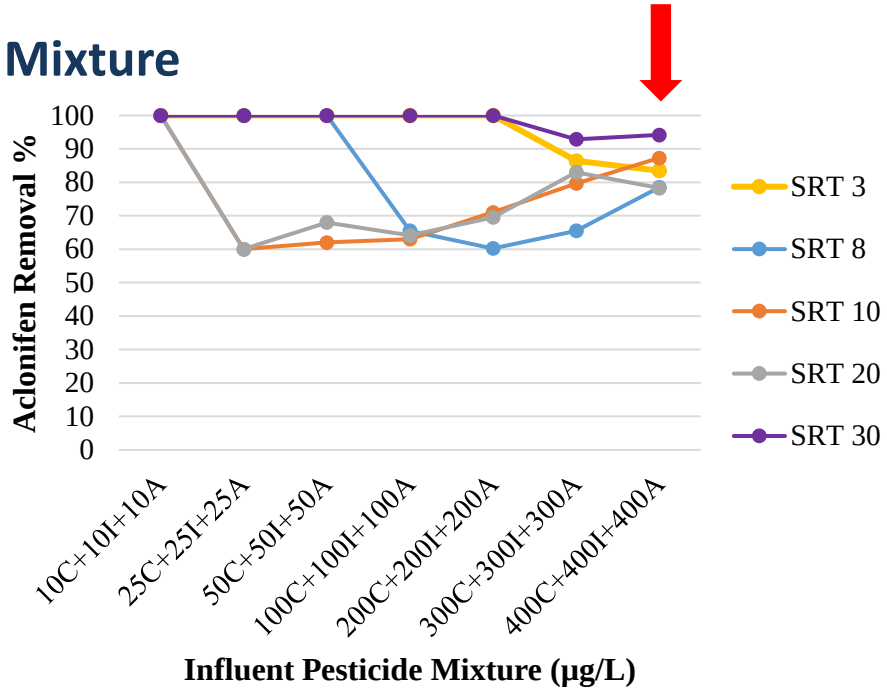
No clear correlation between imidacloprid removal and SRT!



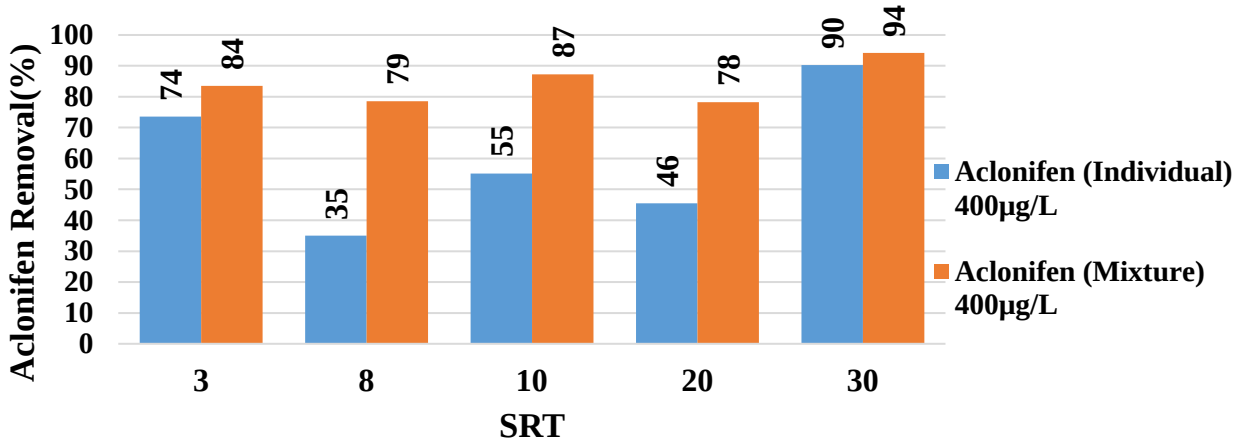
Better removal at mixtures at SRT 8 &10 d!

Aclonifen Removal





No clear correlation between aclonifen removal and SRT!



Better removal at mixtures!

Conclusion

- Both COD and pesticide removals were disrupted beyond
  - 50µg/L with individual pesticide
  - 25µg/L with mixture of pesticides
- There exists no clear correlation between pesticide removal and SRT
- Aclonifen removal is higher than Carbendazim and Imidacloprid
- Carbendazim and Aclonifen removals were better in the reactors bearing mixtures compared to their individual cases

Thank you !

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