



‘Latex-based biofilms for indoor air purification’

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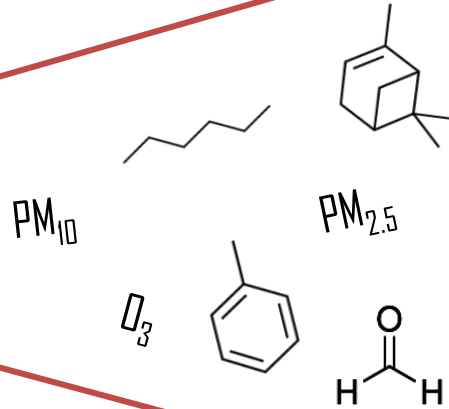
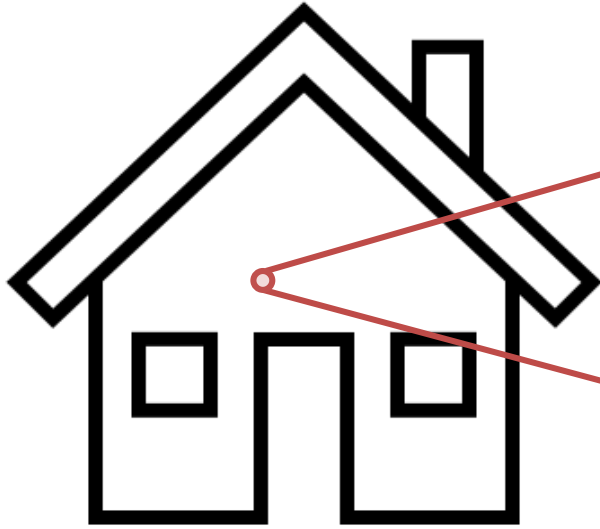
Institute of Sustainable Processes. University of Valladolid.

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METHODOLOGY

RESULTS

CONCLUSIONS



Indoor Air Pollution

>4 annual millions of deaths

Health system costs

Productivity loss

Modern design and
construction

Energy optimization



Insulation and sealing



Indoor pollution
increase



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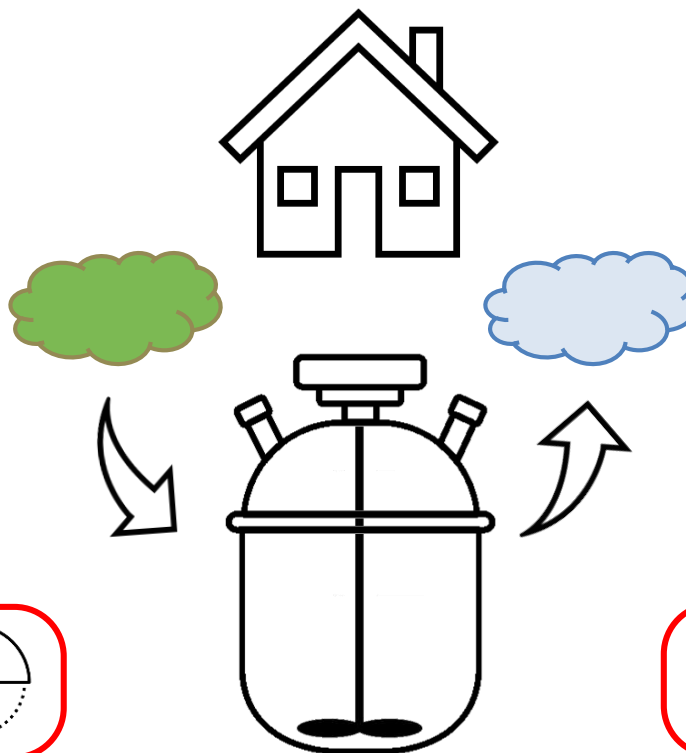
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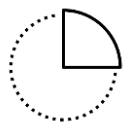
PURIFICATION METHODS

Biotechnologies

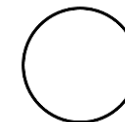
Physical-chemical
technologies



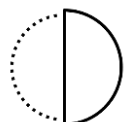
Low concentrations



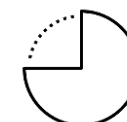
Peaks of pollution



Complex mixtures



Hydrophobicity





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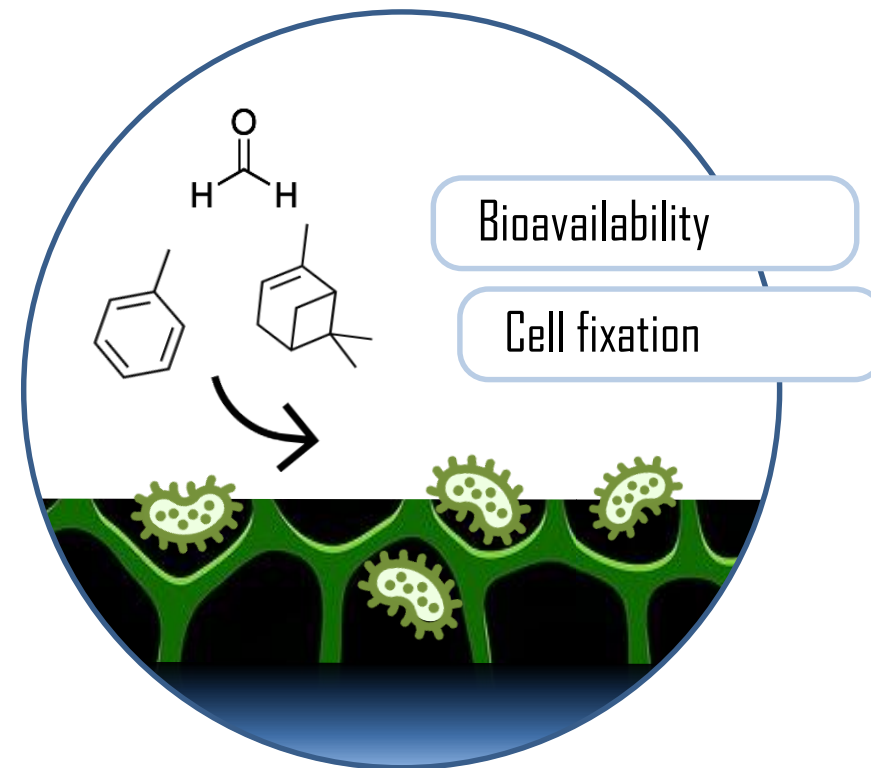
CONCLUSIONS

Biotechnologies



Polymer biocoatings

- ✓ Cope with indoor air pollution
(low concentrations, variable pollutants and concentrations, peaks of pollution)
- ✗ Mass-transfer of hydrophobic compounds
- ✗ Release of microorganisms



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n-hexane (Alkanes)

$9.6 \pm 2.4 \text{ mg m}^{-3}$

TCE (Halogenated)

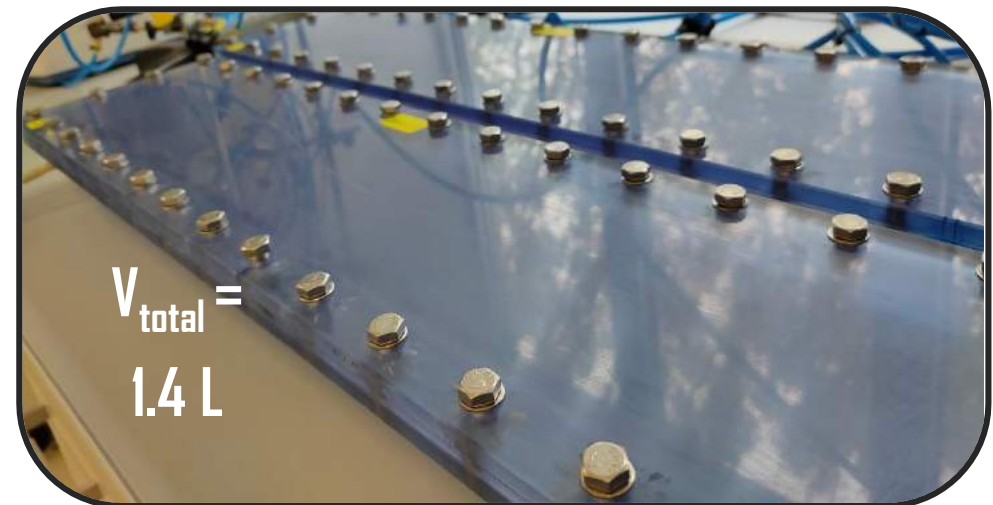
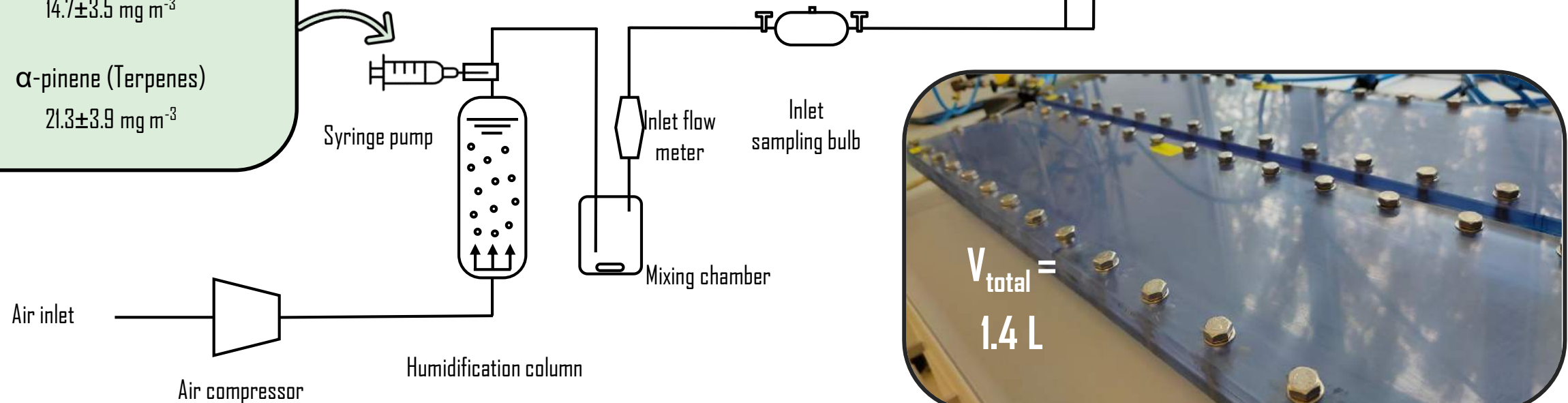
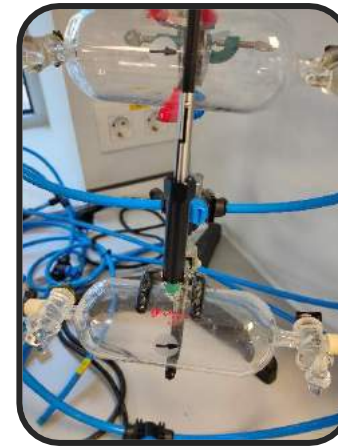
$13.7 \pm 3.0 \text{ mg m}^{-3}$

Toluene (Aromatics)

$14.7 \pm 3.5 \text{ mg m}^{-3}$

α -pinene (Terpenes)

$21.3 \pm 3.9 \text{ mg m}^{-3}$





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Experimental run	Nº	Chamber 1	Chamber 2	Chamber 3	Chamber 4
Presence of latex in the biocoating	1	40 mL BM suspension	BM pellet + 60 mL latex	60 mL latex	40 mL BM suspension + 60 mL latex
Presence of hydrogel in the biocoating	2	50 mL BM suspension	BM pellet + 60 mL latex	Only packing material	BM pellet + 60 mL latex + 50 hydrogel beads
Water content of the latex-biomass mixture	3	50 mL BM suspension	BM pellet + 60 mL latex	50 mL BM suspension + 60 mL latex	BM pellet + 60 mL pre-dried latex
Latex pretreatment and MSM content in the latex-biomass mixture	4	BM pellet	40 mL BM suspension + 60 mL treated latex	20 mL BM suspension + 60 mL latex	40 mL BM suspension + 60 mL latex
Biomass concentration and VOC loading rate	5	40 mL BM suspension (0.5 g)	40 mL BM suspension (0.5 g) + 60 mL latex	60 mL of latex	40 mL BM suspension (2.0 g) + 60 mL latex



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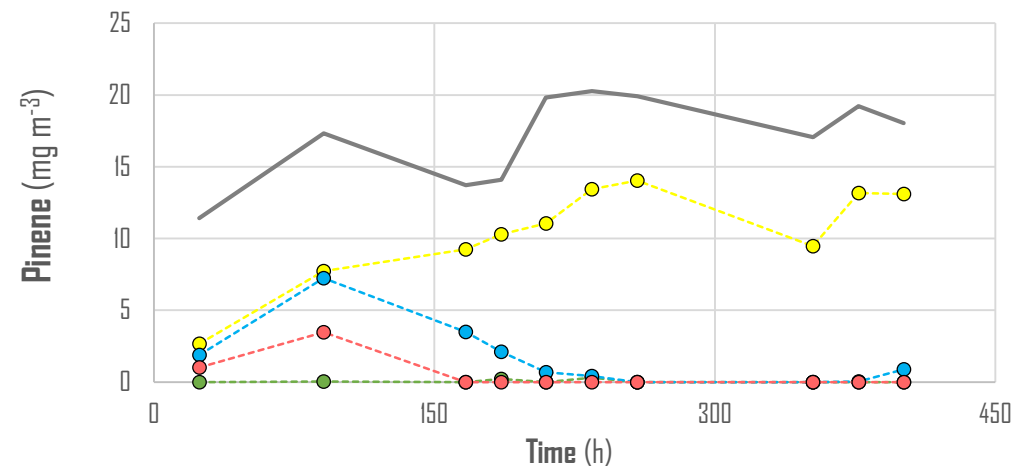
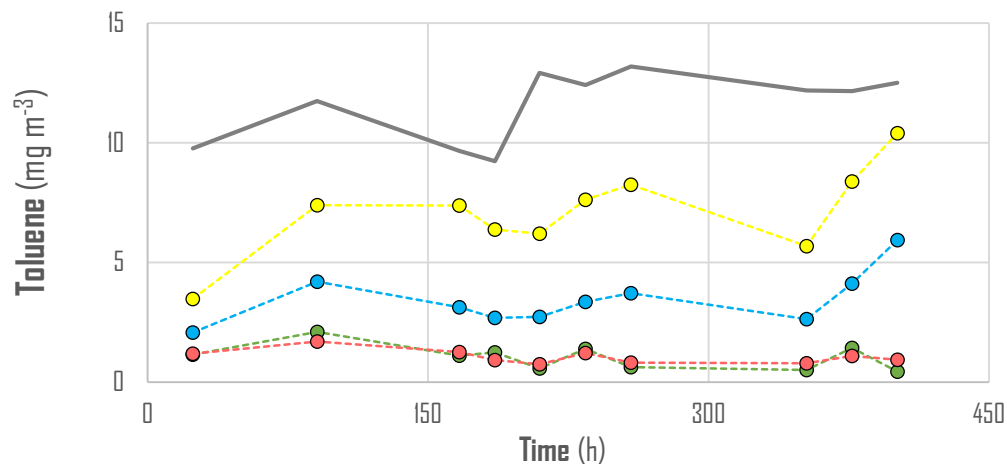
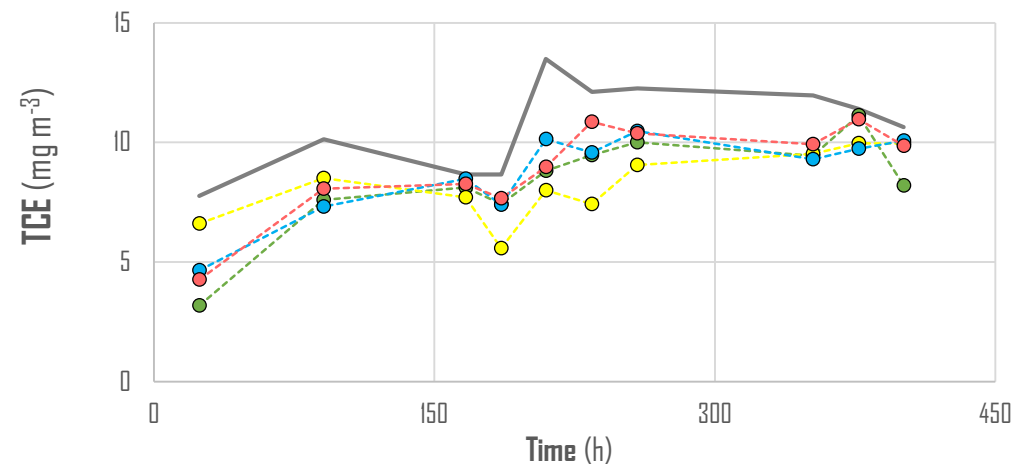
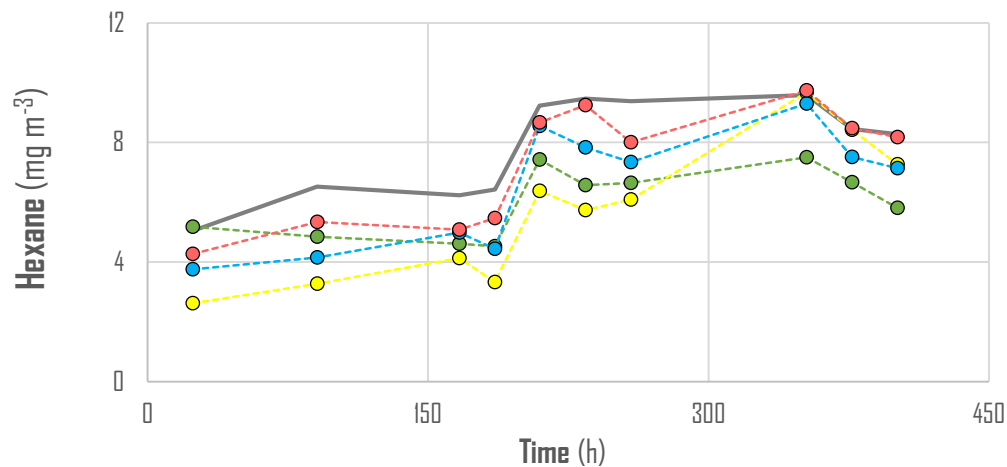
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EXPERIMENTAL RUN 1

Influence of the presence of latex in the biocoating



CHAMBER 1	Biomass suspension (40 mL MSM)	CHAMBER 3	Latex (60 mL)
CHAMBER 2	Biomass pellet + latex (60 mL)	CHAMBER 4	Biomass suspension (40 mL MSM) + latex (60 mL)



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Experimental run	Nº	Chamber 1	Chamber 2	Chamber 3	Chamber 4
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Presence of hydrogel in the biocoating	2	50 mL BM suspension	BM pellet + 60 mL latex	Only packing material	BM pellet + 60 mL latex + 50 hydrogel beads
Water content of the latex-biomass mixture	3	50 mL BM suspension	BM pellet + 60 mL latex	50 mL BM suspension + 60 mL latex	BM pellet + 60 mL pre-dried latex
Latex pretreatment and MSM content in the latex-biomass mixture	4	BM pellet	40 mL BM suspension + 60 mL treated latex	20 mL BM suspension + 60 mL latex	40 mL BM suspension + 60 mL latex
Biomass concentration and VOC loading rate	5	40 mL BM suspension (0.5 g)	40 mL BM suspension (0.5 g) + 60 mL latex	60 mL of latex	40 mL BM suspension (2.0 g) + 60 mL latex



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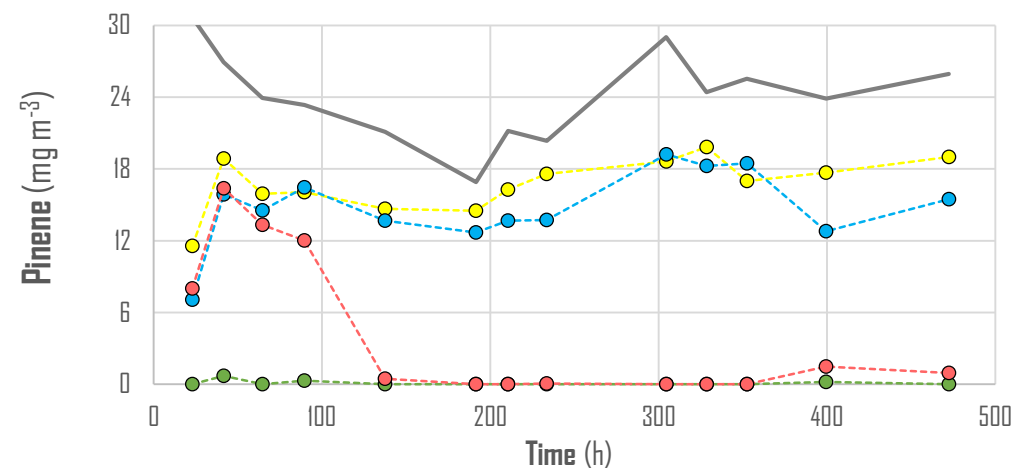
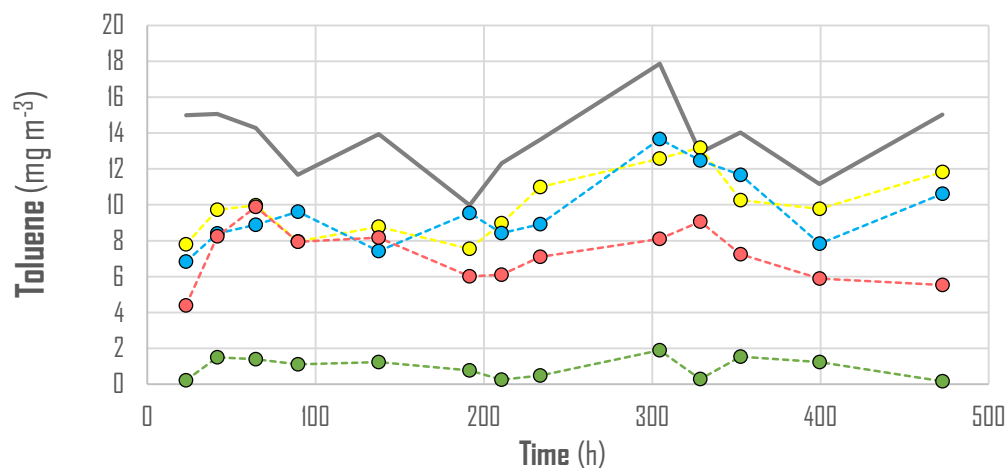
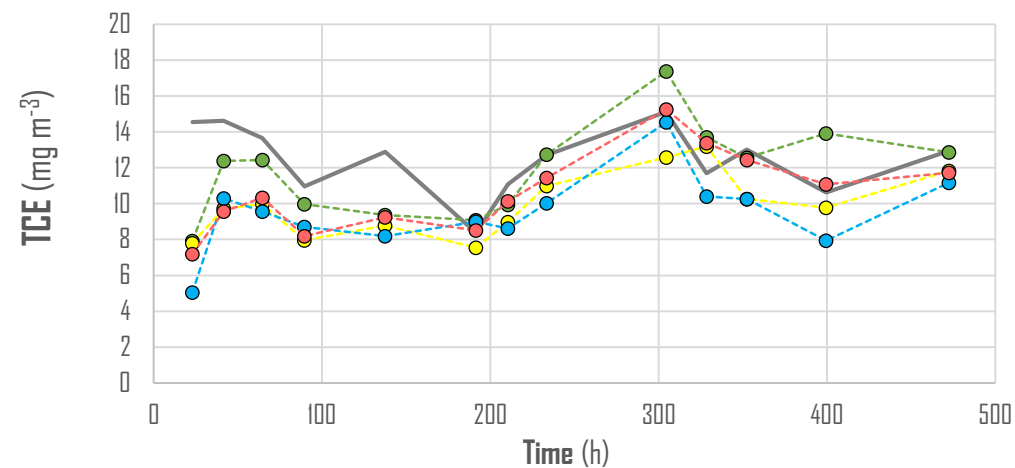
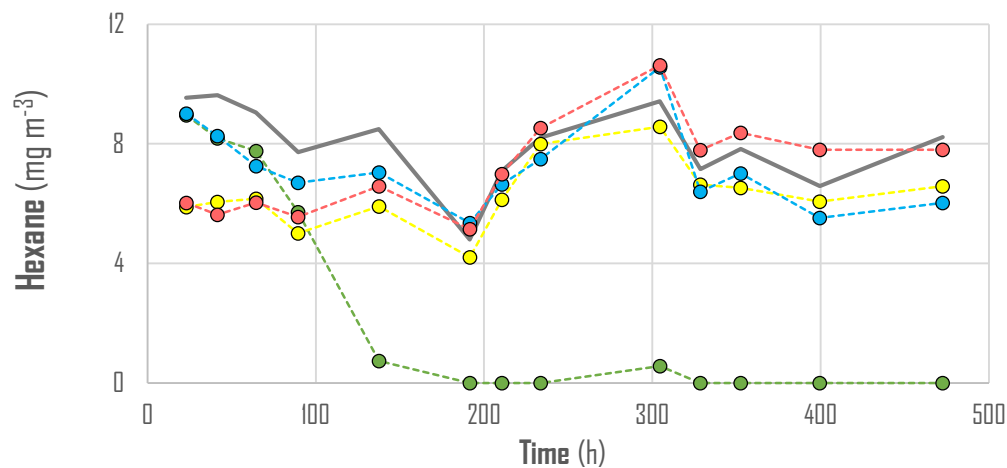
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EXPERIMENTAL RUN 2

Influence of the presence of hydrogel in the biocoating



CHAMBER 1

Biomass suspension (50 mL MSM)

CHAMBER 3

Only packing material

CHAMBER 2

Biomass pellet (0.5 g) + latex (60 mL)

CHAMBER 4

Biomass pellet + latex (60 mL) + 50 hydrogel beads



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Experimental run	Nº	Chamber 1	Chamber 2	Chamber 3	Chamber 4
Presence of latex in the biocoating	1	40 mL BM suspension	BM pellet + 60 mL latex	60 mL latex	40 mL BM suspension + 60 mL latex
Presence of hydrogel in the biocoating	2	50 mL BM suspension	BM pellet + 60 mL latex	Only packing material	BM pellet + 60 mL latex + 50 hydrogel beads
Water content of the latex-biomass mixture	3	50 mL BM suspension	BM pellet + 60 mL latex	50 mL BM suspension + 60 mL latex	BM pellet + 60 mL pre-dried latex
Latex pretreatment and MSM content in the latex-biomass mixture	4	BM pellet	40 mL BM suspension + 60 mL treated latex	20 mL BM suspension + 60 mL latex	40 mL BM suspension + 60 mL latex
Biomass concentration and VOC loading rate	5	40 mL BM suspension (0.5 g)	40 mL BM suspension (0.5 g) + 60 mL latex	60 mL of latex	40 mL BM suspension (2.0 g) + 60 mL latex



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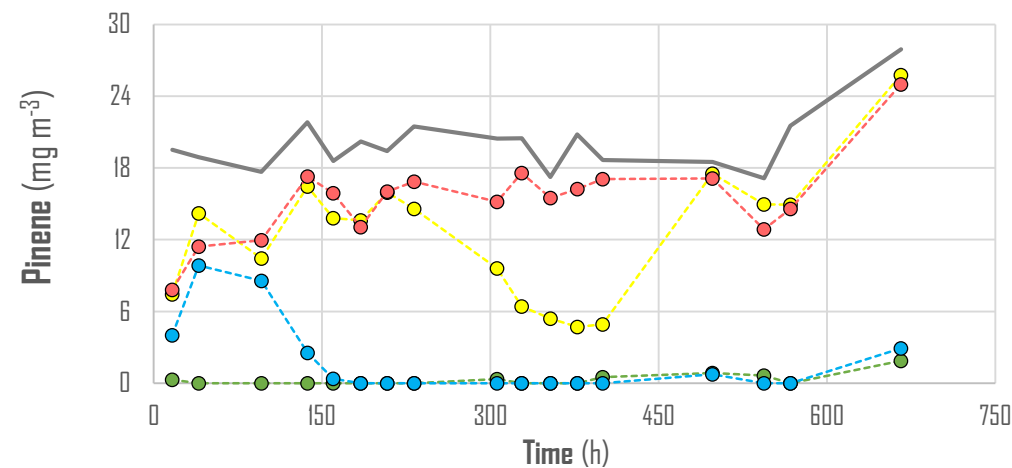
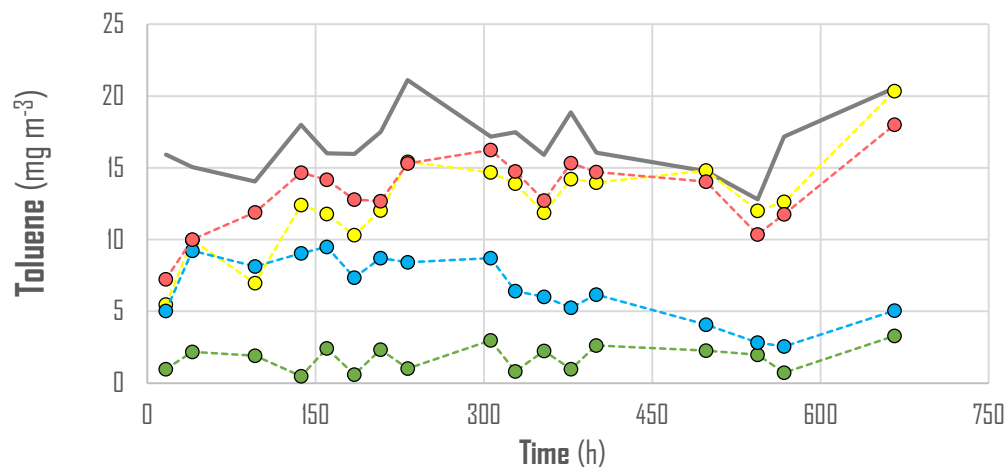
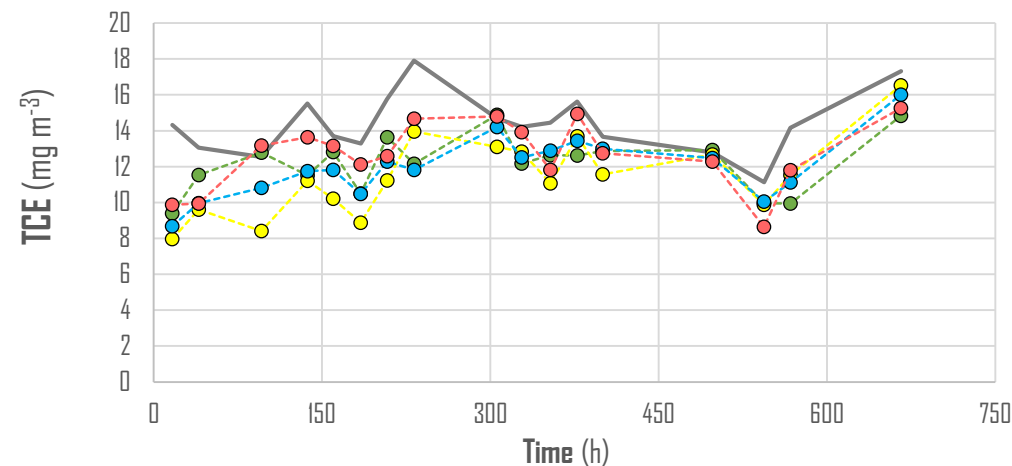
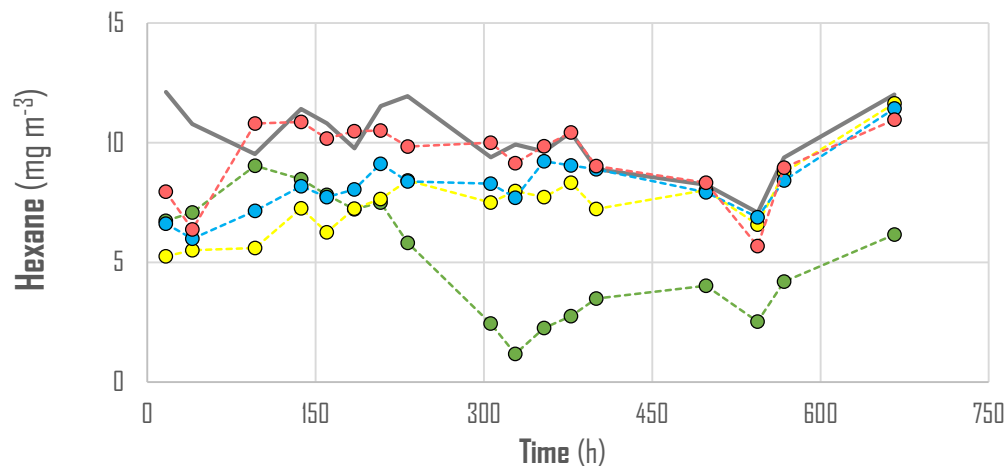
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EXPERIMENTAL RUN 3

Influence of the water content of the latex-biomass mixture



CHAMBER 1

Biomass suspension (50 mL MSM)

CHAMBER 3

Biomass suspension (50 mL MSM) + latex (60 mL)

CHAMBER 2

Biomass pellet+ latex (60 mL)

CHAMBER 4

Biomass pellet + pre-dried latex (60 mL)



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Experimental run	Nº	Chamber 1	Chamber 2	Chamber 3	Chamber 4
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Water content of the latex-biomass mixture	3	50 mL BM suspension	BM pellet + 60 mL latex	50 mL BM suspension + 60 mL latex	BM pellet + 60 mL pre-dried latex
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Biomass concentration and VOC loading rate	5	40 mL BM suspension (0.5 g)	40 mL BM suspension (0.5 g) + 60 mL latex	60 mL of latex	40 mL BM suspension (2.0 g) + 60 mL latex



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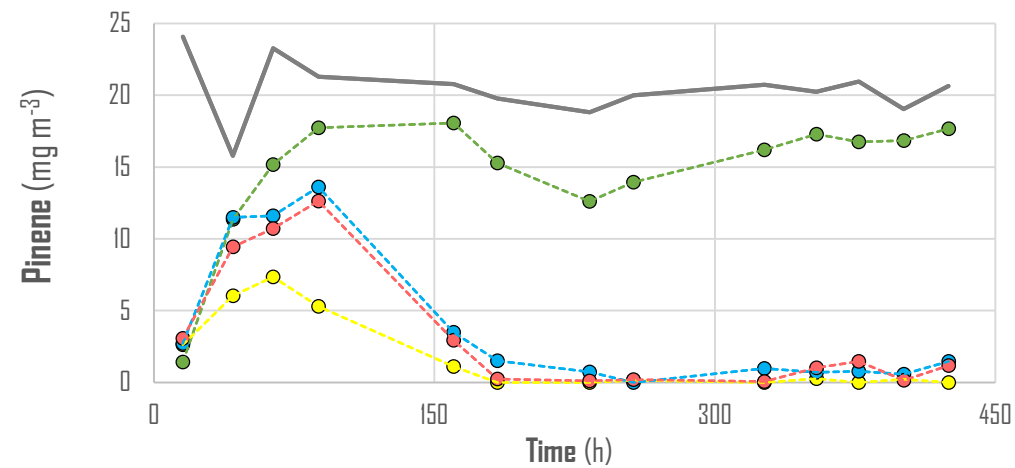
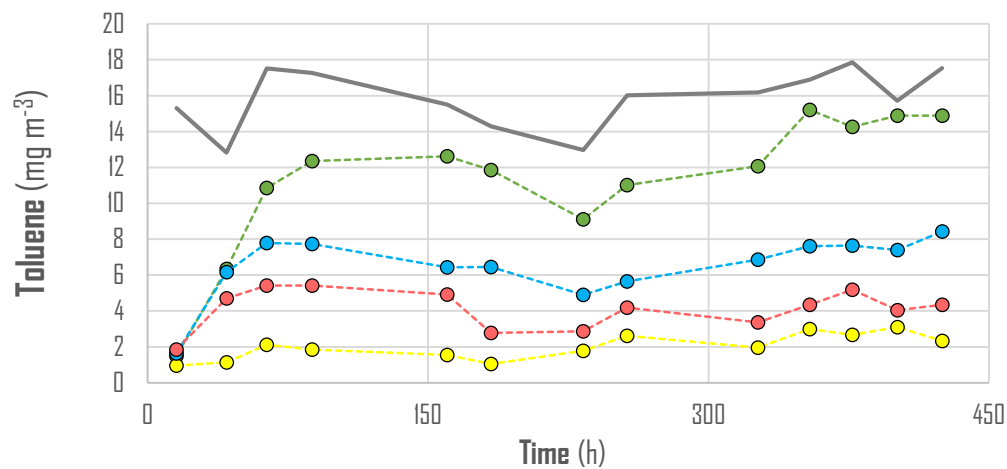
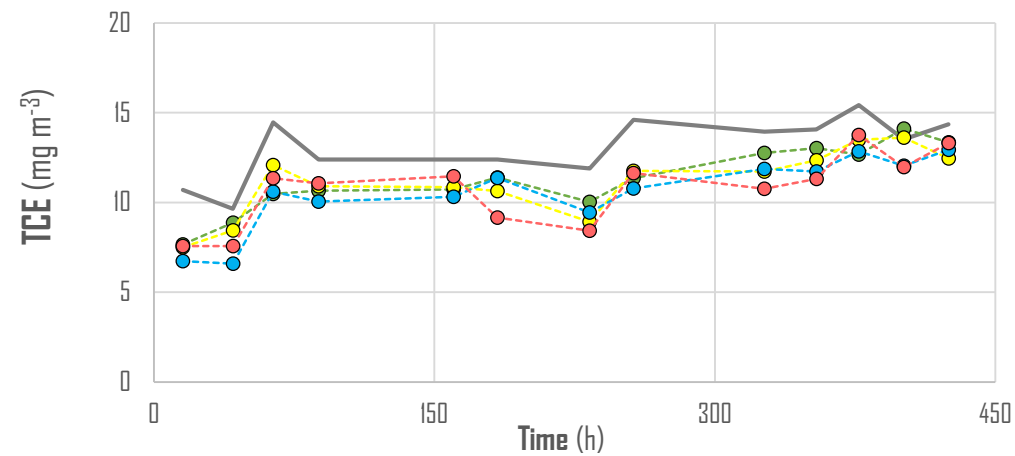
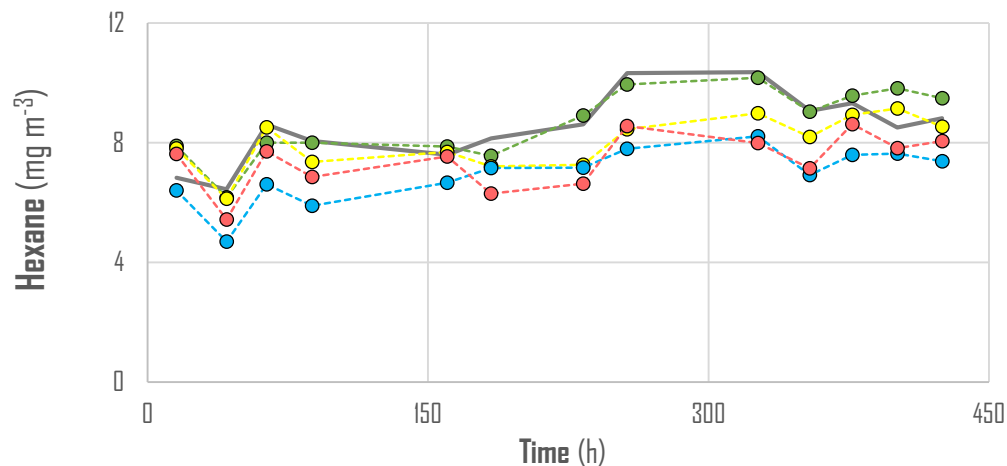
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EXPERIMENTAL RUN 4

Influence of latex pretreatment and MSM content in the latex-biomass mixture



CHAMBER 1

Biomass pellet

CHAMBER 3

Biomass suspension (20 mL MSM)+ latex (60 mL)

CHAMBER 2

Biomass suspension (40 mL MSM) + AC treated latex (60 mL)

CHAMBER 4

Biomass suspension (40 mL MSM)+ latex (60 mL)



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Biomass concentration and VOC loading rate	5	40 mL BM suspension (0.5g)	40 mL BM suspension (0.5g) + 60 mL latex	60 mL of latex	40 mL BM suspension (2.0g) + 60 mL latex



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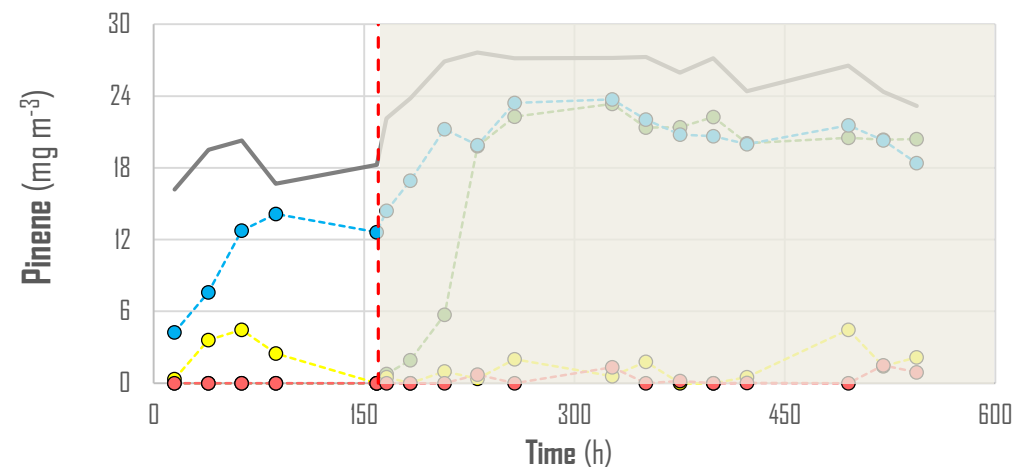
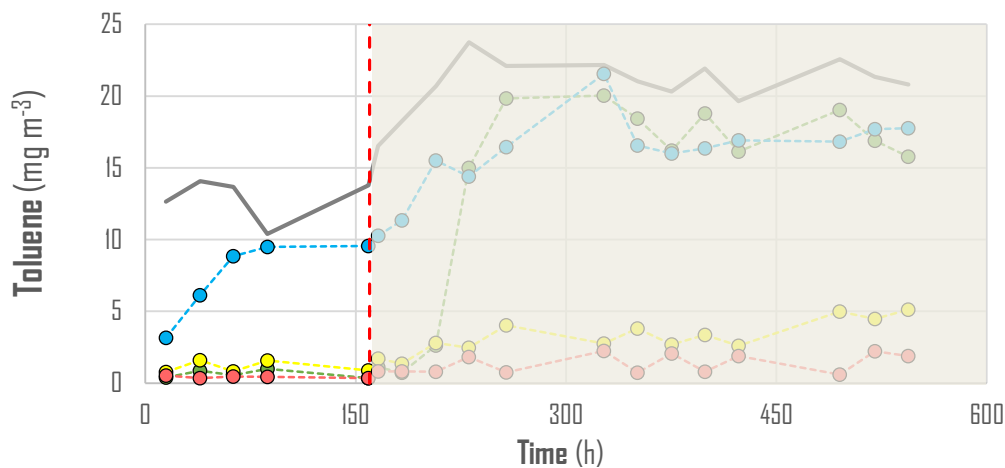
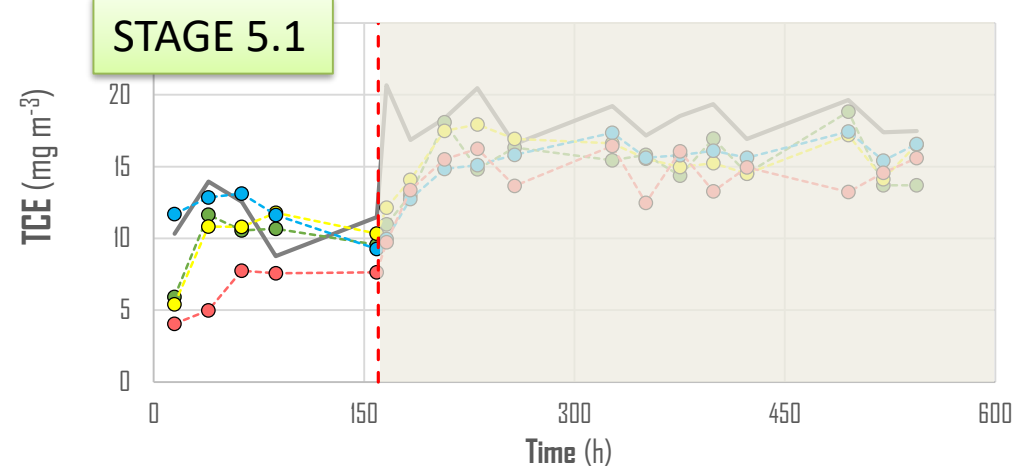
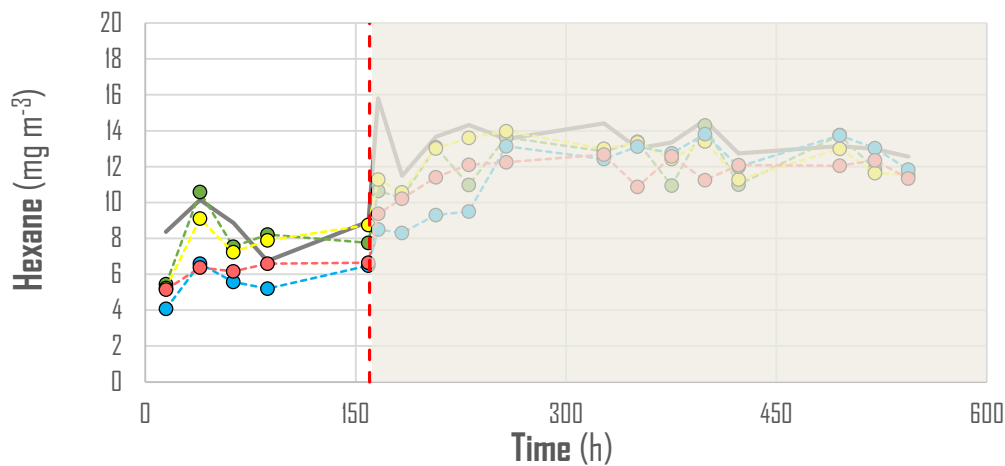
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EXPERIMENTAL RUN 5

Influence of biomass concentration and VOC loading rate



CHAMBER 1	Biomass suspension (40 mL MSM; 0.5 g)	CHAMBER 3	Latex (60 mL)
CHAMBER 2	Biomass suspension (40 mL MSM; 0.5 g) + latex (60 mL)	CHAMBER 4	Biomass suspension (40 mL MSM; 2.0 g) + latex (60 mL)

EXPERIMENTAL RUN 5

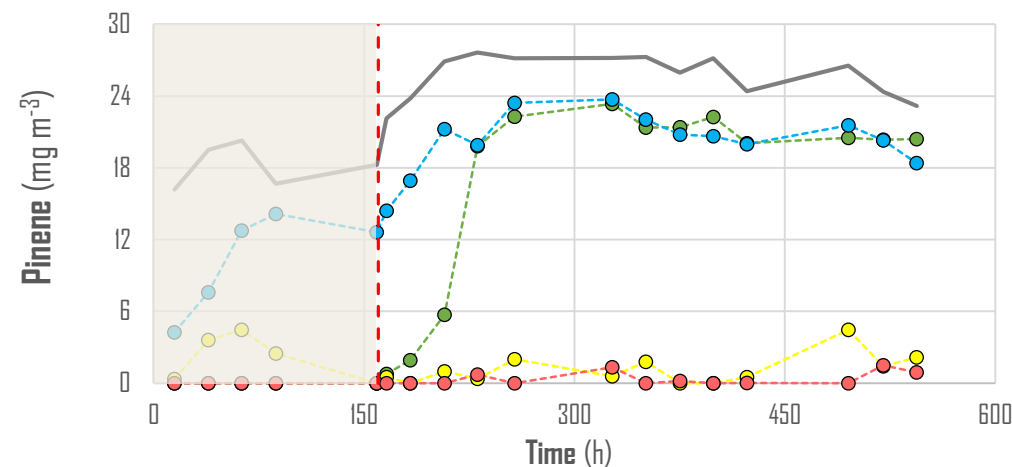
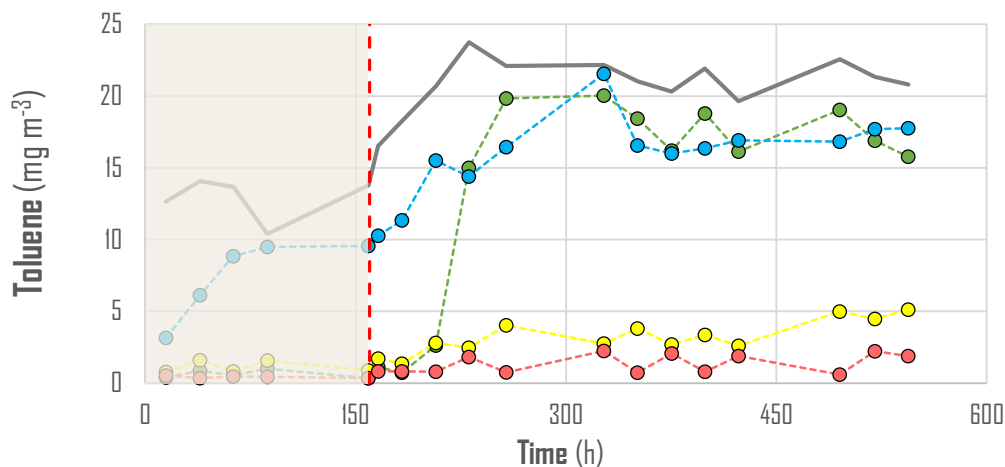
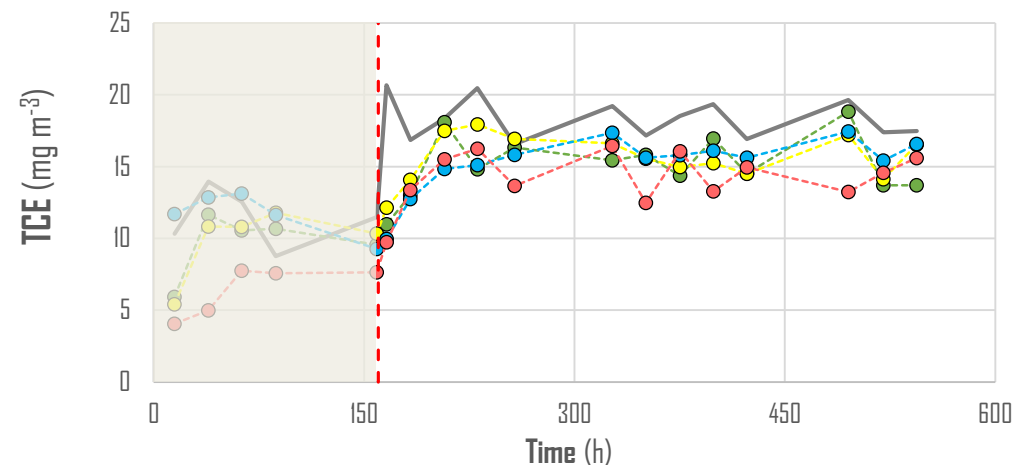
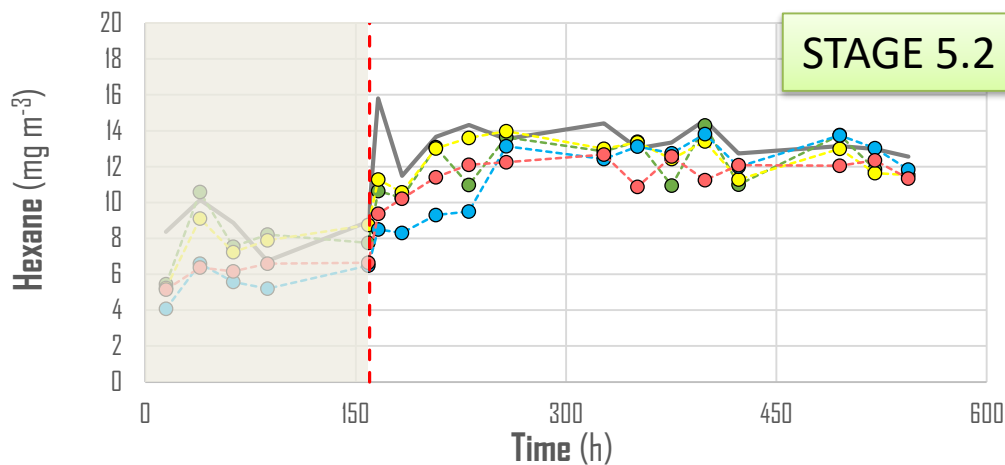
Influence of biomass concentration and VOC loading rate

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CHAMBER 1

Biomass suspension (40 mL MSM; 0.5 g)

CHAMBER 3

Latex (60 mL)

CHAMBER 2

Biomass suspension (40 mL MSM; 0.5 g) + latex (60 mL)

CHAMBER 4

Biomass suspension (40 mL MSM; 2.0 g) + latex (60 mL)



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- High toluene and pinene removal
- Low hexane and TCE removal ~~mass~~→transfer/metabolism
- Removal as high as biomass in suspension (Estrada 2015)
- Essential role of water/nutrients from MSM
- Increased robustness by latex ~~higher~~→treatment capacity

First biocoating study with

Simultaneous treatment of VOCs

Mixed microorganism culture

System relatable to real air conditions



Thank you for your attention

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