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NO ABSORBENTS AS MASS TRANSFER VECTORS FOR BIOLOGICAL TREATMENTS

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Index

Environmental problem targeted

TRANSPORTATION

50 % NO_x emissions

ENERGETIC INDUSTRY

22 % NO_x emissions

95 % NO
5 % NO_2

HEALTH AND ENVIRONMENTAL EFFECTS

LUNG DISEASES

HEART DISEASES

HEADACHES

DIZZINESS

GLOBAL WARMING

ENVIRONMENTAL DAMAGE

8.8 million
causes of deaths
per year worldwide
can be attributed to polluted air

Objective

Nitric oxide (NO) is **slightly soluble** to be treated with conventional technologies

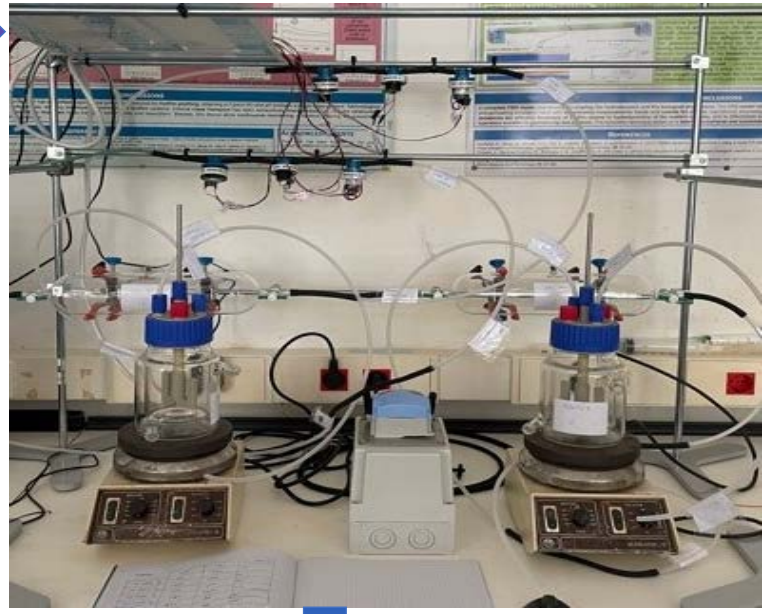
Patent pending

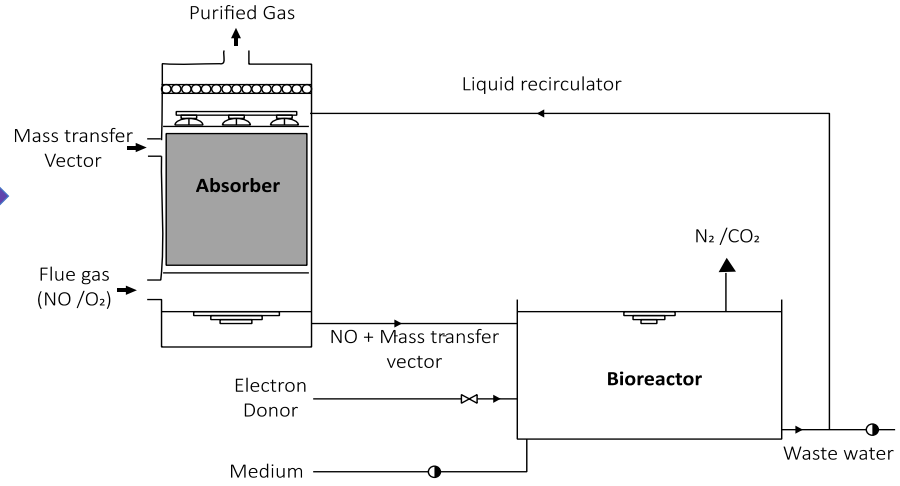
To develop an innovative technology for the treatment of nitric oxide (NO) from combustion process gases and based on two stages: a **chemical absorption stage** with a mass transfer vector and a **biological process stage**, in which the nitric oxide (NO) and regenerates from the mass transfer vector, minimizing the environmental impact of the treatment.

Research steps

bottles 500 ml

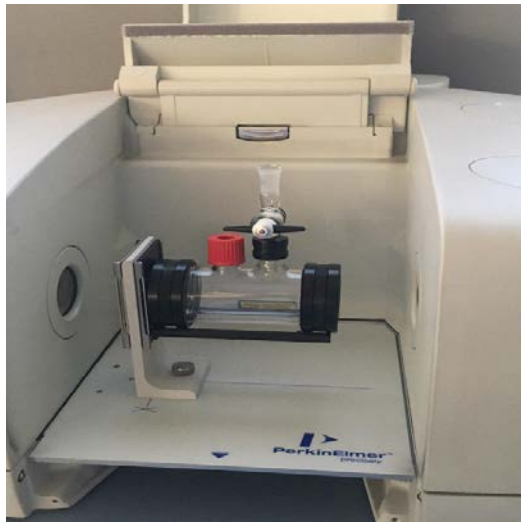
120 ml vials





Experimental methodology of absorption test

1. 120 mL vials or 500 mL bottes filled with N_2 gas.
2. The volume of NO (10%) needed to prepare the mixture of the desired concentration was injected.
3. The volume of absorbent was injected while maintaining a slight overpressure inside the vial to prevent air from entering.

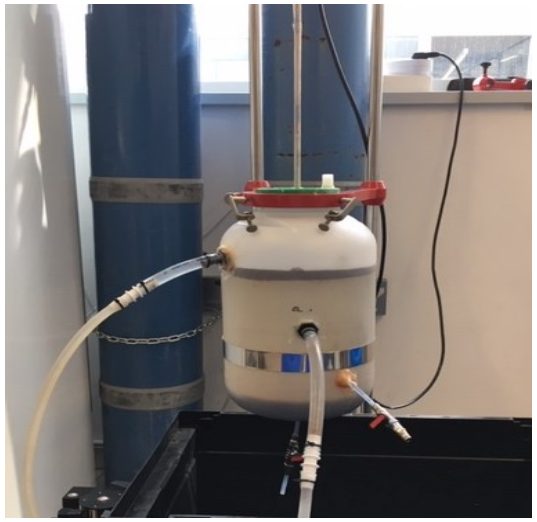


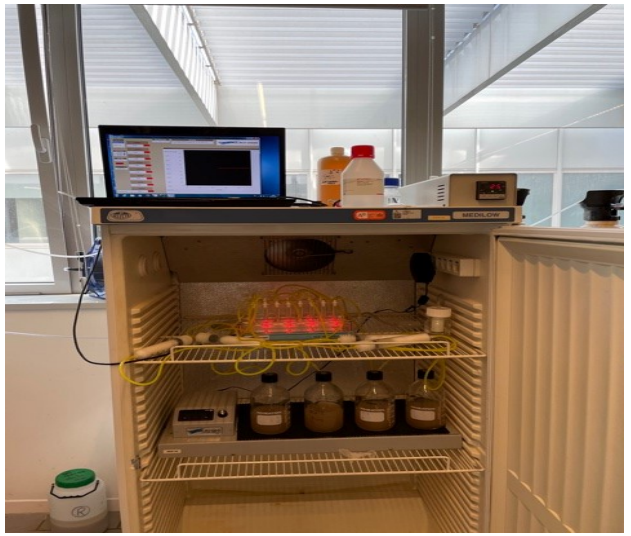
Mass transfer vectors:

Non-aqueous phase solvents
NAPs

Experimental methodology of biocompatibility test

SBR
Enriched
denitrifying
bacteria





Anaerobic
respirometry

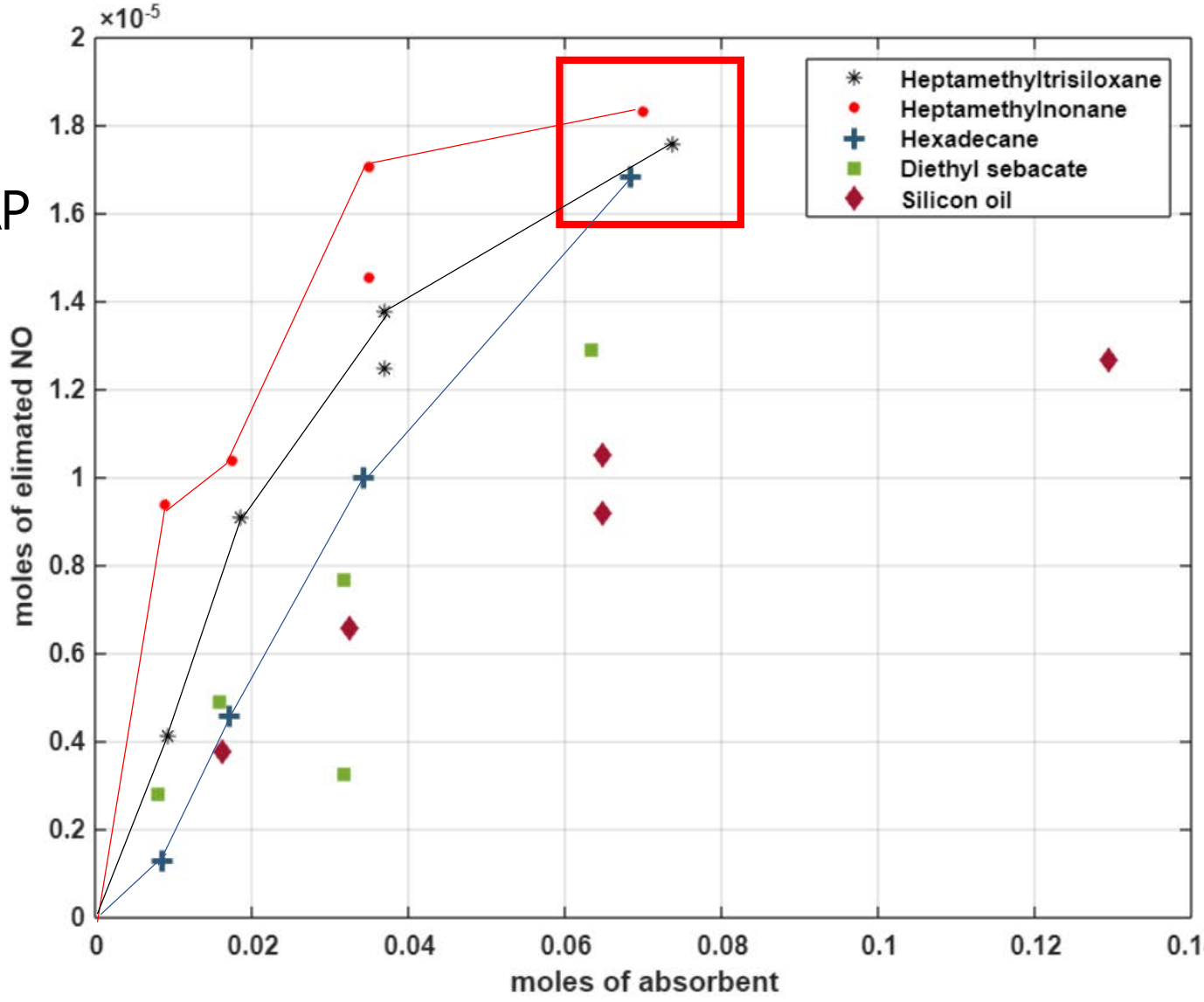
WWTP
Manresa
(Catalunya)

Aerobic
respirometry
(Ultimate DBO –
OxiDirect®)

Results (absorption test)

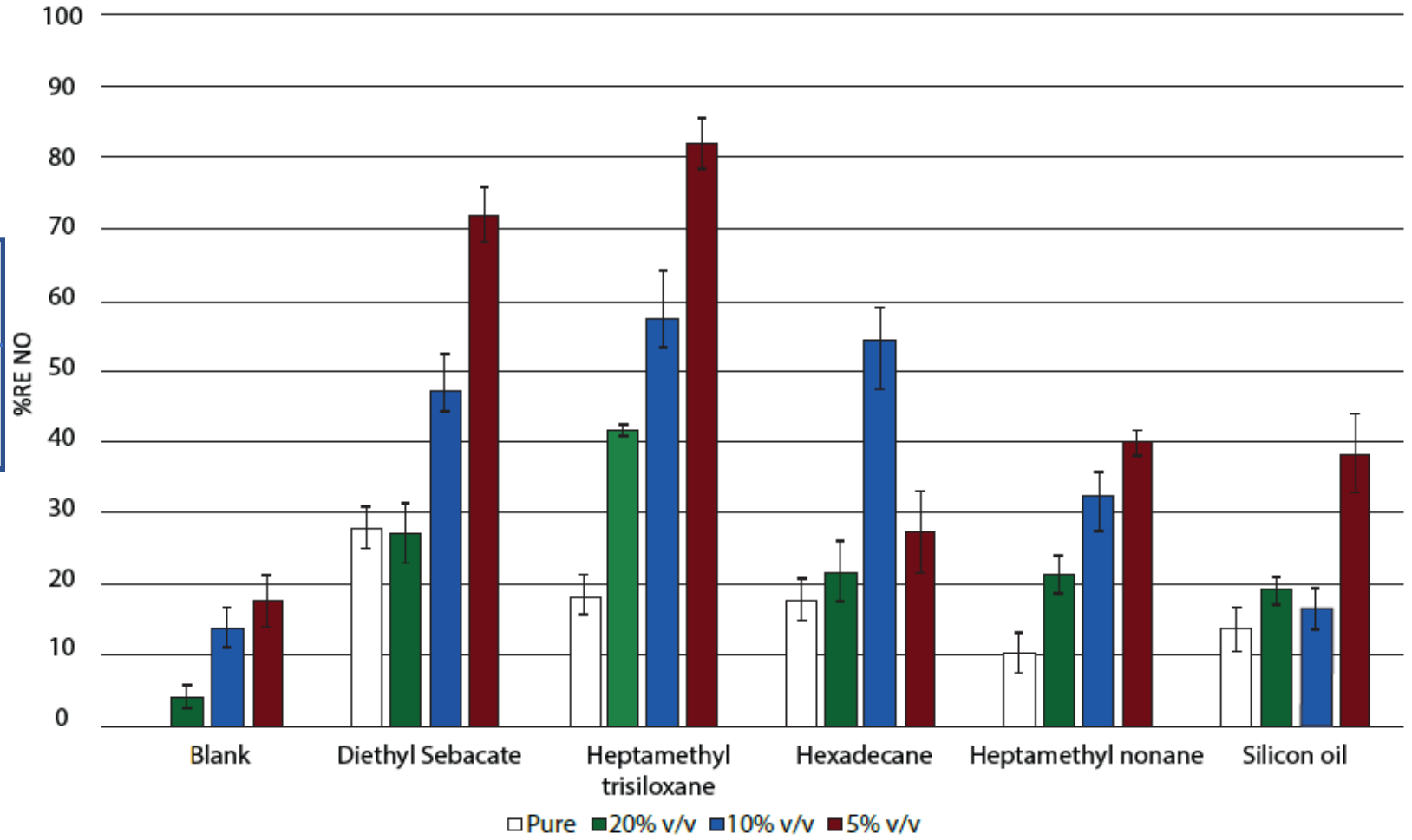
- 120 mL vials
- Different amounts (moles) of NAP
- Gas phase (NO) and NAP

GAS PHASE (NO-NO_2)
NAP



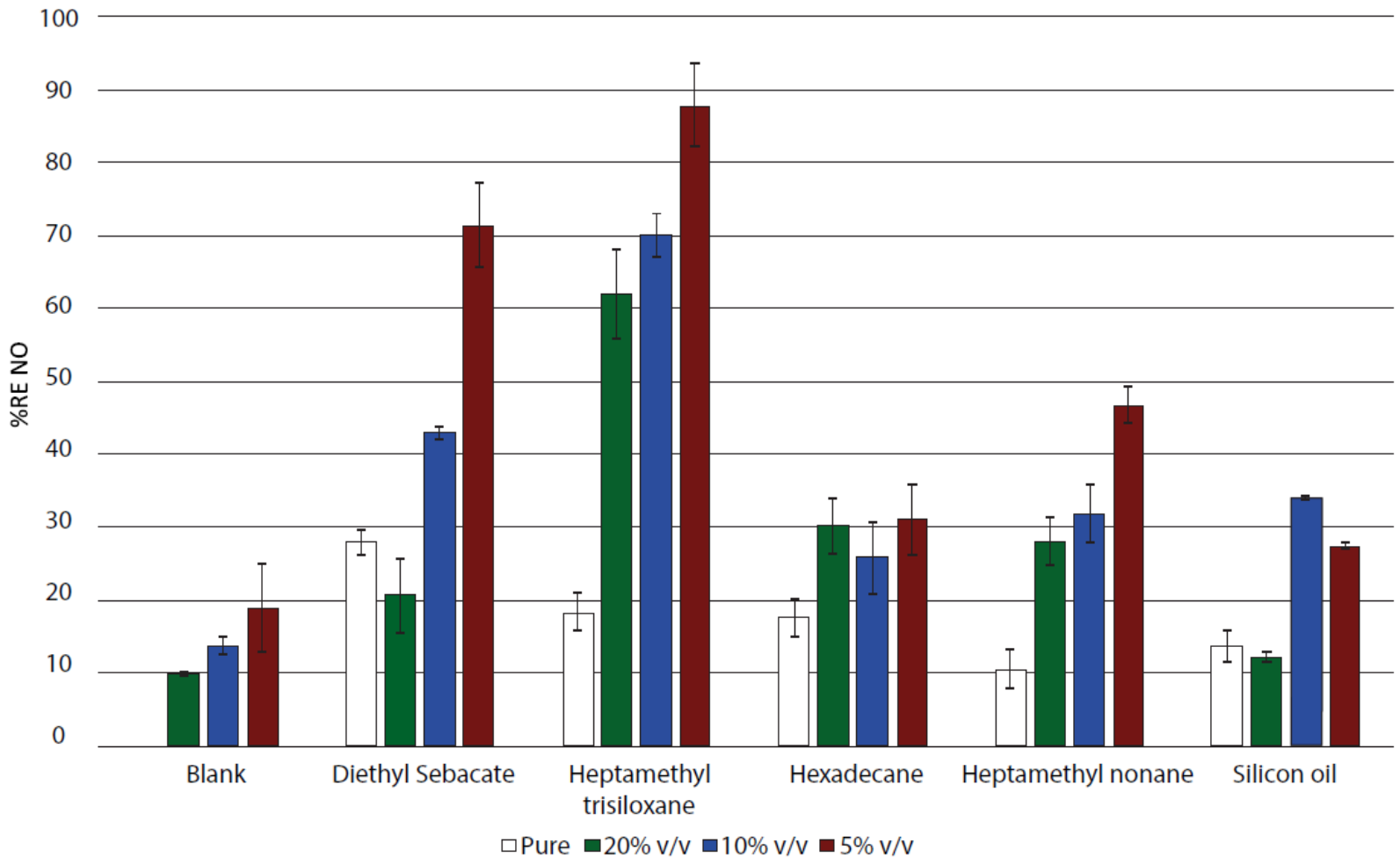
Results absorption test (NAPs-aqueous phase - water)

GAS PHASE (NO-NO_2)
NAP + WATER



Results absorption test (NAPs-aqueous phase - buffer)

GAS PHASE (NO-NO_2)
NAP + PHOSPHATE BUFFER

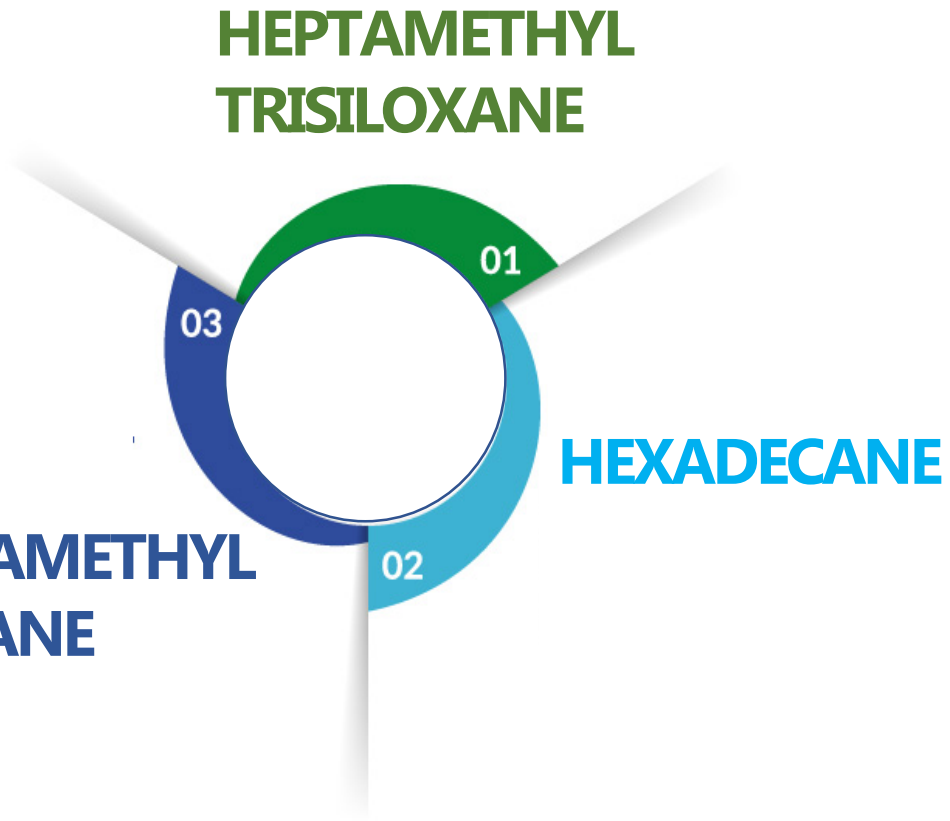


Results of biocompatibility studies

NAP	Toxicity	Biodegradability (Anaerobic)	%Biodegradability (Aerobic)
Hexadecane	No	No	8
Diethyl Sebacate	No	Yes	100
Heptamethyl nonane	No	No	1
Heptamethyl trisiloxane	No	No	7
Silicone oil	No	No	0

$$\%\textbf{Biodegradability} = \frac{COD_{experimental}}{COD_{Theoretical}} * 100\%$$

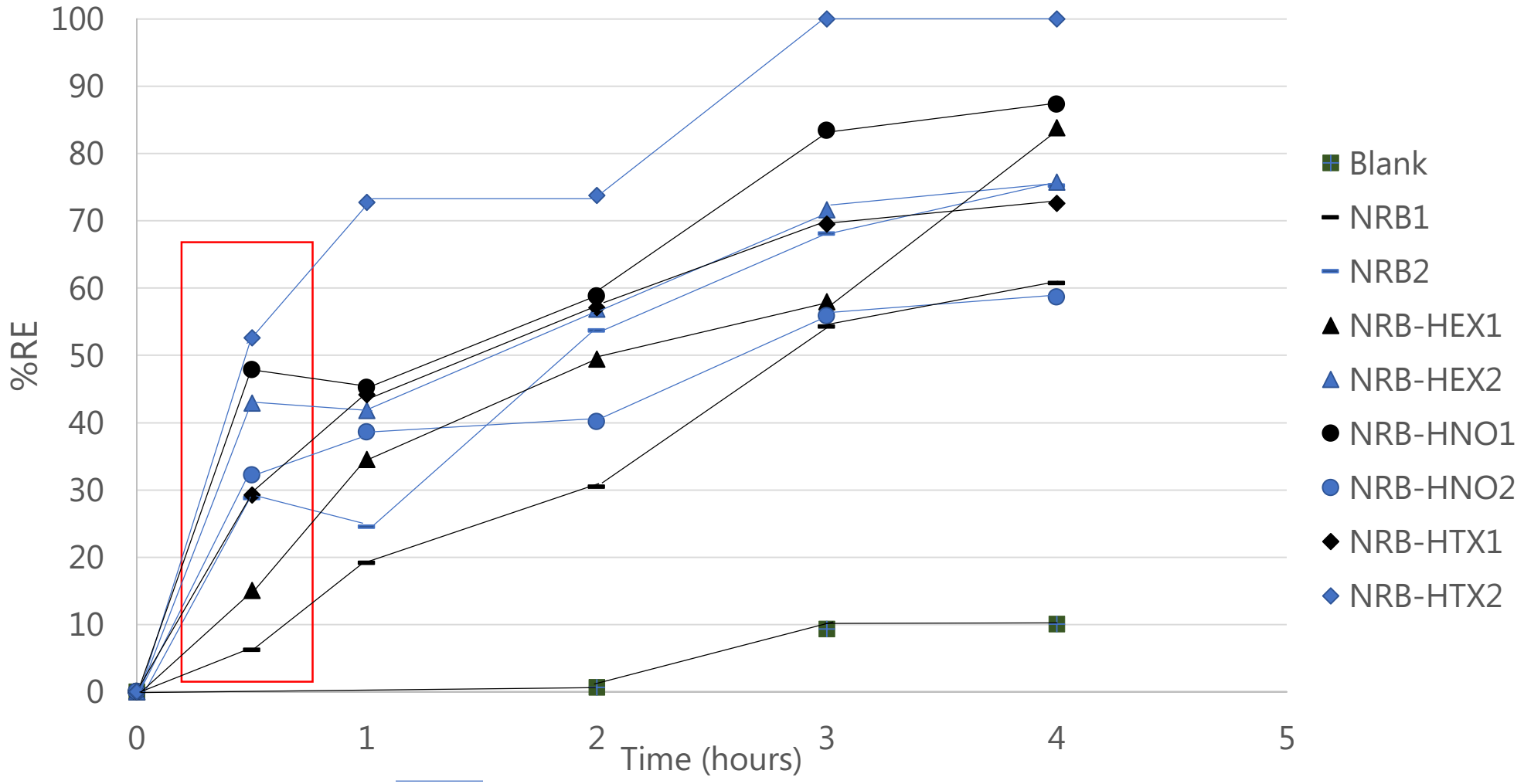
Results of integration CABR systems



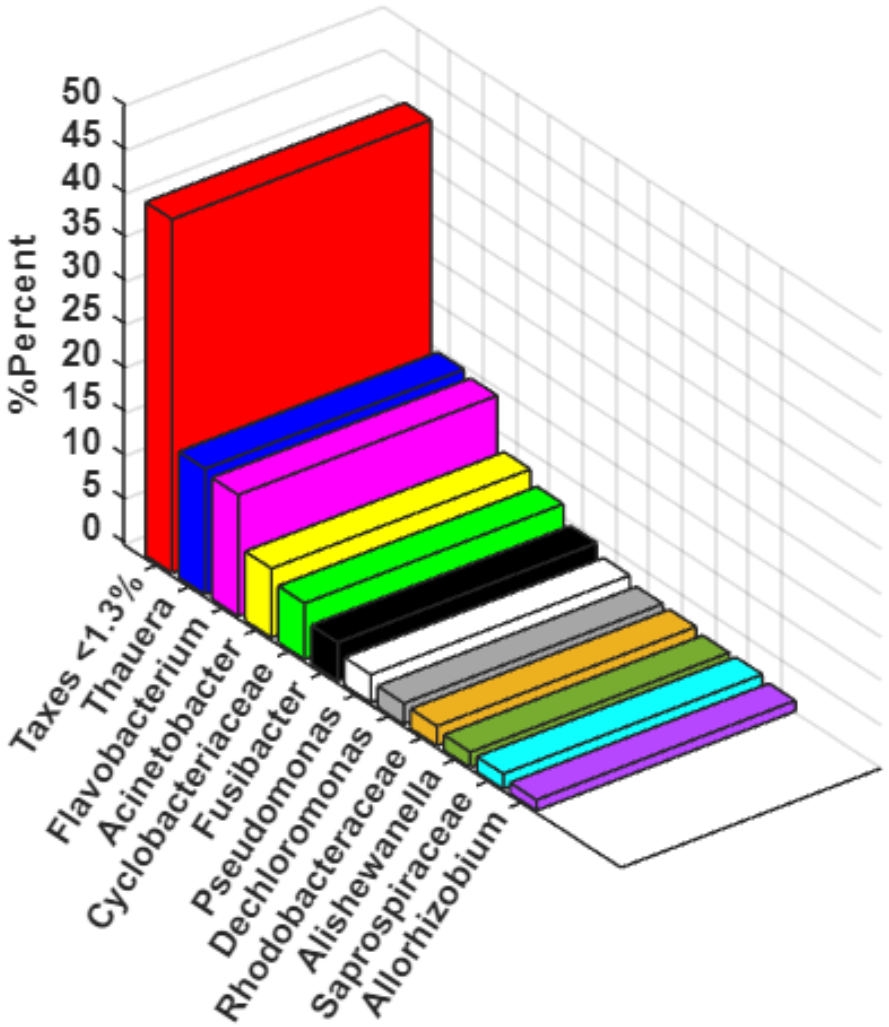
1. 2,5 mL NAP's – Enriched biomass
2. 2,5 mL NAP'S – Enriched biomass X2

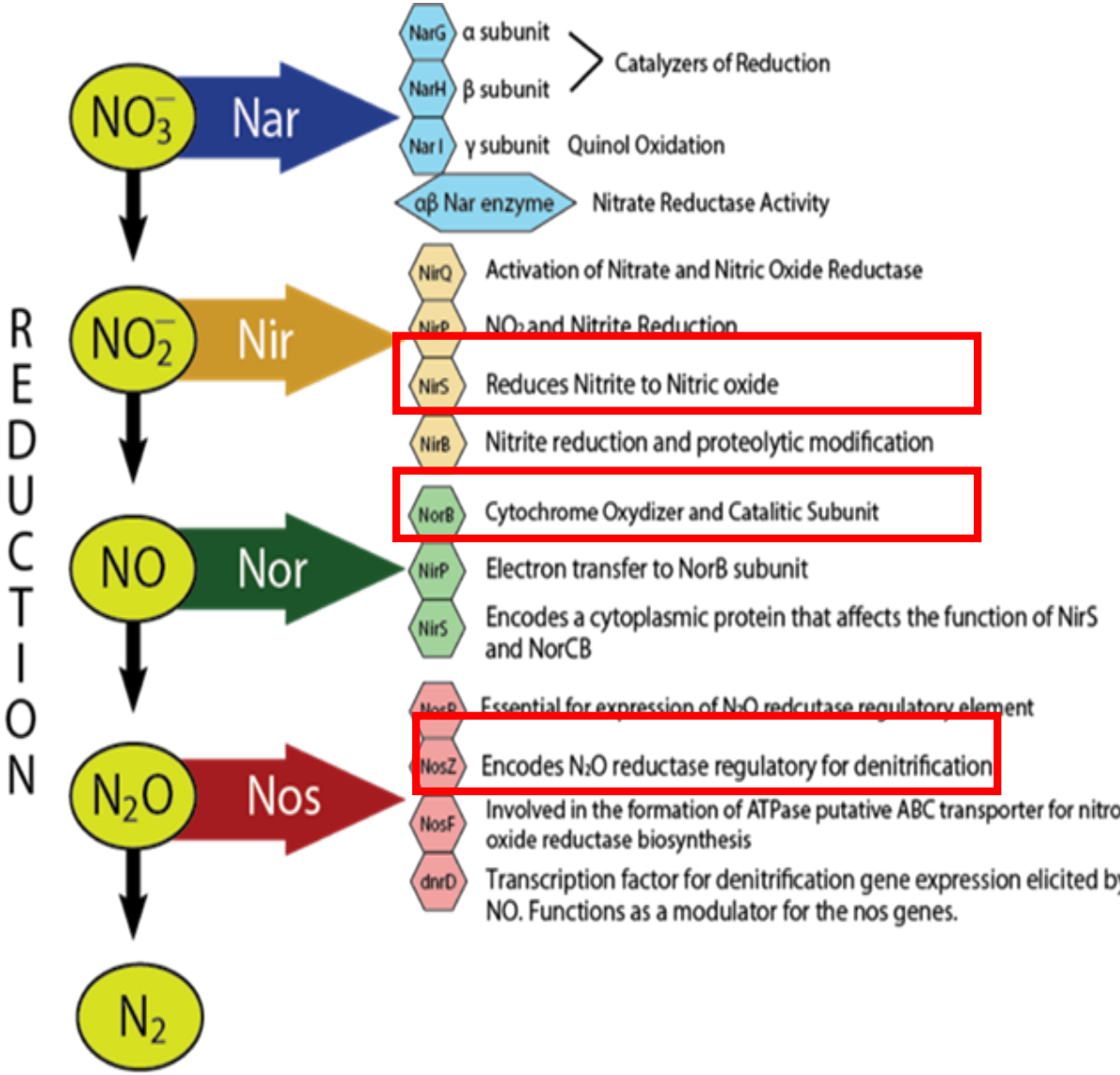
Gas phase (NO-NO2)
NAP, mineral medium and biomass

Results of integration CABR systems



Microbial community analysis and qPCR





Conclusions

- ✓ The results of this work showed that all the NAPs (HEX, HNO, HTX, DSE, SO) could be used as mass transfer vectors for chemical absorption - biological reduction systems of NO, with heptamethyl trisiloxane being the compound that showed the greatest absorption capacity both in its pure state and in contact with an aqueous phase. In the CABR tests, it was shown that NO elimination improves in a short time (30 minutes) when the three mass transfer vectors (HEX, HTX, HNO) and enriched denitrifying bacteria are added.

- ✓ None of the NAPs studied turned out to be toxic for denitrifying bacteria. However, diethyl sebacate resulted to be biodegradable, which, to be used in biological processes, would generate high operational costs because NAP could not be reused in the process.

Future challenges

- ✓ Increasing the TRL of the technology scaling up to bench scale in which each of the stages can be studied.
- ✓ Maintain a NO removal efficiency greater than 80% at bench scale.
- ✓ To optimize the recirculation of the mass transfer vector in order to reduce operating costs.
- ✓ Study the effect that other gases such as CO_2, SO_2 and O_2 have on microbial activity and the absorption process.
- ✓ Adapt the technology to the diversity of combustion processes such as power plants or incinerators, taking into account legal requirements, NO concentration and gas flow conditions.

Thank you!

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