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ABSTRACT

LATEX-BASED BIOFILMS FOR INDOOR AIR PURIFICATION

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Summary

Indoor air quality is nowadays a matter of concern. People spend as much as 90% of their time indoors, where air is often more polluted than outdoor air. Indeed, more than 4 million deaths are attributed to this environmental problem every year. Prevention or elimination of the source is not always a technically or economically feasible solution, and air purification techniques are very often needed.
Traditionally, physical-chemical technologies have been used. However, the particular characteristics of indoor air, which include low concentrations, wide variability of pollutants, concentration peaks and hydrophobicity, limit the effectiveness of these technologies.
In this context, biotechnologies have emerged as a solution that can cope with the above-mentioned limitations. More specifically, latex-based biocoatings are promising technologies with additional advantages. The biocoating is based on a porous polymer matrix where microorganisms are entrapped in a non-growing steady state. This configuration allows a direct contact between cells and polluted air, thereby mass transfer is enhanced while preventing any microorganisms release to the atmosphere. The bioavailability of indoor air pollutants, in particular that of hydrophobic volatile organic compounds (VOCs), is improved.
Although latex-based biocoatings represent a promising technology for indoor air purification, the research in this area is very limited. Some studies have already demonstrated their capacity for VOC abatement; however, the experiments are restricted to small laboratory scale far from a real indoor air purification unit.
In this study, a more realistic latex-based biocoating approach for VOCs abatement was investigated. n-hexane, trichloroethylene, toluene and α-pinene were selected as model indoor air pollutants. The performance of different latex and biomass mixtures was assessed in flat PVC reactors, where polyurethane foam was used as packing material. The influence of several parameters (water, nutrients and biomass contents in the mixture, degree of drying of the biocoating and inlet loading rate) on VOC removal was studied under continuous operation at low pollutant concentrations (n-hexane 9.6±2.4, trichloroethylene 13.7±3.0, toluene 14.7±3.5 and α-pinene 21.3±3.9 mg m^{-3}).
VOC abatement was highly dependent on the water content of the mixture. Optimal performance was obtained at higher levels of water content, although the biocoating

was partially wet. Toluene and pinene showed high degradation efficiencies (>95%) under optimal biocoatings operation, though hexane experienced a limited degradation as a result of its high hydrophobicity. Trichloroethylene degradation was negligible under all tested conditions. When the inlet load rate was doubled, the latex-based biofilm performance remained optimal while control experiments lost metabolic activity due to desiccation, confirming the higher robustness of the latex-based biocoatings.

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- ☐ Policy and associated regulations for odour and air quality.
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- ☐ Odour/VOC perception, impact, formation and dispersion.
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- ☐ Source characterization and odour/VOC mapping.
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