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Behaviour and Fate of Nonylphenol in Soils Containing Contaminated Sewage Sludge.

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INTRODUCTION

The nonylphenol polyethoxylates are non ionic surfactants widely used. Their final biotransformation product, namely nonylphenol (NP), is an oestrogenic compound commonly found in sewage sludge. The aim of this work is to investigate the behaviour and the degradation of nonylphenol in soils containing contaminated sludges.

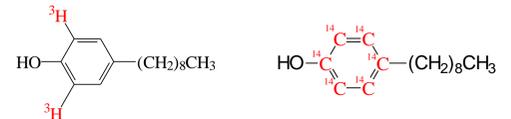
MATERIAL AND METHODS

Extractable compounds :

- solid matrix (soil-sludge-mycelium) : liquid-liquid extraction, concentration/purification and reversed-phase HPLC analysis with UV, ³H, ¹⁴C detection.
- liquid media : on-line concentration and reversed phase HPLC analysis with UV, ³H, ¹⁴C detection.

Unextractable and volatile radioactivity :

- combustion (³H or ¹⁴C) or ³H₂O or ¹⁴CO₂ trapping, respectively,
- liquid scintillation counting.



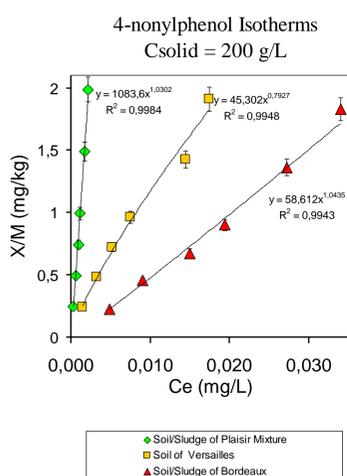
RESULTS

Physico-chemical characteristics of Nonylphenol (NP) in Soil-Sludges Mixtures :

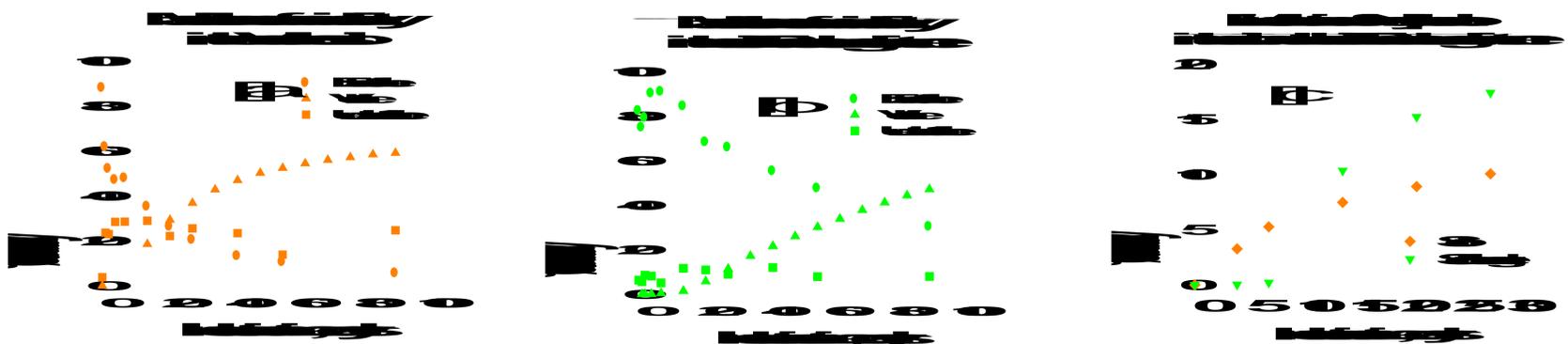
4-nonylphenol adsorption on sludges mixtures ≠ 4-NP adsorption on soil
Adsorption capacity of sludges to 4-NP : Plaisir > Bordeaux

High levels of contamination (4-NP) of the two sludges :

Sludge Origin	NP Amount, mg.kg ⁻¹
Plaisir (78)	337±12
Bordeaux(33)	100±10



Fate of nonylphenol (NP) in soil-sludges mixtures :



Extractable radioactivity was only composed of NP and tritiated water. In the soil, half-life of NP was estimated to be 2 days [a]. By contrast, in the presence of sludge, it was increased to 50 days [b]. The experiments with tritiated NP were validated with ¹⁴C labeled NP [c]. NP mineralization still occurred, with a smaller extent. Nevertheless, filamentous fungi well grew in some assays conducted with soil/sludge mixtures. In that case, results showed a strong correlation between fungal development and contaminant breakdown.

Fate of nonylphenol in cultures of *Trametes versicolor* :



The white rot basidiomycete *T. versicolor* is known to degrade phenolic compounds. In liquid cultures, it was able to partially mineralize NP. Most of the radioactivity was associated with an insoluble polymeric compound. Then, NP modified laccase production (phenoloxydase, E.C. 1.10.3.2.) by *T. versicolor*. After purification, these enzymes were able to convert NP to a polymeric compound, with a maximal activity at pH 5. Identification of the fungal strains isolated from soil/sludge mixtures is under progress. Nevertheless, in liquid cultures, one of them degraded 20% of the NP to ¹⁴CO₂ within 12 days.

CONCLUSION

- The sludges contained high level of NP and modify NP adsorption in the soil,
- This one from Plaisir decreased also the degradation rate of NP in the soil,
- The sludge modified the exocellular enzyme production by the fungus *Trametes versicolor*.

Further research is needed to :

- study the sludge effects on NP bioavailability,
- assess the ecotoxicology of the sludges towards soil microorganisms.