Investigating the Potential of Agri-food Waste Substrates to Enhance Reductive Dehalogenation of Chloroethene-Contaminated Groundwater

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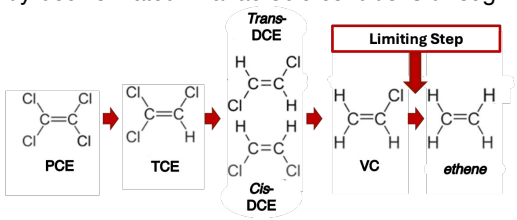
INTRODUCTION

Chloroethenes (tatrachloroethene (PCE), trichloroethene (TCE), dichloroethene (*cis*-DCE) and vinyl chloride (VC)) are relevant contaminants due to their wide use in industrial activities and to improper past disposal. They are efficiently dechlorinated in anaerobic conditions through **organohalide respiration** by organohalide respiring bacteria.

PCE and TCE reductive dehalogenases (pceA and tceA) and three VC reductases (bvcA, vcrA and cerA) are known to be involved in this pathway. In bioremediation procedures, bacterial organohalide respiration is enhanced by the addition of a redox source, usually a fermentable substrate, that feeds the anaerobic trophic chain of organic carbon degradation.



AIM

Food wastes were added as redox sources to test their ability to enhance organohalide respiration in chlorinated ethene-contaminated groundwater

WORKFLOW

Microcosms set up

Food wastes: molasse, tomato extract and whey.

They were added to microcosms in order to reach a COD of ~200 mg L^{-1}.

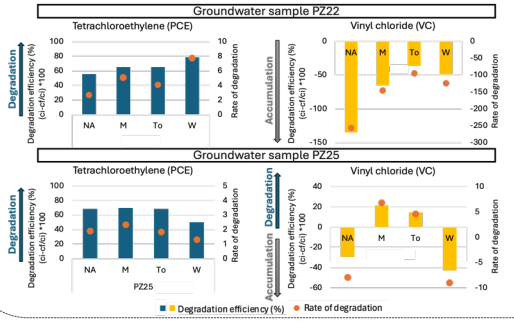
Microcosms were set up with two different groundwaters (Pz22, Pz25) of a CE contaminated aquifer.

CE concentration (mg L^{-1})	Pz22	Pz25
PCE	5.8	1.7
TCE	30.0	5.1
cis-1,2-DCE	18.9	4.3
VC	98.0	5.6

Food wates physico-chemical characterization

Substrate	pH	COD (g L^{-1})	N-NO_3 (mg L^{-1})	N-NH_4 (mg L^{-1})
Molasse	5	494.5	6200	9660
Tomato extract	4.67	114±11	88.5±3.5	57.5±0.7
Whey	4.76	453±30	33±4.2	115±1.4

Chloroethenes quantification



- CE were quantified after 4 months of incubation by GC-MS.
- The addition of waste substrates promoted the degradation of vinyl chloride at different extents according to substrate nature.
- The effects were more evident in the more contaminated groundwater sample, due to a different composition of the microbial community.

Organohalide respiration: biomarkers quantification

- Molasses and tomato extract were more effective than whey in stimulating *Dehalococcoides* population growth and reductive dehalogenase genes *tceA* and *vcrA*.
- Functional biomarkers were more concentrated in groundwater Pz22, where CE contamination was higher.

CONCLUSION

Food wastes proved to be efficient substrates for the biostimulation of organohalide respiration thus permitting to develop more sustainable bioremediation techniques in frame with circular economy concepts

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