Microbial Pb(II) precipitation: the role of biosorption as a Pb(II) removal mechanism

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INTRODUCTION

- An industrially obtained consortium (IOC) of bacteria precipitates hazardous Pb(II) as PbS and Pb(0).
- Dead bacteria has been widely studied as biomass for passive Pb(II) removal by adsorption (biosorption).

OBJECTIVE

- Inhibit metabolic activity of IOC without damaging cell structure.
- Investigate potential metabolically independent mechanism of Pb removal.

METHOD & MATERIALS

- IOC grown in 20 g/L tryptone, 10 g/L yeast extract, 1 g/L NaCl, 0.041 g/L $NaNO_3$ solution for 24 h.
- IOC thereafter exposed to NaN_3 for 3 h.
- Dead IOC spiked in various amounts into different concentrations of Pb(II) .

Analytical methods: Aqueous Pb(II) measured with AA spectroscopy, metabolic activity measured with MTT, and surface characterized by FTIR spectroscopy.

RESULTS

- Metabolic activity undetected after NaN_3 sterilization.
- Damage of cell structure undetected after NaN_3 sterilization (Fig. 1b)

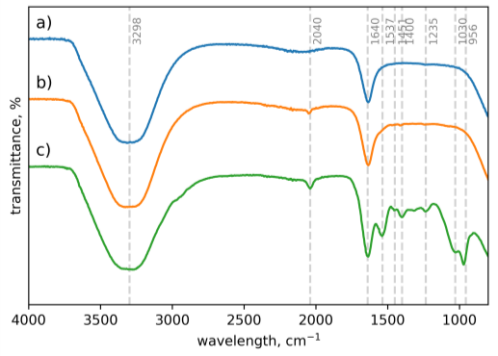

Fig. 1: FTIR spectra of IOC a) after 24 h growth period, b) after 3 h exposure to NaN_3, and c) after exposure to NaN_3 and $Pb(NO_3)_2$.

- Pb(II) removal from solution corresponded with significant changes to cell structure (Fig. 1c), specifically observed as changes in amide, phosphate, and carboxyl groups.
- 61.7 % of 80 mg/L Pb(II) solution removed after 3 h by NaN_3 sterilized IOC (Fig. 2).

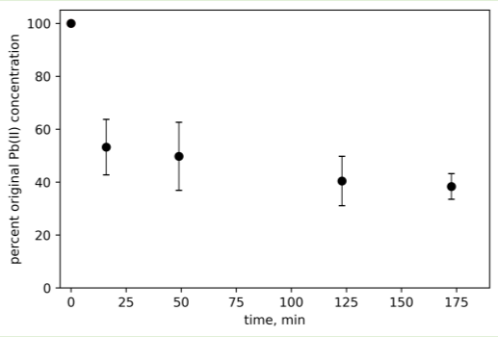

Fig. 2: Percent lead remaining in solution as a function of time after the addition of the NaN_3-sterilized consortium.

- Maximum Pb(II) removal was observed at an initial concentration of 125 mg/L Pb(II) for IOC dosed between 25.2 and 47.5 mg/L..

CONCLUSIONS

- Pb(II) removal not exclusive to living IOC.
- Chemical binding of Pb(II) to cell surface plays a role in Pb(II) removal by dead IOC.
- Dead IOC shows potential as an effective material for Pb(II) biosorption.

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