Effect of selenium oxyanions on the bioconversion of phenol and CO/CO_2 to value-added chemicals and their recovery

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Social impact:

Selenium (Se) is a trace element for which there is a very marginal demarcation between being an essential nutrient and a toxic element. The oxyanions SeO_3^{2-} and SeO_4^{2-} can be reduced to less toxic, insoluble elemental Se(0) nanoparticles, with the help of aerobic or anaerobic microorganisms. Certain bacteria and fungi have the capability to reduce toxic metal oxyanions with simultaneous detoxification of persistent organic pollutants paving the platform for dual microbiological remediation. In this research, phenol was chosen as the model organic pollutant because it is frequently found in the waste effluents of oil and petrochemical industry along with other toxic heavy metals such as Cr^{+6}, Se^{+6} and Se^{+4}. The main objective of this research was to use phenol as the carbon source for dissimilatory reduction of toxic selenite and selenate by a fungal-bacterial consortia. The metabolites of the consortia will be analysed to estimate the VFA (volatile fatty acids) composition. Besides, the effect of Se oxyanions on the production of alcohol by anaerobic solventogenic *Clostridium* using CO/CO_2 as the carbon source will also be investigated. Finally, this research will also focus on the recovery of VFA and alcohol from the fermentation broth using a suitable adsorbent.

Technological challenges:

The main focus of this research is the bioconversion of inhibitory substrates to value added chemicals and to estimate the effect of Se oxyanions on the bioprocess. The important problem during the bioconversion of inhibitory substrates is the slow or no growth of the biomass as most of the value-added chemicals are produced during the secondary growth phase of the microbes. The potential limitation or challenge will be the long term operation of the aerobic fungal-bacterial bioreactor and the maintenance of high pollutant removals. Due to limited availability of literature on this topic and the absence of a metabolic pathway for the dual remediation of phenol and Se oxyanions, certain unknown experimental constraints pose a challenge. Besides, the toxic Se oxyanions may have some mutagenic effect on solventogenic *Clostridium* which in turn can hamper the biofuel production. Another important challenge will be the development of a cost-effective, eco-friendly recovery strategy for VFA and alcohol.