Bioremediation of soil contaminated with Cr (VI) by *Cellulomonas* strain ES6

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INTRODUCTION AND METHOD

- In the environment we can find chromium in trivalent form [Cr (III)] or in the hexavelent form [Cr (VI)] as a consequence of a lot of industrial activities contaminating the soil.
- Cr (VI) at low concentrations is soluble, mobile, toxic and mutagenic for animals and plants. In contrast, Cr (III) is less toxic and mobile in external environment and it is an essenital nutrient that is very popular in some diets [3].
- The methods to remedy this contamination consist in physical or chemical methods but recently microorganisms that are able to reduce the hexavalent chromium to a less detrimental form of trivalent chromium by making a bioremediation process have been discovered [3].
- *Cellulomonas hominis* ES6 is a raod-shaped gram-negaive bacterial genus that belong to phylum actinobacteria. This bacteria stands out for its metabolic capacity to reduce Cr (VI) to Cr (III) for long periods of time even in abscence of an external electron donor because it is able to acumulate reserve substances where there is in an external electron donor [4].
- Enzymatic reduction of Fe (III) to (II) performed by *Cellulomonas sp.* ES6 strains seems to be an important process for the reduction of Cr (VI) [2].
- The aim of this study is to test different compunds and conditions which can help to reduce Cr (VI) in a better way and to analise that, an *ex situ* sistem will be applied.

For the ex situ treatment three steps have to be optimized [3]:

1. Leaching column of Cr (III) and Cr (VI) of chromium contaminated sample.
2. Transformation of Cr (VI) to Cr (III) in a immobilized reactor thanks to the action of Cellulomonas sp. ES6.
3. Adsorption column that contains *G. lucidum* which is used as a adsorbent post-tratment unit to remove Cr (III) from the system.

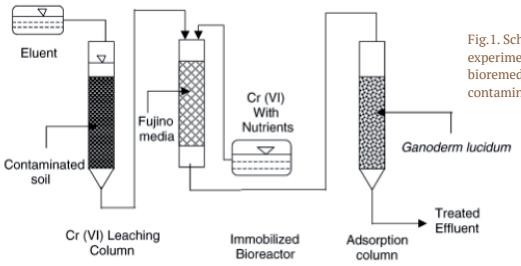

Fig.1. Schematics of the experimental setup for bioremediation of Cr (VI) contaminated soils. [3]

RESULTS

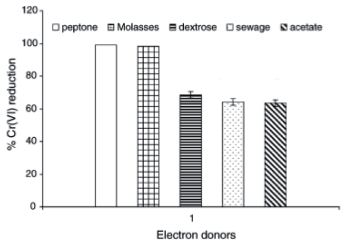

Fig.2. Effect of electron do on Cr (VI) reduction. [3]

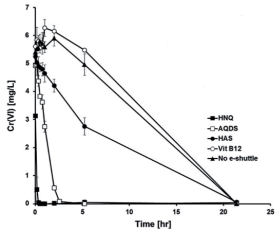

Fig.3. Cr (VI) reduction in presence of different electrons shuttles. [2]

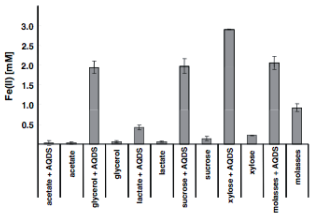

Fig.4. Fe (II) productions in presence of different carbon sources and electron shutlles. [1]

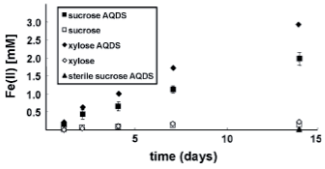

Fig.5. Influence of ADQS concentration on Fe (II) production. [1]

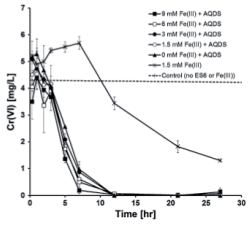

Fig.6. Cr (VI) reduction in function of Fe (III) concentration. [2]

DISCUSSION AND CONCLUSION

- In aerobic conditions more quantity of Cr (VI) has been reduced than in facultative anaerobic conditions.
- Peptone and Molasses are the best electron donors because they cause the highest reduction of Cr(VI) (Fig.2.). Molasses was selected as electron donor for further stuides, as it was plenty aviable as a waste producte so the tratment cost can be reduced in contrast to when using pure sucrose or other sugars.
- The results˙show that the presence of electron shuttles, mostly ADQS and HNQ, can increase the rate and extent of both Cr (VI) and Fe (III) reduction by microorganisms (Fig.3).
- With the presence of ADQS approximately 90% of the present Fe (II) had been reduced to Fe (II) and together with molasses shows one of the best reductions of Fe (III) that could help Cr (VI) reduction (Fig.4).
- The results also show that there is a direct, positive and almost lineal relationship between the used ADQS and existing Fe(II) concentration (Fig.5).
- Fig. 6 confirms the hypothesis that Fe (III) reduction helps Cr (VI) redution, showing that as more presence of Fe (III) more reduction is prodeuced.
- *Cellumonas sp.* ES6 is able to reduce Cr (VI) during periods up to 141 days without presence of nutrients or an external electron donor [4].
- Numerous Cellulomonas spp., including strain ES6, have been obtained from contaminated soils and they may play an important role *in situ* remediation of C (VI). It might be possible to mantain a biobarrier activity by periodic addition of fresh substrate in contaminated soil but more studies on soil and sediments are needed.

REFERENCES

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