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Innovation The Research Concept

The Adsorption of Heavy Metals By Sulphate Reducing Bacteria

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Abstract

Sulfate-reducing bacteria, Desulfovibrio spp., use sulfate as an electron acceptor to form hydrogen sulfide, which increase the pH of the water and precipitates heavy metal sulfides from the water. However, the sulfate-reducing bacteria require a carbon source. Methanol was experimentally tested to serve as a cheap carbon source. By using the sulfate reducing bacteria, the amount of precipitate produced was very low compared to previous precipitation processes. However, the sulfate-reducing bacteria have a slow growth rate; therefore, it takes several months for the bacteria to reduce the sulfate at their maximum rate.

keywords: Adsorption, Immobilisations, Chemostat, Anaerobic

Introduction

The Adsorption of Heavy Metals By Sulfate Reducing Bacteria:

The metal ions that form sulfides at pH 7.5 were removed from solution e.g Ag, Hg, Pb, As, Ni by Desulfovibrio. A large number of the ions that were removed do not have insoluble sulfides and the conclusion was that another powerful immobilization mechanism or adsorption process was present in addition to the precipitation of insoluble sulfides.[1] The adsorbent was produced using sulfate-reducing microorganisms in a 100ml. chemostat. The chemostat was first sterilized in an autoclave and then flushed with oxygen-free nitrogen and then isolated from atmospheric oxygen to establish and maintain anaerobic conditions. The temperature was maintained at 32°C by placing the chemostat in a water bath with temperature accurately controlled at 32°C. [2-3]

The evidence suggests that one powerful mechanism by which this can occur is the immobilization of the heavy metals such as Fe and Mn by colonies of sulfate-reducing bacteria (SRB) such as Desulfovibrio that occur in anaerobic regions of the mud.[4-5] Most of the heavy metals that find their way into the anaerobic muds are paramagnetic, so when they are immobilized in the SRB cluster, the cluster becomes paramagnetic and may be removed by magnetic separation. If the adsorbent compound is introduced into the mud together with iron sulfate, over a period of time, the population of SRB colonies will increase and heavy metals will be precipitated and immobilized in the colonies. [10-16]

Objective of the Study

Heavy concentration of heavy metals is soil has toxic effect. Remediation of heavy metals by bacteria in atmosphere is interesting field and needs further study.

Comparative Studies of Bacterial Growth

Growth of all the three bacteria will be studied by two methods vis.
(a) Plate count method, (b) Turbidimetric method for comparison, sulphate, reducing bacteria (Desulfovibrio desulfuricans) was also included in our study.
Comparative growth rate of the bacteria will be studied as a function of (A) time and (B) dilution of the medium.

Effect of Time On Bacterial Growth

Plate count method showed that in the early stage of growth upto about 12 days, the growth rate of white bacteria and black was almost equal. Growth rate of orange bacteria was maximum. After 22 days, the growth rate order was found to be different. It was minimum and maximum for black. The growth rate of orange was lesser than growth rate of black and that of black was lesser than that of orange.
Turbidimetric method study showed that in the early stage of growth i.e. upto 5 days, the growth rate as exhibited by absorbance, was in the following increasing order i.e. wnite < < orange < black(D). Thereafter the order of growth rate changed. Complete absorbance was obtained on 7th day with black. On 9th day with orange bacteria and on 14th day with black and white bacteria.

Thus, the bacteria whose growth rate was maximum exhibited complete absorbance in shortest time and that in which growth rate was minimum, time for complete absorbance was maximum.

Effect of Dilution On Bacterial Growth

Growth of all the four bacteria at different dilutions (10° to 10^{-6}) was studied.

Orange Bacteria

Growth rate of orange bacteria was studied at different dilution both by plate count and turbidimetric estimation methods. Bacteria growth decreased with increase in dilution i.e. from 10° to 10-6. This was more evident by plate count method. Results obtained by turbidimetric method was not conclusive.

Black Bacteria

Decrease in growth rate with dilution was evident with black bacteria. In this case, plate count measurement and turbidity measurement showed the same trend.

White Bacteria

Plate count studies related with white bacteria showed that growth rate decreased with dilution, absorbance result was not conclusive.

Black (D) Bacteria

Result obtained with black (D) bacteria showed decrease in growth rate with dilution. The difference in bacterial count could be obtained upto ten days only. In twenty days, bacterial count in all the four dilution became almost equal. In absorbance and after 7th day, all the dilutions showed maximum absorbance.

Conclusion

Effluents from tannery industrial process contains low but toxic concentrations of metal ions in solution. The adsorption process followed by magnetic separation described in this research work allows for the removal of metal ions to very low concentration, rapidly and inexpensively, further, it allows for the collection of these materials in a highly concentrated material form.

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