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BIOREDUCTION OF TOXIC CR VI BY CRS- BACILLUS SPECIES C31171

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Abstract- The world's ever increasing population and her progressive adoption of an industrial based lifestyle has inevitably led to an increased anthropogenic impact on the biosphere. In industrial, opportunities exist for the release into the ecosystem of potentially hazardous compounds specially heavymetals like CrVI at various stages of the operation.Microbes (bacteria/fungi) are the most important eco-friendly agents for the biodegradation and detoxification of toxic industrial pollutants .Bioremediation is the mostpromising, eco-friendly and cost effective technology widely used now a days to clean up toxic heavy metals from industrial effluent and soil.Most of the microorganism were unable to grow in acidic effluent. Present research article reports Bioremediation of toxic metal pollutant CrVI from acidic effluents of electroplating industry by chromate reducing strain Bacillus Sp.c31171 isolated from electrooplatting industrial sludge .

Keywords- *Bioremediation, Bioreduction, Effluent, CRS*

I. INTRODUCTION

Bioremediation is reclaiming or cleaning of contaminated sites using microbes or other organismsThis entails the removal, degradation, or sequestering of pollutants & toxic wast Heavy metals have vast industrial applications due to their technological importance. Chromium is the seventh most abundant element on earth and exists in several oxidation states. Chromium exist in nature in two stable oxidation states of, Cr (III) and Cr (VI), which have contrasting toxicities, mobilities and bioavailabilities.[1] CrVI release in the effluent of Electroplating industries, tannery industries, lather industries textile and ceramics[2] contributes to one of the major industrial pollution problems our country is facing today There are about 1000 electroplatting and 3000 tanneries in India which discharge about 105 m3/d of wastewater by every industry. The chromium in raw wastewater4 is 150-5000 mg/l 4 .Cr (VI) is toxic, cancerous and mutagenic, Whereas Cr (III) is nontoxic, insoluble and can be precipitatized. [3]Wastewaters from these industries possess several toxic effects to life forms and the environment. Accumulation of these toxic metals in human has several adverse actions such as growth and developmental abnormalities, carcinogenesis, mental retardation etc.

The conventional treatment methods used for this purpose include chemical precipitation, lime coagulation, ion exchange, chemical oxidation, electro dialysis, ultrafiltration and solvent extraction [4].

However, chemical processes are inefficient, energy intensive and prohibitively expensive [5].Bioremediation offers an alternative, eco friendly, economical and effective procedure which can be successfully used.

[6]As per the present study the isolated Bacillus sp[7] was found to reduce 100% of chromium from the medium after 164 h. in acidic media(pH=1)

II. MATERIALS AND METHODS

Microorganisms isolation and Characterization
The effluent was collected from a disposal site of electroplating industry MIDC area Nashik, India at weekly intervals for five weeks, pooled together and stored at 4 °C for analysis.

The collected effluent was analyzed for following physicochemical parameters Dissolve oxygen, Biological oxygen demand (BOD) , chemical oxygen demand (COD),CaCo3 alkanility, total hardness, Cadmium, Chromium, Zinc, Choride , total Sulphate, total phosphate, total nitrate,colour, turbidity, pH[6]To isolate Isolation of the microorganism chromium resistant bacteria 1 gm. Sample of effluent contaminated sludge from electroplating industry was mixed in 50 mL of the sterile distilled water[8]. Diluted sample of this solution was spread on agar-agar nutrient plates .The growth of the bacterial colony was observed after 24 h of incubation at room temp It was subcultured on nutrient agar plate.

Isolated colonies were inoculated and spread on saperate agar-agar nutrient plate sto get isolated colonies. Fresh inoculum from overnight culture of Selected strain was characterized morphologically, biochemically, and physiologically [9] by 16 S rRNA sequencing [R] as Bacillus Sp.c31171.

Sr. No.	Time interval for Sample analysis	Bio reduction of Cr VI
1	24 hr	20.5%
2	48 hr	29 %
3	72 hr	64%
4	96 hr	71%
5	120 hr	79%
6	144 hr	95%
7	156hr.	100%

The strain was allowed to grow in nutrient broth for 48 hr. to get enough mass of strain. Broth containing culture was centrifuged at 200rpm for 30 min to get pallet of strain.

Sr.No.	pH	% Reduction of Cr VI
1	1	70.6
2	3	71.5
3	5	75.8
4	7	81
5	9	72.1

Encapsulation of CRS
Turbid broth containing was centrifuged for 2 hr. at 200 rpm. 2.5 gm. of sodium alginate was dissolved in 100 ml of water and then stirred uniformly to give uniform solution of sodium alginate. Then pallet of CRS was mixed in solution and mixture was drop in the conical flask containing solution of calcium chloride. To get beads containing CRS. Beads were store in 1% CaCl2.

Preparation of stock solution :
Effluent was collected from selected electroplating industry and diluted to get conc. Of CrVI 100 mg/lit.50 ml of stock solution was taken in 250ml conical flask. 10gm. of beads were added in the solution the solution was kept at room temperature and periodic metal uptake was analyzed for CrVI by UV-Visible spectrophotometer.The metal uptake was also analyzed for various pH by adjusting pH from highly acidic range to basic range by drop wise addition of 1N NaOH.

III. RESULT AND DISCUSSION

Effect of Time
Isolated Chromium reduction srtain was able to reduse CrVI from solution as mention in Fig -1 and Fig-2

Effect of pHpH of effluent was increases from acidic range to basic range by drop wise addition of 1 N NaOH CRS at different pH allowed to biodegrade CrVI for 96 hr. and it was observed that along with pH reduction of Cr VI goes on increases till pH 7. At pH 7,bioreduction of Cr VI was maximum as shown in F

IV. CONCLUSION

Its non toxic trivalent form and could reduce100% CrVI with in a week even in high acidic condition. Industrial effluent wastreated with in capsulated chromium resistant bacterial isolate strain at normal temperature condition . This resulted in the reduction of 100% diluted effluent respectively in one week of chromate. It reflects the good. The process of reduction is enzymatic and further understanding of the mechanism is in progress. Conventional technologies to clean up heavy metals ions from the contaminated waste have been utilized but these technologies are not cost effective, having major problem of solid waste disposal and alternating to these more expensive technologies are the bioremediation methods which are eco -friendly, inexpensive and safe.

All experiments were conducted in 250 ml conical flasks containing 100 ml of chromium solution. Before mixing the bacterial strains, the pH of the chromium solution was adjusted to the required value with 0.01N NaOH. Bacterial cell suspension was added to metal solution and was placed in an incubating shaker at 150 rpm. At regular time intervals, samples were taken aseptically and were centrifuged at 10,000 rpm for 10 min at 4ºC. Pellet obtained were digested and the amount of chromium accumulated was determined spectrophotometrically at 540 nm in a spectrophotometer using diphenylcarbazide as the complexing agent (APHA, 1990).

REFERENCES

[1]. A. K. De, A. K. Sen, D. P. Modak and S. Jana, Comparative studies on the toxicity of Mercury (II) and Chromium (VI) to aquatic plants and their removal by these plants. In Environmental Management and Planning, A. K. Sen, Ed. Wiley Eastern Limited, New Delhi, 2008, pp.207-218.

[2]. H . S hen and Y. T. Wang , “Bi olog i cal reduction of ch romium by E. coli,” Journal of Env ironme ntal Eng i nee r ing , vol. 120, no.3, pp. 560–572, 1994.

[3]. W.A.Smith,W.A.Apel,J.N. Petersen,and B.M.Peyton, “E ffect of car bon and energ y source on bacter ial chromate re

duction," Biore mediat ion Jour nal , vol. 6, pp. 205–215, 2002.

[4]. R.S.BaiandT.E.Abraham,"BiosorptionofCr(VI) from aqueous s olution by Rh izopus nig r icans," Biores ourc e Technolog y , vol. 79, no. 1, pp. 73–81, 2001.

[5]. Camargo F.A.O., Okeke B.C., et al. (2004) Hexavalent chromium reduction by immobilized cells and the cell-free extract of Bacillus sp. ES 29. J. Bioremed, 8(1–2): 23-30.

[6]. Natarajan S, Selvakumar G, Chandrabose MS , Shanmugam K. [1988]. Methods of Water Analysis, I edition, Books World, Coimbatore, p.3-20.

[7]. Ray,S., Ray,M. [2009]. Bioremediation heavy metal toxicity with special references to chromium, Alameen. J Med Sci, 2(2): 57-63.

[8]. Wani PA, Khan MS, Zaidi A. [2007]. Chromium reduction, plant growth promoting potentials and metal solubilization by Bacillus sp, isolated from alluvial soil. Curr. Microbiol. 54: 237-243.

[9]. Ganguli A, Tripahi AK. [2002]. Bioremediation of toxic chromium from electroplating effluent by chromate reducing Pseudomonas aeruginosa A2 Cr in bioreactor. Appl. Microbiol. Biotech. 58 (3): 416-420.10.Zahoor A, Rehman A (2009). Isolation of Cr (VI) reducing bacteria from industrial effluents and their potential use in bioremediation of chromium containing water. J. Environ. Sci. 21: 814-820.

[10]. Chuan and Liu,1996; Palmer and Wittbrodt, 1991; Lawson, 1997.

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