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MANGO PLANT LEAVES (MPL) WERE USED FOR THE REMOVAL OF ZN^{2+} ,CD^{2+} AND PB^{2+} METALS FROM PULP AND PAPER MILL EFFLUENTS

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Key words :

ABSTRACT

Heavy metals are major environmental pollutants.Some metals are not biodegradable therefore a need of removal methods i.e economic and easy handleable.Mango plant leaves was found to have natural capacity to accumulte heavy metals at significant concentration. Phytoremediation or biosorption for a new technology aimed at removing these metals from dilute solutions or from the industrial wastage like pulp and paper mill wastewater.The concentration of these metals was determined by ICP-AES. The method also indicated that the order of adsorption affinity was $Pb^{2+}>Cd^{2+}>Zn^{2+}$.

INTRODUCTION

The heavy metal ions, specially, Zn (II), Cd (II) and Pb(II) have become prominent pollutants. Even the traces of these metal ions present in different types of waters may prove highly toxic (1–2). The concentration of these metal ions is increased in waters by different types of human activites like mine drainages, industrial effluents, acid rain etc. Their removal from water is hence, significant and to meet these a large number of methods have been suggested. In the present method the mango plant leaves (MPL) has been used for the removal of Zn^{2+},Cd^{2+} and Pb^{2+}.Some other workers (3-4) have also used plant substrates to remove different types of pollutants.

MATERIALS AND METHODS

Mango plant leaves were collected from nearest area. These leaves was dried four hours in an oven at 60^0 C and finally powdered to give size to the sample particles between .075mm and .250mm. Dry powder of MPL was used for the bioadsorption (removal) studies.

Stock solutions (10000ppm) of Zn^{2+} Cd^{2+} and Pb^{2+} were prepared in conductivity water. The solution pH was adjusted with HCL and NaoH. Exactly 100mL of sample solutions were taken into beakers containing 1gm of plant substrate. Each system was stirred for specific period of time. After stirring the samples were filtered. The filtrate was heated with 5mL of concentrated HNO^3 and evaporated to near dryness on water bath. The residue was dissolved in 3mL conc HCL by slight warming made to volume and filtered to remove any insoluble material. The extract was analysed for Pb, Cd and Zn concentration by ICP-AES at Sophisticated Analytical instrument Facility (SAIF)IIT, Mumbai.

RESULTS AND DISCUSSIONS

The experimental analsis was conducted to determine

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the actual amount of metals bound to MPL powder as well as the influence of pH upon binding of Zn^{2+}, Cd^{2+} and Pb^{2+} ions in paper mill wastewater samples. Three different paper mill wastewater samples were analysed by ICP-AES for their Zn^{2+}, Cd^{2+} and Pb^{2+} components. Table-1 illustrates the metal content of the pulp and paper mill wastewater (effluent) sample. It can be gleaned from the table that significant amount of Pb^{2+} and Zn^{2+} was present in all three wastewater samples while Cd^{2+} was present at very low concentration.

Binding of MPL powder with Zn^{2+} Cd^{2+} and Pb^{2+} ions present in paper mill wastewater samples:

Previous experiments have identified the optimum pH values for binding of MPL powder to Zn^{2+} Cd^{2+} and Pb^{2+} ions in artificially contaminated water samples hence the same optimum values were employed for each binding experiment in this study.

Table 1. Metals content of pulp and paper mill effluents

Sites of sample collection	Metals ppm		
	Zn	Cd	Pb
Central pulp and paper mill effluent Ukai-Songarh (Guj)	0.40	0.14	1.38
Padmji pulp and paper mill effluent Pune (M.S)	0.67	0.46	0.92

It can be seen from the table that binding capacity of the MPL powder towards Pb^{2+} in paper mill wastewater samples was found to be 29.71% (average). The result obtained is consistent with the literature (5) result obtained by Pili (32.30%) when MPL powder was mixed with the mixture of Zn^{2+} Cd^{2+} and Pb^{2+} in artificially contaminated water samples.

The sample observation has been noted in the case of binding of MPL powder with Zn^{2+} ions. Avearged of 26.3% was achieved of the binding of MPL powder towards Zn^{2+} ions present in all the sites. Ambignous result was obtained with the Cd^{2+} ions in all the three sites (Table 2) in which its concentration was found to be below the detection limit of 0.1ppm.

Binding competition between Pb^{2+} and Zn^{2+} ions :

Results shown in Table 1 indicate that both at Ukai-Songarh and Padmji, Pune wastewater samples contain equimass amounts of Pb^{2+} and Zn^{2+} i.e. about 1mg metal / 1mL of sample and that it was Pb^{2+} which binds most to MPL powder than Zn^{2+} ions in these samples . This observation is in contrast to what has been reported, that is in the case of artificially prepared wastewater samples. The binding for equimass amounts of metals to MPL powder must follow this order Zn^{2+}>Cd^{2+}>Pb^{2+}. Figure 1-illustrates that in natural wastewater system it does not follow the trend but rather both metals Zn^{2+} and Pb^{2+} prefer to bind to MPL powder in almost same concentrations. This could be

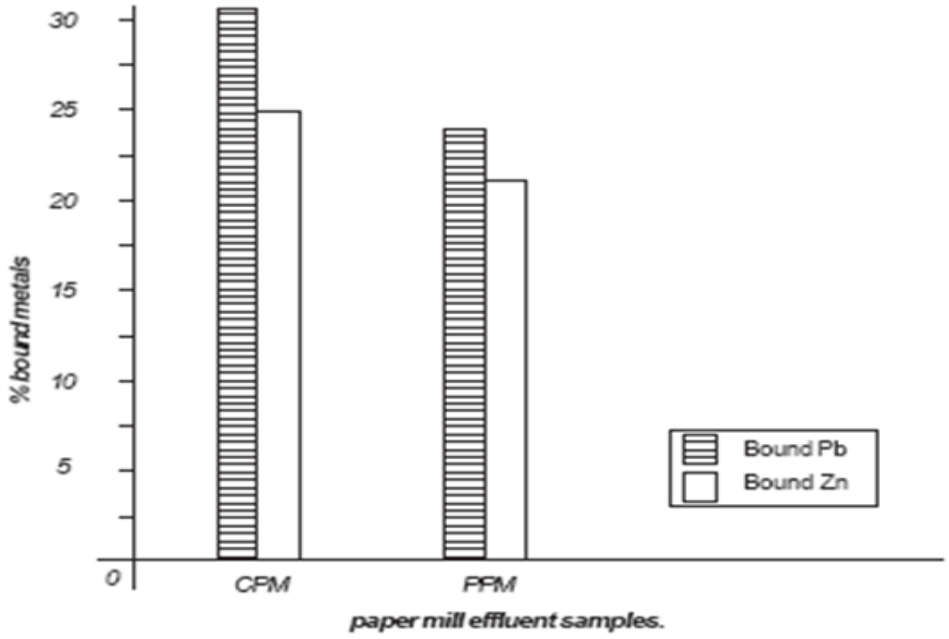

Fig. 1 Comparison of % bound Pb^{2+} and Zn^{2+} ions on MPL power

Table 2. Amount of Zn Pb and Cd ions bound to MPL

Sites of sample collection	Zn bound at pH 6 (ppm)	Cd bound at pH 9 (ppm)	Pb bound at pH 8 (ppm)
Central pulp and paper mill effluent,Ukai - Songarh (Guj)	0.16	0.01	0.34
Padmji pulp and paper mill effluent Pune (M.S)	0.22	0.01	0.26

attributed to the stronger affinity of Pb^{2+} to the MPL powder in the presence of the other competing ions. This is due to the higher relative ion exchange selectivity coefficient of Pb^{2+} than of Zn^{2+} , thus providing stronger ionic interaction with the sulphate groups of the MPL powder (6-8).The results obtained from the experiments demonstrate that MPL powder is a potentially effective extractive agent for the remediation of heavy metals such as Pb^{2+} and Zn^{2+} ions in paper mill effluent samples.

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