



## REMOVAL OF HEAVY METAL IONS FROM WATER USING NATURAL ZEOLITES

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### ABSTRACT

Different varieties of zeolites viz. clinoptilolite, heulandite, stilbite, natrolite and scolecite were collected from nearby areas of Aurangabad (M.S.). Each zeolite was treated separately with the water sample. In each case ppm level of  $Pb^{2+}$ ,  $Ni^{2+}$  &  $Cu^{2+}$  ions in pre-treated and post-treated liquid was determined. It has been found that clinoptilolite and heulandite exhibit high potential for the removal of heavy metal ions from the water.

**KEYWORDS** : heavy metal ions, clinoptilolite, heulandite

### 1.INTRODUCTION:

The wide spread use of chemical fertilizers, pesticides and contamination of water sources with industrial waste increases the concentration of heavy metal ions in water bodies. Especially  $Pb^{+2}$ ,  $Ni^{+2}$ ,  $Cu^{+2}$  are common metal ions that tend to accumulate in organisms, causing numerous diseases and disorders [1]. These metal ions are common ground water contaminants at industrial places. Various methods exist for removing heavy metal ions including sorption, precipitation, ultra filtration reverse osmosis [2]. Activated carbon adsorption is considered to be an effective process for the removal of heavy metal ions at low concentration but the use of activated carbon is not suitable due to its high cost [3]. Different treatment processes are available, among which ion exchange is considered to be cost effective. The low-cost ion exchangers such as zeolites are used for the removal of heavy metal ions from the water bodies [4].

Zeolites are naturally occurring hydrated aluminosilicates. The structure of zeolites consists of three dimensional frameworks of  $SiO_4$  and  $AlO_4$  tetrahedras, linked to each other by oxygen atoms. The relatively rigid anionic framework forms channels with free diameter  $2.5\text{\AA}$  to  $16\text{\AA}$  and inter connected voids which are occupied by water molecules and exchangeable cations like sodium, potassium or calcium. These cations are exchangeable with certain cations in solutions such as lead, nickel, mercury, cadmium, copper [5]. The natural zeolites, especially heulandite and stilbite are abundantly occur in Marathwada region of Maharashtra, India. An attempt has been made to test their utility for the removal of heavy metal ions Pb, Cu and Ni from the water.

### 2.RESULTS AND DISCUSSION

The zeolite crystals were collected from the nearby areas of Aurangabad city (M.S.). The zeolites were characterized by x-ray diffraction, infrared spectroscopy and thermal analysis (TGA/DTA). It has been confirmed that the

collected zeolites were clinoptilolite, heulandite, stilbite, natrolite and scolecite . All the zeolites were crushed and sieved to get 200µm sized crystals. Synthetic stock solutions of Cu<sup>+2</sup>, Pb<sup>+2</sup>, and Ni<sup>+2</sup> were prepared by using nitrate salts (AR-grade) of respective metal ions. Each zeolite variety was assessed separately for its capacity to

remove the metal ions from the aqueous solution . The Pre- and Post- ppm levels of metal ions in the water sample were determined by using atomic absorption spectroscopy , employing Hitachi-Z8000 instrument. The regeneration of the zeolites was done by using 1M CaCl<sub>2</sub> aqueous solution .

**Table-1 Effect of different zeolites as removal of metal ions from water**

Zeolite	Concentration of metal ions in ppm						Removal		
	Initial			Final					
	Pb	Cu	Ni	Pb	Cu	Ni	Pb	Cu	Ni
Clinoptilolite	50	50	50	1.5	07	12	48.5	43	38
Heulandite	50	50	50	9.8	16	21	40.2	34	29
Stilbite	50	50	50	27	31	37	23	19	13
Natrolite	50	50	50	47	45	45	03	05	05
Scolecite	50	50	50	42	41	42	08	09	08

Treatment of different zeolites with water exhibits ion exchange property. It reveals that these zeolites particularly clinoptilolite ,heulandite were capable of removing metal ions from the water . The most effective zeolite was found to be clinoptilolite thereby removing 48.5ppm of Pb<sup>+2</sup> ions, 43ppm of Cu<sup>+2</sup> ions and 38 ppm of Ni<sup>+2</sup> ions followed by heulandite removing 40.2ppm of Pb<sup>+2</sup> ions, 34 ppm of Cu<sup>+2</sup> ions and 29 ppm of Ni<sup>+2</sup> ions and stilbite removing 23ppm of Pb<sup>+2</sup> ions, 19ppm of Cu<sup>+2</sup> ions and 13 ppm of Ni<sup>+2</sup> ions. The natrolite and scolecite were less effective zeolites for the removal of metal ions from the water. The natural zeolites particularly clinoptilolite and mordenite have been implicated for the removal of metal ions from wastewater[6,7]. These zeolites were easily regenerated and reusable .however no change in their ability to remove heavy metal ions was recorded after regeneration

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