

Removal of Nickel (II) From Water

Jyotsna Lal

Associate Professor

Department of Chemistry

Christ Church P. G. College, Kanpur .U. P. India

Corresponding Author's E-mail: jyotsna_lal@yahoo.com

Abstract

Several methods as well as low cost adsorbents have studied for the removal of Nickel a toxic metal ion which has contaminated the ground water of Kanpur in Uttar Pradesh as well as soil of Haryana state. Nickel acts as an enzyme inhibit or in metabolism

Keywords: -Nickel (II), Toxic metal ion, Metals, Textiles, Nutrients

INTRODUCTION

There are a number of toxic trace metals found in natural and waste waters, some of these are essential at low levels of concentrations serving as nutrients for animals and plants but toxic at higher levels. These metals may originate from a variety of sources including the nuclear power, defence and fuel reprocessing industries; surface finishing processes in the aerospace industry; and silk –screening processes in the computer industry. In addition, ground waters at many sites are contaminated with these metal ions, making their removal and

concentration a necessary step in the restoration of these areas.

The industrial town of Kanpur has a many cotton textiles, chrome leather tanning, chemical manufacturing industries. A survey was conducted and found that in comparison to other industrial areas of India the ground water of Kanpur city contains a very high concentration Ni Table 2. [Ground Water Quality Series 1996-97]

The process of adsorption has an edge over other methods, due to its simplicity and sludge free clean operation. Activated carbons are widely

used as adsorbents for purification of aqueous solutions of heavy metals. The author wishes to draw attention

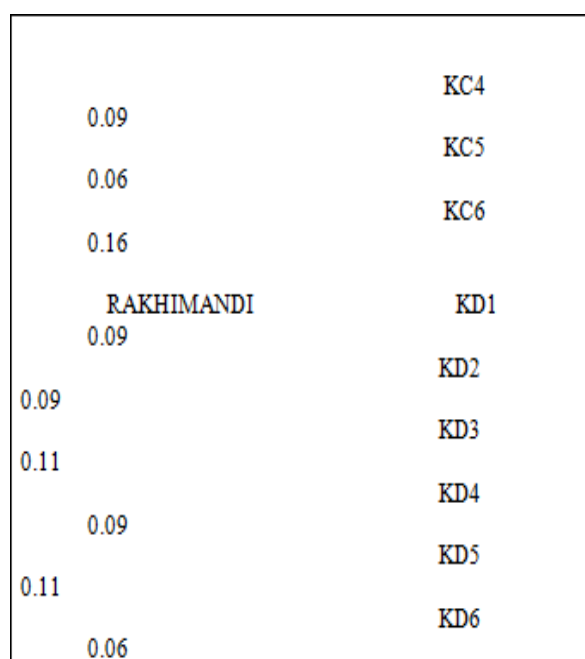
toward the various low cost technologies are available for removing Ni from water

Table 1 Nickel in the Ground Water of Industrial Areas of India

Area Industry	mg /l
Rourkela, Bihar steel	0.0 - 0.66
Goa ore-mining	0.10-0.34
Himachal Pradesh	0.013-0.14
Uttar Pradesh	0.01-0.033
“ “	
Kerala	0.002-0.004
“ “	

Table 2 Nickel in Groundwater of Industrial Area of Kanpur City .Up India

mg/l	block
JAJMAU	KA1
0.04	KA2
0.05	KA3
0.05	KA4
PANKI	KB1
0.09	KB2
0.04	KB3
0.05	KB4
0.07	KB5
0.04	KB6
0.04	NARAIKHEDA
0.04	KC1
0.03	KC2
0.06	KC3



HEALTH HAZARDS DUE TO HIGH NICKEL INTAKE

Heavy metals Ni, As, Hg, Pb, Cd act as effective enzymes inhibitors. The viruses or carcinogenic metals with their tendency for chelation are associated with vitamins; protein and nucleic acid. These metals ions may replace the (ZnII, MgII) from the normal enzyme system or nucleic acid and may alter the structure and function of genetic material resulting in the formation of cancer. It has been shown that specific metals are required for genetic regulation and wrong metal ions, even the essential metal ions in wrong concentrations can lead to errors resulting in metal carcinogenesis. The fashioned DNA molecule require only deoxy nucleotides and not ribonucleotide be

incorporated in to the nucleic acid. The ability of DNA polymerase 1 to distinguish between these two monomers types has been shown to depend on the nature or the metals used to activate the enzyme thus the presence of Mg(II) insure incorporation of deoxy nucleotides, but Ni (II), Mn(II) and Cr(VI) permits the concurrent incorporation of ribonucleotides. Thus the presence of Ni (II), Mn(II) and Cr(VI) lead to incorporation of the wrong sugar (Ribonucleotides) in place of deoxynucleotides in to the nucleic acid with both type of enzyme (RNA and DNA polymerase) carcinogenic metals are suppose to cause error.[Chakrawarti.2003]

Table 3 Nickel Status in Soils of Haryana State

Range of Ni % Area	Total area
mg/ kg	km 2
< 0.75	25083.83
56.79	
0.75- 1.25	8837.0
20.00	
1.25-1.75	5711.1
12.93	
1.75-2.25	2596.3
05.88	
>2.25	1940.3
04.39	

**Table 4 Effect of Nickel [20- 80mg/Kg] Contaminated Soil on Plant Growth
[Hisar .Haryana]**

Crops	% age reduction
Brassica juncia	19.70
Brassica carinata	9.40
Green gram	5.0
Pegion pea	12.0
Black gram	20.8
Wheat grain	37.4
Barley grain	5.30

METHOD AND MATERIALS

Preparation of adsorbents

For manganese dioxide impregnation, the reported method [KiranKumar1984] was used. Crushed and washed coal having geometric mean size 0.102 mm (24g) was added to a solution of potassium permanganate (26.675 g in 325 ml distilled water) at 90 C in a water bath. The slurry was stirred for 10 minutes, followed by

slow addition of 300 ml of 2 N hydrochloric acids in 10 minutes with constant stirring. Stirring was continued for another 10 minutes followed by washing of excess precipitate with distilled water and 0.05 M perchloric acid till the supertant liquor becomes clear. The adsorbent following pretreatment / impregnation was removed, washed several times with distilled water, dried at 60 + 1 C and desiccated.

Iron (III) hydroxide impregnation on coal was done by reported method [Jyotsna Lal 1992] Crushed and washed coal having geometric mean size 0.102 mm (20g) was slurried in 100ml distilled water to which 2gm of iron (III) chloride was added Using 2 N sodium hydroxide solution the pH of the slurry was then adjusted to ~11.5 and the total volume made upto 200ml, the slurry was allowed to settle for 24 hr. The adsorbent following pretreatment / impregnation was removed, washed several times with distilled water, dried at 60 + 1 C and desiccated.

All solutions were prepared using analytical grade chemicals. Stock nickel

solutions were prepared from nickel sulphate. Batch adsorption studies were carried out in coppered conical flasks using a mechanical shaker. pH was adjusted by a digital pH meter nickel was analyzed in solution using EDTA complexometric titration and spectrophotometrically

RESULTS AND DISCUSSION

Metal accumulation by micro organisms environmental scientists and engineers try to utilize this property of bio accumulation for monitoring metal pollution as well as removal \ recovery of property of bio accumulation for metals from natural and waste waters .

Table 4 Low Cost Adsorbents Tested For Ni [II] Removal from Water

Sorption	capacity mg/gm
Natural clay	12.5
Clay-HCl	10.93
Clay-NaCl	14.54
Red mud	15.0
Dye treated rice hull	6.16
Na OH treated rice hull	12.31
Rice hull	5.58
Fly Ash	0.683
Polymerized onion skin	7.55
Peanut hull carbon	53.65
Granular AC	1.49
Fe [III]/Cr[III] hydroxide	22.94
Sphagnumpeat	14.69
Bituminous coal	6.47
Chemically treated coal	7.29
H2O2 treated coal	8.12
Melon seed husk	5.9
Pea moss	9.18
Coir pith carbon	62.5
A C Cloth CS-1501	8.82
A C Cloth CS-1301	7.36
Blast furnace slag	55.75
Coconut tree sawdust carbon	133.5
Soyabean hull	89.52
Cotton seed hull	46.57

Table 5 Microorganisms Which Can Bind Nickel in Their Biomass

Microorganism	Site of binding
Candida sp	Ni cell wall [mannan-protein layer & inner glucan-chitin layer]
Cyano bacteria	“ “
Anabena, Nostoc sp	
Arthro bacter. Klebsilla	
Consortia of bacteria,	
Staphylococcus aureous	
Bacillus lichenforms	Ni , Cu, Fe [III] , Mn , Au .
Cell wall [Teichoic acids]	
Bacillus subtilus	Ni Fe ,Mn ,Cu , Zn , Mg , Pb
Cell wall [Peptidoglyan]	

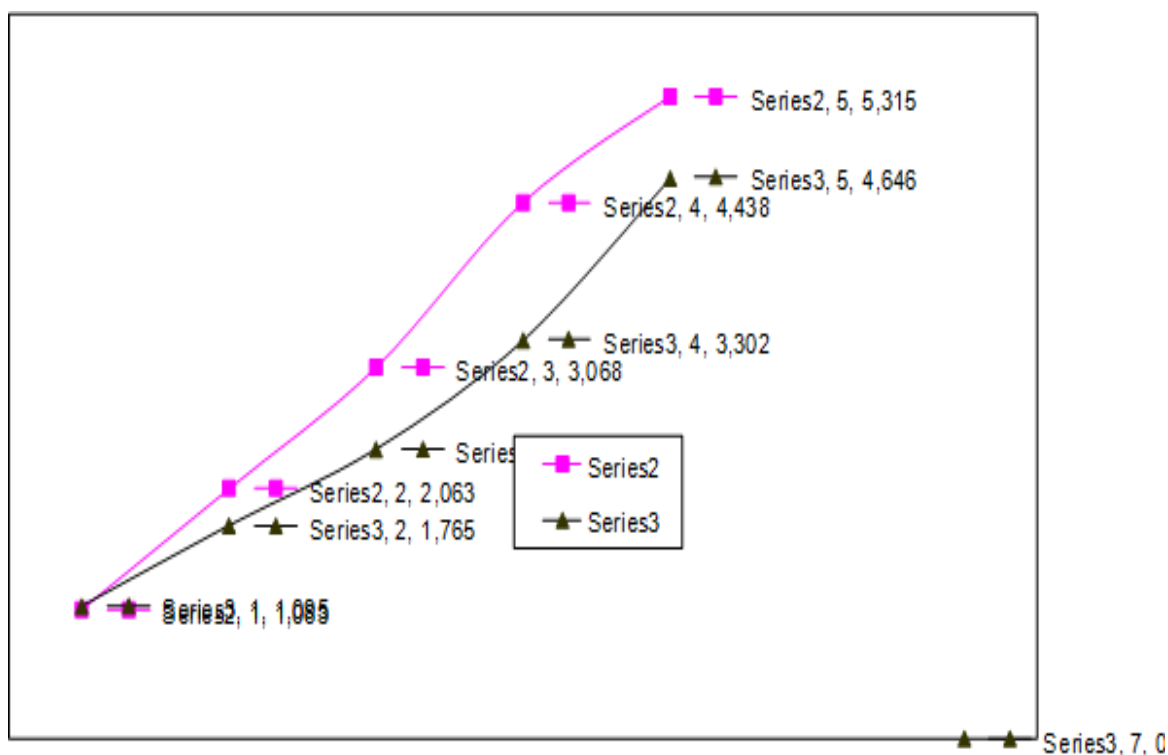


Figure: 4 Ni Removals by Eicchornia Crassipes

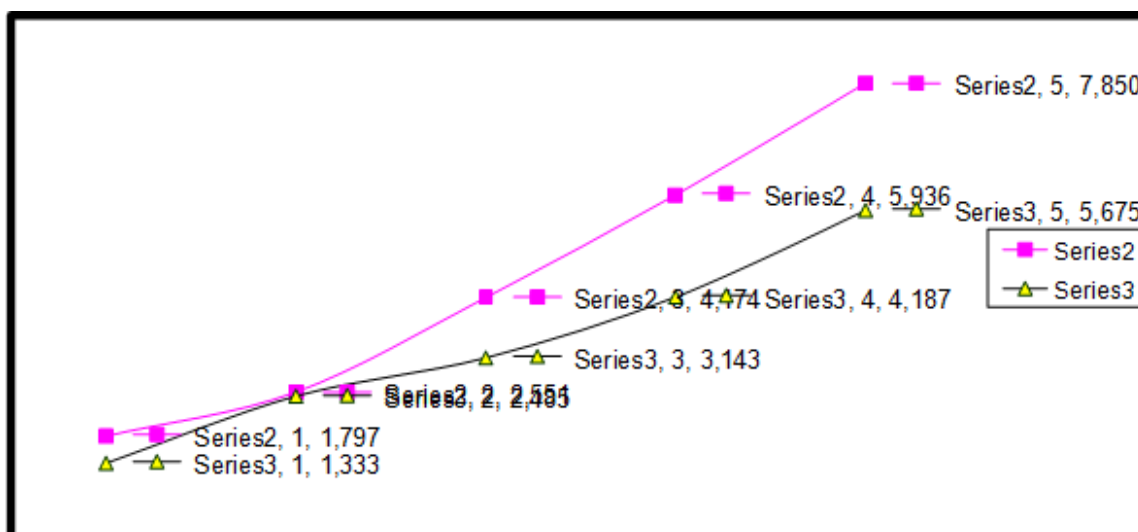


Figure: 5 Nickel Removal by Water Lettuce and Pistia Stratiotes

CONCLUSION

In this paper we have studied how the ground waters at many sites of Kanpur and soils of Haryana have been contaminated with metal ions, which is very toxic at higher level. In this paper we have also discussed several methods as well as low cost adsorbent for the removal of Nickel (II) a toxic metal. First Crushed and washed coal used for manganese dioxide impregnation and then followed by Iron (III) hydroxide impregnation on coal.

Quality in Kanpur Status, Sources and control measures

- V. Jyotsna Lal; DK Singh;[1992] Removal of toxic metal ions from waste water by coal based adsorbent , Pollution Research,11,37-42
- VI. Kiran Kumar .T. V[1994] Manganese dioxide impregnated bituminous coal, M.Tech. Dissertation I.I.T. Kanpur

REFERENCES

- I. Kadrivelu [2003] IJEP 23, 1343-1350
- II. Jyotsna Lal [2003] IJEP 23, 1401-1407
- III. Grewal Panwar [2002] 22, 953-955
- IV. Ground Water Quality Series [GWQS/8/ 1996-97] Ground Water