SOME HEAVY MATERIAL REMOVAL FROM WASTE WATER BY USING OF MARBLE POWDER

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Abstract

The marble powder were used in this used as low cost adsorbent material for removal of Ni(II),Cu(II) , Cr(VI) & Fe(III) ions from aqueous solutions. To study the adsorption process several parameter such as pH of adsorbent effect of contact time , effect of adsorbent amount were conducted in these experiment it was found that the obtained maximum adsorption capacities of marble powder as a low cost adsorbent material to clean up the water in the environment from toxic heavy metals such as Ni(II) ,Cu(II),Cr(VI) & Fe(III) ions

Keywords: Adsorption capacity; Heavy metals; Adsorbent; wastewater Treatment; Marble powder

1. Introduction

In india Environmental pollution particularly from heavy metals and minerals in the waste water is the most serious problem. Due to extensive anthropogenic activities such as industrial operations particularly mining agricultural processes and disposal of industrial waste materials & their concentrations has increased to dangerous levels .Heavy metals in industrial effluent include Chromium nickel ,lead, copper ,zinc , Iron, arsenic ,cadmium,selenium and uranium for the removal of heavy metals so many efficient methods reviewed such as ion exchange chemical precipitation , reverse osmosis , ultrafiltration ,nanofiltration ,coagulation, etc However these methods have several disadvantages such as high reagent requirement , generation of toxic sludge , unpredictable metal ion removal etc.adsorption process being very simple economical & effective .

Heavy metals contamination of water is a serious threat to the globe ecosystem , water pollution by heavy metals has been a major concern for chemists and environmental engineers Nowdays the industrial and domestic wastewater if not properly managed is responsible for severe damage to the environment and adversely affecting the health of people the most important characteristic that distinguishes heavy metals from other pollutants is their non-biodegradability and their unfavourable tendancy to accumulate in living organism due to their unfavorable tendency to accumulate in living organisms due to their biodegradability and persistence can accumulate in the environment elements such as food chain and thus may pose a significant danger to human and animal health [1] In many countries the level of industrial pollution have been steadily rising , and the pollution problem of the industrial wastewater is becoming more serious in the world at least 20 metals are classified as toxic and half of these are emitted into the environment in quantities that pose risk to humans health [2]

Different technologies have been used for the removal of heavy metals for wastewater mainly they include ion exchange, precipitation, ion exchange membrane processes evaporation, chemical oxidation solvent extraction & biological materials. As most available techniques for removal of heavy metals involve high investments and not suitable for small scale industries

Relatively a new green technology for the treatment of industrial wastewater was adsorption of heavy metals and dyes from aqueous solutions by using natural & low-cost adsorbent material

In present work , marble powder were used as adsorbent material for removal of Ni(II),cu(II),Cr(VI)& Fe(III) ions from aqueous solutions and wastewater samples

2. Materials and methods: Preparation of adsorbents

The waste marble powder were collected from locally available stone cutting shop marble powder were grinded into powder and were boiled is distilled to remove any dust from it & filter the residue of marble powder it was treated with formaldehyde and finally with very dilute solution of sulphuric acid. It was then stirred for half an hour vigorously using mechanical stirrer at room temperature then it was filtered and washed with distilled water repeatedly to remove free acid

After chemical treatment the residue (treated red kotta) was dried first in air and finally in oven at 90-100°c for 8-10 hours and powdered electric grinder

The adsorbent once prepared were used throughout the experimental work . the particle size of the adsorbent was of the same mesh (micron)

2.1 Preparation of adsorbate solution:

The standard solution of metal ion were prepared as following

The standard solution of metal ion were prepared the stock solution of nickel , copper & chromium(1000 mg/L) were provided from BDH Company the working standard solutions were prepared by diluting 100ml of the stock standard solution of the selected ion to one litre with distilled water A 5 ml of this solution was diluted to 50 ml of distilled water to get a solution contains 10 mg/L selected ion .These concentrations were used through experiments . The reagent decomposes rapidly in solutions of low pH

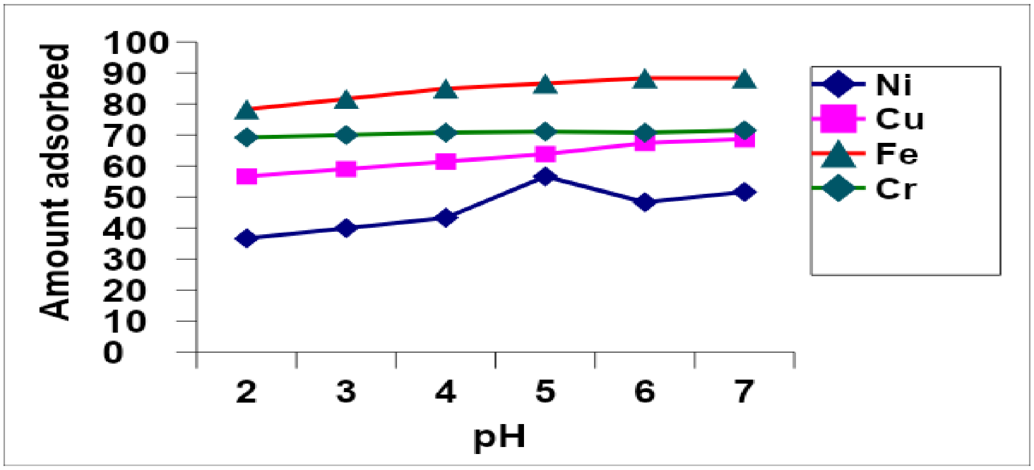
All the adsorption experiments were carried out at room temperature copper ion solution is prepared by dissolving 0.39 gm of pure copper (II) Sulphates pentahydrate in 1 litre of distilled water

E.D.T.A Standard solution was prepared by drying an amount of E.D.T.A at room tempthen dissolving 0 .393 g of the dried E.D.T.A in a 100ml volumetric flask. The concentration at equilibrium was determined after calibrating the instrument with standards within the concentration range 6-10 PPM Ni(II) ,Cu (II) ,Cr(II)& Fe (III). The experiment was done by varying the amount of adsorbents (1 gm to 5 gm /100 ml) concentration of metal ion solution (100-500mg/L) and pH(2-7) at different time interval

3. Results and Discussion: Effects of PH

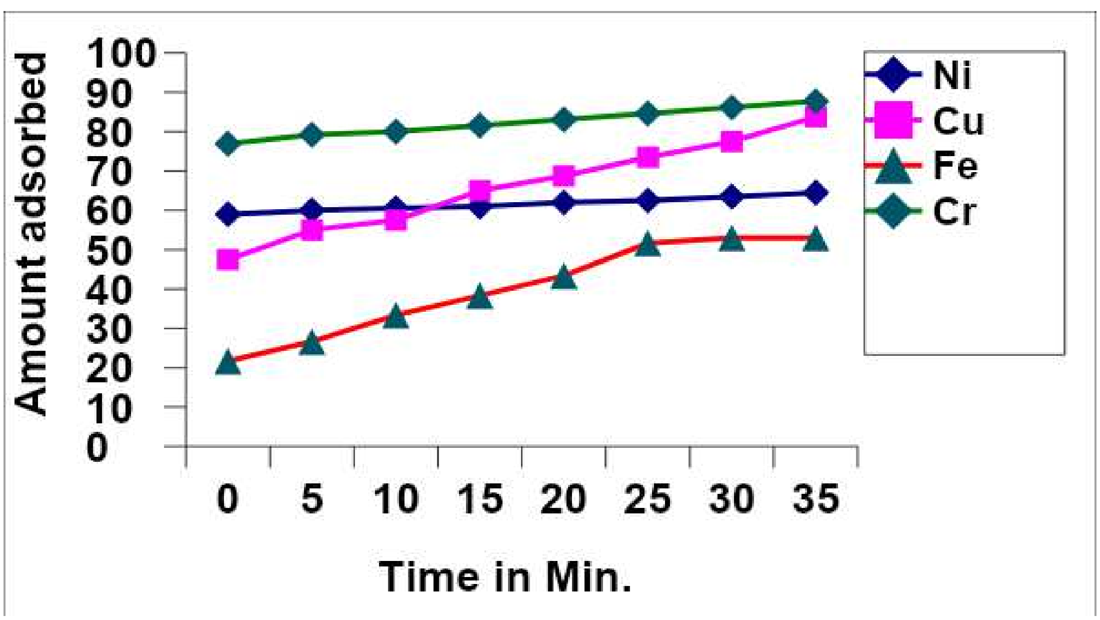
According to several authors [3-6] , pH has been reported as one of the major parameters controlling the adsorption capacity of metals onto adsorbents because it affects the solubility of the metal ions the degree of ionization of the adsorbent during reaction and concentration of the counter functional groups of the adsorbent

The higher adsorption capacities were attained at PH 7.0 for removal of chromium (VI) 89.62 % for removal of nickel 81% ,removal of copper(II) 85.55% & removal of iron 70.00% at pH 7 Showed the effect of pH Value on the adsorption capacity of *NI(II), Cu(II) and Cr(VI) & Fe (III)* ions onto marble powder . The adsorption capacity of *Ni(II),Cu(II)and Cr(Vi) &Fe (III)* ions onto Marble powder was increased as the PH increased



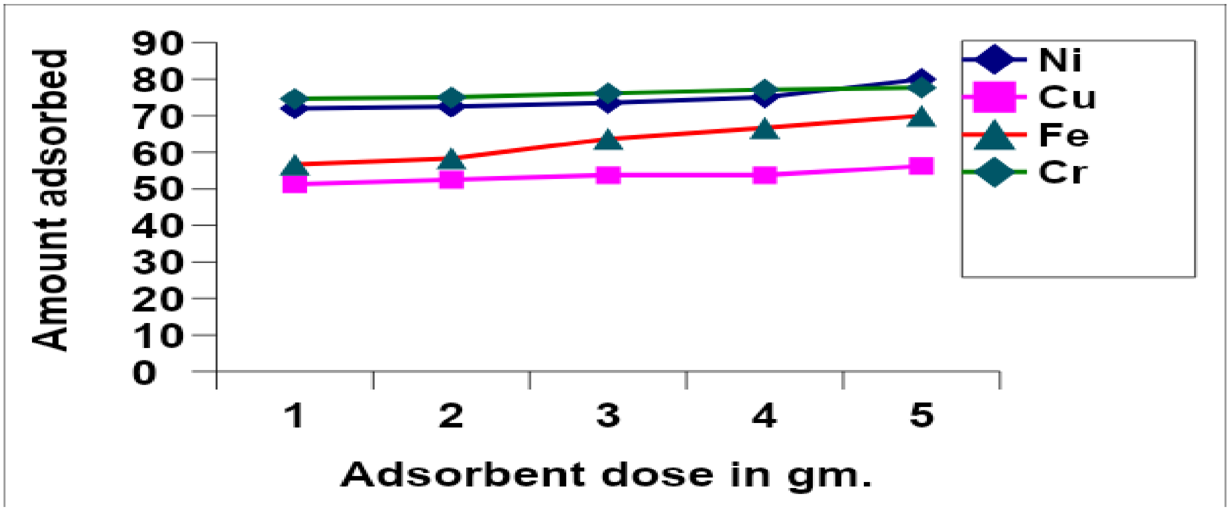
At higher PH Due to the availability of large number of OH- ions and consequently the diffusion barrier is increased which results into poor adsorption. In present finding at higher pH There is change in order of reaction with change in pH which suggest the role of adsorbent it may be leaching out at higher pH as adsorbent is building waste material constituting mainly various organic components therefore out studies restricted to the higher pH level 7 .

3.1 Effect of Contact time



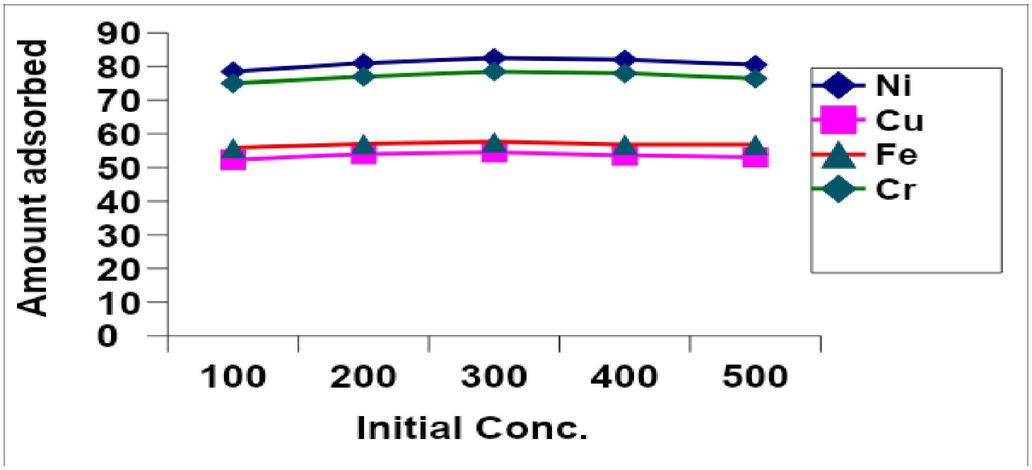
The contact time is one of the effective factors in batch adsorption process and it is essential to evaluate the effect of contact time required to each equilibrium the adsorption capacity of Ni(II),Cu(II) & Cr(VI) & Fe (III) ions by marble powder increases as the contact time increases and reached the equilibrium state. The adsorption process contact time plays a vital role irrespective of the other experimental parameters that affects adsorption kinetics [7]

3.2 Effects of adsorbent dosage



The effects of adsorbent amount on metal ion adsorption was studied by preparing (0.5 to 50 PPM) Solution of *Ni(II),Cu(II),Cr(Vi) & Fe (III)* Containing different doses adsorbent *(1.0,2.0,3.0,4.0,5.0 gms)* as shown in table (3) after shaking the solution were filtered and filtrates were analyzed by using marbel powder and percentage removal efficiency was calculated for each case .

the effect of adsorbent capacity of *Ni(II),Cu(II) Cr(Vi) & Fe(III)* is shown in figure 7 to 9 .The increased adsorbent dose i.e., marble powder increased the adsorption of Nickel (II) ,Copper (II) & Chromium(VI) & Iron (Fe) ions increasing adsorbent doses provided a greater surface area which could accommodate a higher quantity of heavy metals and due to the equilibrium limitations the quantity of metals being adsorbed for a certain surface area of adsorbent decreased .



3.3 Effect of initial metal concentration

The effect of metal concentration was studied by adding 1 gm of marble powder to 100ml of heavy metal concentration and *Ni(II) ,Cu(II) , Cr(VI) & Fe(III)* ions by marble powder it was resulted that the adsorption capacity of *Ni(II) ,Cu(II) and Cr(Vi) & Fe(III)* ions onto marble powder increased with increase in initial concentration of metal ions it means that the adsorption is highly dependent on initial concentration of metal ions this is because at lower concentration the ratio of initial number of metal ions to the available surface area is low subsequently the fractional adsorption sites become independent of initial concentration however at high concentration the available sites of adsorption becomes fewer and hence the adsorption of metal ions is independent upon initial concentration [8]

3.4 Adsorption Isotherms

The capacity of adsorption isotherm is fundamental and plays an important role in determination of maximum capacity of adsorption the Langmuir and freundlich models are the most widely used models in the case of adsorption of metal ions by adsorbent even though the metal uptake may not exactly follows the monolayer adsorption mechanism

3.5 Langmuir adsorption isotherm

The Langmuir adsorption isotherm is the best known linear model for monolayed adsorption and most frequently utilized to determine the adsorption parameters. The affinity between the adsorbent and the different metals quantified by fitting the obtained adsorption values to the Langmuir isotherm. The Langmuir adsorption isotherms are based on these assumption Langmuir [9]. The linear form of the Langmuir equation is giving

$$q = \frac{klce}{1 + a / ce}$$

Where g(mg/g) is the amount of metal ions adsorbed onto the unit mass of the adsorbent to form a complete monolayer on the surface Kl is the Langmuir equilibrium constant which is related to the affinity of hinding sites [10] Ce the solution phase metal ion concentration and α_L is the Langmuir constant. The constant K_L and α_L are the characteristic of the Langmuir equation and can be determined from linearized form of the Langmuir equation.

The plots of 1/ce against 1/x/m are presented in fig1.1 to 1.4 for adsorption of *Ni(II),Cu(II) and Cr(VI) & Fe (III)* ions onto marble powder at room temperature

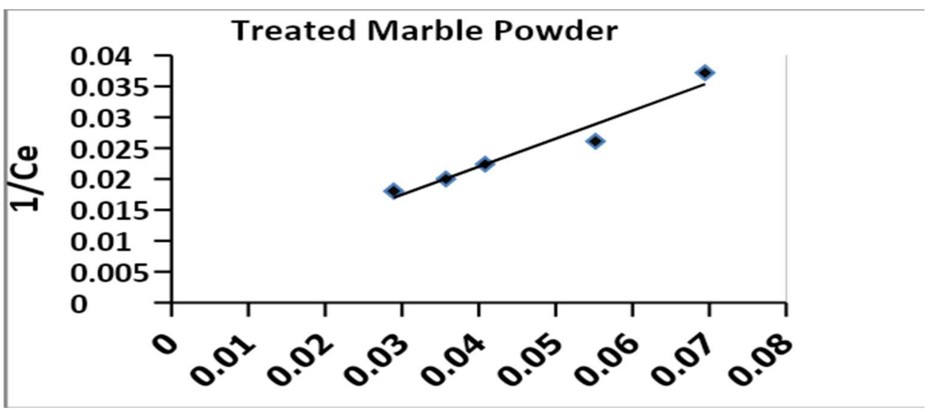


Fig: 1.1 Adsorption of Nickel on the surface of marble powder.

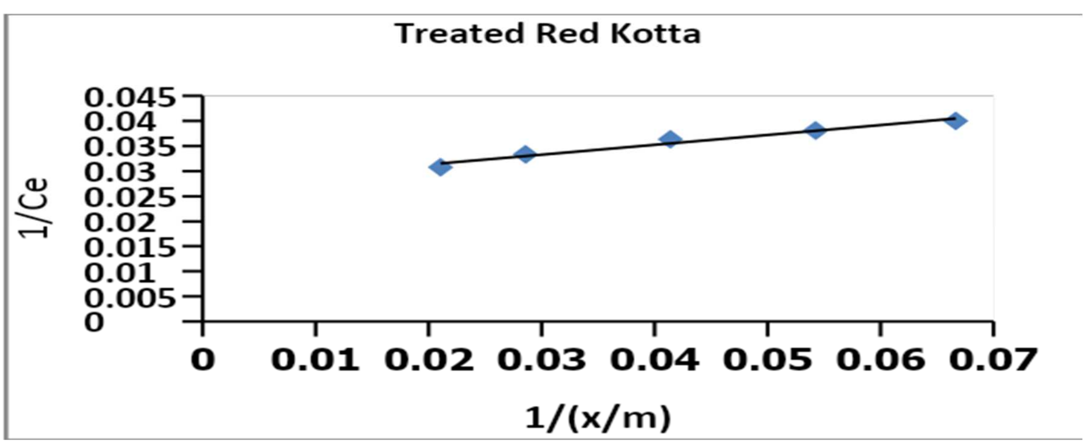


Fig: 1.2 Adsorption of Copper on the surface of marble powder.

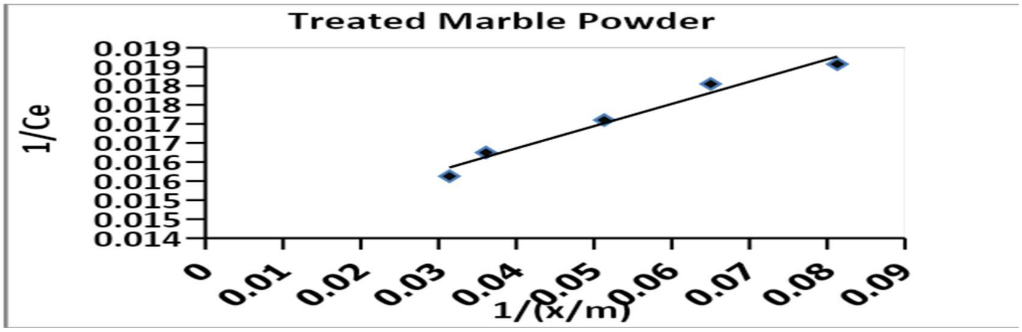


Fig: 1.3 Adsorption of Chromium on the surface of marble powder.

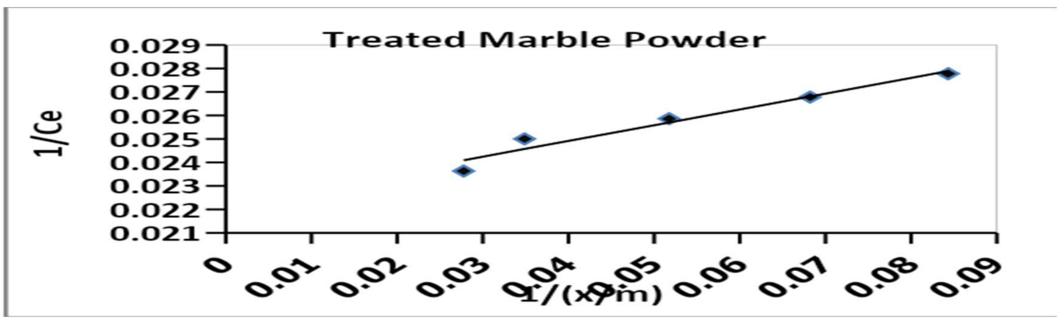


Fig: 1.4 Adsorption of Iron on the surface of marble powder.

3.6 Removal of nickel, copper and chromium from industrial waste water by marble powder

In accordance with the results obtained previously the procedure was applied to waste water employing marble powder as the removing material waste water was treated under the best conditions to remove *Ni (II) ,Cu (II) , Cr (VI) & F(III)* where pH = 7 Contact time 01 h and the adsorbent concentration was 1 gm the results which obtained by marble powder as in the following table

- *Removal percent (P%)= --------------------- ×100 = %*
- *Removal percent of nickel – 81%*
- *Removal percent of Copper -85.5%*
- *Removal percent of Chromium – 89.62%*
- *& Removal percent of Iron -70%*

4. Conclusion

In this work , experiments were studied under laboratory condition from the experimental data of adsorption of *Ni(II)* ,*Cu(II)* , *Cr(VI)* ions onto marble powder surface the following points can be concluded the adsorption capacity of the metal ions was found dependent on initial PH ,Contact time , adsorbent amount and metal concentration of heavy metal concentration. The maximum adsorption capacity of marble powder for removal of heavy metals was -89.62 %

For Ni(II) , 81.0% For Cu(II) and 85.5 %for Cr(VI) 89.62 % & Fe (III)70 % at 1 gm dose amount of marble powder the experimental results for all target metal ions were fitted very well to Langmuir mathematical equation the best correlation was for Langmuir –Freundlich model ($R^2 = 0.998$) Kinetic data were fitted to the pseudo first –second order model

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