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Brief communication

Adsorption of Chromium (VI) From Wastewater Using Blended Natural Adsorbent

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ABSTRACT

In this study adsorption of chromium (VI) ion by using blended natural novel adsorbent like neem leaves powder with peanut shell powder. The batch Adsorption experiments were conducted by different proportions of blended neem leaf powder and peanut shells powder and variations in the weight of adsorbents, contact time at room temperature, and various pH. Investigate the concentration of adsorbate before adsorption and after adsorption by 1, 5 Diphenyl Carbazide Colorimetric method with reference to calibration curve. Results obtained by blended neem leaves powder with peanut shell powder adsorbent are more effective at pH 6. Removal of efficiency increases with increasing contact time and dosage of adsorbent. This adsorbent is low cost and readily available in nature.

Keywords: Adsorption, Blended adsorbents, Colorimeter, 1, 5 Diphenyl Carbazide, Metal ion, pH, etc.

INTRODUCTION

Recent significant issue surroundings Contamination removed by physical, biological, or chemical method. In adsorption method adsorbate molecules accumulated on the adsorbent surface. The human body can suffer grave health consequences from water contaminated with heavy metals, even at low concentrations or trace amounts. Therefore heavy metals are removed from aquatic bodies, which is very important for public health. Techniques that are frequently employed include ion exchange, evaporation, chemical precipitation, and reverse osmosis. They are very expensive, time consuming and less efficiency. Among those the adsorption one of the best method to heavy metals removed from polluted water because it is less expensive, easy to handled, and more efficient in low initial concentration of heavy metal. The heavy metal chromium (VI) one of the major toxic pollutant released in the nearby water bodies through different industrial process like aluminium manufacturing, textile dyeing, paint, metallurgy, electroplating, leather tanning, ink manufacturing (Jonas Bayuo *et al.,* 2019). Chromium (VI) causes lung cancer, digestive tract cancer, eye and liver damage, capillary damage, nausea, vomiting, severe diarrhea and effect on CNS.

The process of chromium (VI) removal by using many adsorbent materials such as silica, alumina, charcoal powder, carbon nanotubes,

volcanic rocks, activated alumina and activated charcoal. These adsorbents require more process and less eco-friendly and expensive. The alternative many natural adsorbents such neem leaves powder, peanut shell powder, cow dung powder, banana peels powder, orange peel powder and saw dust etc. are easily available, eco-friendly and less expensive. The removal of chromium by neem leaves powder as adsorbent (P. Venkateswarlu *et al.,* 2007). And Groundnut shell powder (Jonas Bayuo *et al.,* 2019). In present study chromium (VI) removal by using blended neem leaves powder with peanut shell powder as natural adsorbent at different parameters like pH, contact time, volume of adsorbate solution and adsorbent dosage was studied.

Materials and methodology

Preparation of Adsorbents

The Neem leaves *(Azadirachta Indica)* and peanut shells were collected from local areas of sironcha taluka (District Gadchiroli, Maharashtra). Collected Neem leaves and peanut shells cleaned by purified water by multiple times to remove dust particle and contamination and dried in shed. Dried Neem leaves and peanut shells grinded into powder by using grinder and sieved to smaller particle size. The powdered Neem leaves and Peanut shell dried in shed. Dried Neem leaves powder and peanut shells powder stored in air tight reagent bottle. Sieved Neem leaves powder and Peanut shell powder blended different proportion and used as adsorbent.

Adsorbate solution

A concentrated Cr(VI) stock solution was prepared by dissolving 2.8287 g of 99.9% pure $K_2Cr_2O_7$ in 1000 milliliters of distilled water. From this stock solution, standard solutions ranging from 10 to 100 milligrams per liter (mg/L) of Cr(VI) were prepared by appropriate dilution.

Adsorption experiment

In this study 50 mL of the 1000 ppm chromium solution was poured to a volumetric flask (1000 mL) is dilute by deionized water until the desired concentration is achieved to prepared 50 mg/L chromium (VI) aqueous solution. 1M NaOH and 1M HCl were added to the adjusting the pH of solution. A 250 mL conical flask filled with 25 mL of 50 mg/L of chromium (VI) solution is subjected to 30 min of shaking at room temperature on a magnetic stirrer with 1 g of powdered neem leaves and peanut shells combined as an adsorbent. filter paper No. 40 was used to filter the mixture. The 1, 5 Diphenyl carbazide colorimetric method is used to analyse the final chromium concentration at a wavelength of 540 nm. The formula for calculating the percentage of chromium solution removal is $(C_o\text{-}C_t) \times 100/C^o$. for various parameters repeated same experimental procedure.

RESULTS AND DISCUSSION

Impact of adsorbate solution pH

Adsorbents charge of surface is affected by pH. The solution of pH of increases acidity of the chromium (VI) solution decreases. The pH of chromium solution varies 1 to 7 adjust with adding 1N HCl and 1N NaOH. Up until the solution's pH of 1–6, the of Cr(VI) ion percentage removal increases and then gradually decreases. The highest of Cr(VI) ion percentage removal at pH 6. (P. Venkateswarlu *et al.,* 2007) reported the % of of Cr(VI) ion removal maximum at pH 7, by Neem leaves powder as adsorbent. (Jonas Bayuo *et al.,* 2019) reported that the Cr(VI) % removal maximum at pH 8 by using Groundnut shells powder as adsorbent. Fig. 1 illustrates how the pH of the adsorbate solution affects removal.

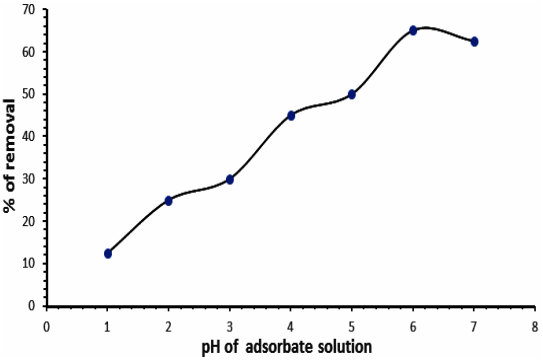

Fig. 1. The impact of chromium solution pH on the percentage of Cr(VI) ions removed

Impact of dose of adsorbent

The variation proportion of chromium removal calculate by plotting graph % of removal chromium vs adsorbent dosage. Fig. 2. Shown that the removal % of chromium (VI) ion rises as the adsorbent dosage at pH 6, 25 mL volume of adsorbate solution and 30 min agitation time. The amount of adsorbent varies from 1 g to 5 g. The capacity of adsorption increases with increasing the amount of adsorbent because the dose of

adsorbent increase the surface area of adsorbent is also increases. Fig. 2 illustrates the variation in the impact of adsorbent dose on the % of chromium(VI) ion elimination.

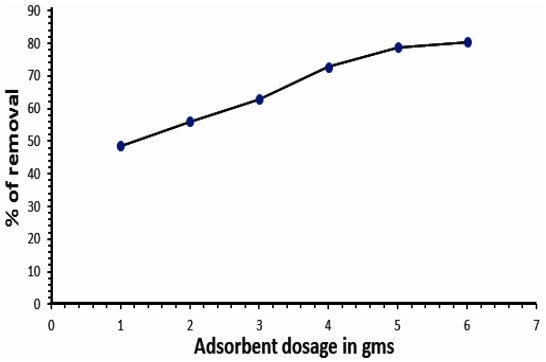

Fig. 2. Impact of adsorbent dosage on % of removal of chromium (VI) ion

Impact of time of contact

The results from Fig. 3. The % of chromium (VI) adsorption increases up to 50 mins at pH 6, 1 g of adsorbent dosage. After 50 mins the % of chromium (VI) removal decreases. The contact time varies from 10 to 80 minutes. The equilibrium of adsorption attain at contact time 50 minutes. (P. Venkateswarulu *et al.,* 2007) reported that the adsorption equilibrium attained at 5 h agitation time by using Neem leaves powder as adsorbent. (Jonas Bayuo *et al.,* 2019) reported that the adsorption increases up to 120 mins by using Groundnut shells powder as adsorbent.

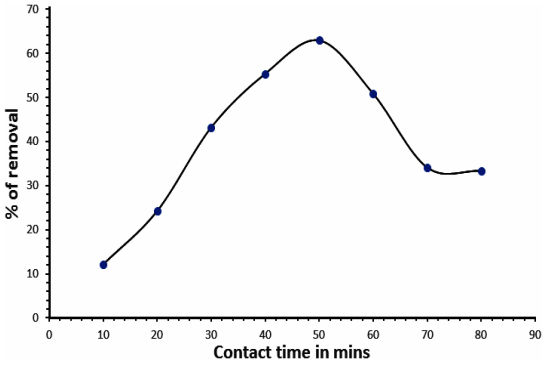

Fig. 3. Impact of duration of contact on % of chromium (VI) ion removal

Impact of volume of adsorbate solution

Figure 4 illustrates how the chromium solution volume affects the percentage of chromium ions removed. The volume of adsorbate increases from 25 mL to 150 mL at pH 6, 30 mins contact time and 1 g of adsorbent. The % of chromium(VI) removal decreases from with increasing the volume of chromium solution. (P. Venkateswarulu *et al.,* 2007) reported that % of removal of chromium decreases from 94.5% to 79.3% with increasing volume of aqueous solution.

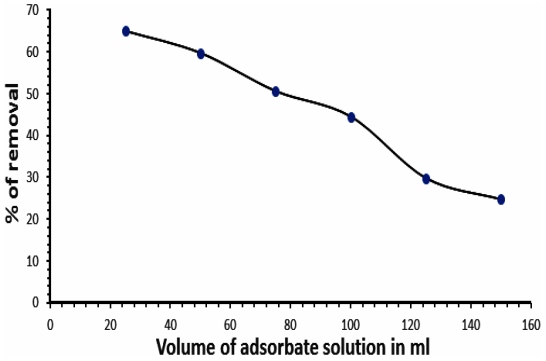

Fig. 4. Impact of volume of adsorbate solution on % of Cr(VI) ion removal

CONCLUSION

A greater proportion of Cr(VI) ion elimination is achieved by increasing the adsorbent's dose. At pH 6, Cr(VI) adsorption is at its highest. For chromium adsorption, the equilibrium contact duration is 50 minutes. The amount of chromium extracted, however, decreases as the volume of the chromium adsorbate solution rises.

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Conflict of interest

The author declare that we have no conflict of interest.

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