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CHROMIUM (VI) REMOVAL FROM A WASTEWATER USING BLENDED NATURAL ADSORBENTS

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ABSTRACT:
The adsorption of chromium (VI) ion by using blended natural adsorbent like neem leaves powder with peanut shell powder. The batch adsorption experiments were performed by blended neem leaves powder with peanut shells powder covering various parameters include weight of adsorbents, contact time, pH and volume of adsorbate solution. Calculate concentration of chromium (VI) after adsorption by 1, 5 Diphenyl carbazide colorimetric method with reference of calibration curve. In the present investigation results concluded that blended neem leaves powder with peanut shell powder adsorbent is more effective at pH 6 and removal of chromium (VI) efficiency increases with increasing contact time and dosage of adsorbent. For the adsorption of chromium (VI) ions, the Freundlich isotherm model is regarded as an appropriate absorption model with a correlation coefficient (r2) value of 0.9952. The used adsorbent is novel, low cost, eco-friendly and readily available in nature.

Keywords:- Adsorption of chromium (VI), Neem leaves powder, Peanut shell powder, Colorimeter, 1, 5 diphenyl carbazide.

INTRODUCTION :

Recent significant issue surroundings contamination removed by physical, biological, or chemical method. In adsorption method adsorbate molecules accumulated on the adsorbent's surface using this method. 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 in a 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 methods 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 pollutants 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 diarrhoea 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

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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 investigate that chromium (VI) removal by using blended neem leaves powder and peanut shell powder as natural adsorbent at different parameters like pH of adsorbate solution, contact time, volume of adsorbate solution and adsorbent dosage.

MATERIALS AND METHODOLOGY :

1.Preparation of Adsorbents

The neem leaves (*Azadirachta Indica*) and peanut shells 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 local grinder and sieved to smaller particle size further powdered neem leaves and peanut shells dried in shed. Dried neem leaves powder and peanut shells powder stored in air tight reagent bottle. Stored neem leaves powder and peanut shell powder blended and used as adsorbent.

2. Adsorbate solution

The 1000 mg/ml Cr (VI) stock solution was prepared by dissolving 2.8287 grams of 99.9% pure K2Cr2O7 in 1000 ml of distilled water. From this stock solution, standard solutions ranging from 10 to 100 (mg/L) of Cr (VI) were prepared by appropriate dilution.

3. Adsorption Experiment

The 50 ml of the 1000 ppm chromium solution were 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 used to the adjusting the pH of solution. A 250 ml conical flask containing 25 ml of 50 mg/L of chromium (VI) solution is subjected to 30 minutes of shaking at room temperature on a magnetic stirrer with 1g of blended powdered neem leaves and peanut shells 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 removal in solution is (Co-Ct) x 100/Co. for various parameters repeated same experimental protocol.

RESULTS AND DISCUSSION :

1.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 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. Figure 1 illustrates how the pH of the adsorbate solution affects removal.

2. Impact of adsorbent dosage

The variation proportion of chromium removal calculate by plotting graph %of removal chromium vs adsorbent dosage. Figure 2. Shown that the removal % of chromium (VI) ion

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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 1g to 5g. The capacity of adsorption increases with increasing the amount of adsorbent because the dose of adsorbent increases the surface area of adsorbent is also increases. Figure 2 illustrates the variation in the impact of adsorbent dose on the % of chromium (VI) ion elimination.

3. Impact of contact time

The results from figure 3. The % of chromium (VI) adsorption increases up to 50 mins at pH 6, 1g of adsorbent dosage. After 50 mins the % of chromium (VI) removal decreases. The contact time varies from 10 to 80 mins. The equilibrium of adsorption attains at contact time 50 mins. (P. Venkateswarulu et.al. 2007) reported that the adsorption equilibrium attained at 5-hour 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.

4. *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 1g 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.

5. Adsorption isotherm

It is imperative to establish a proposed existing adsorption isotherm model with the experimental data in order to develop a suitable adsorption system. The Freundlich and Langmuir models, two well-known isotherm models, have been used to analyse the adsorption values. The presented graph was used to calculate the correlation coefficient (r2) of the model; a value around one is seen to be the most fitting model for adsorption system design.

5.1 The Langmuir isotherm model

According to Langmuir's hypothesis, under isothermal conditions, the adsorbate variety has affinity for the adsorbent's surface. One of the many presumptions made by the isotherm is that there is no interaction between the adsorbate and the adsorbent site and that the adsorbent surface contains the adsorbing sites in a fat plane. The formula can be expressed as

$$Ce/ Qe = 1/ K.Qm + Ce /Qm$$

where Qe is the amount of ion adsorbed per unit weight of the adsorbent (mg/g), Ce is the equilibrium concentration of the ion in solution (mg/ml), Qm is the adsorption capacity in monolayer, and K is the equilibrium constant. The correlation coefficient (r2) value of the adsorption of chromium (VI) is 0.9351.

5.2 The Freundlich isotherm model

The Freundlich adsorption isotherm shows the relationship between an adsorbent's surface concentration and solute concentrations in a liquid media. When the precise amount of the solute in the solution is unknown, the Freundlich isotherm model is employed. The formula expressed as follows (Manoja das et al. 2019).

$$\ln qe = \ln k + 1/n \ln ce$$

where n is an empirical parameter that denotes the intensity of adsorption, qe is the ion adsorbed on the surface, and k is the adsorbent's relative adsorption capacity (mg/g), which is a constant. The r2 value of Freundlich isotherm model found 0.9952 shown in fig.6.

CONCLUSION :

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The neem leaves and peanut shells easily available, less expensive and eco-friendly. From literature survey individual neem leaves or peanut shell powder used as adsorbent for removal of chromium from aqueous solution. The current research used blended neem leaves powder and peanut shell powder used as adsorbent for removal of chromium (VI) from wastewater. The present study investigates that greater proportion of Cr (VI) ion removal is achieved by increasing the adsorbent dose. At pH 6, Cr (VI) adsorption is maximum. 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 increases. Both the Freundlich and the Langmuir isotherms were fit by the adsorption data. It was found the Freundlich isotherm model, whose correlation coefficient (r2) value was 0.9952, was suitable for creating an adsorption model. Thus, the current study concludes that chromium (VI) can be effectively removed from wastewater by blended neem leaves with peanut shell powder.

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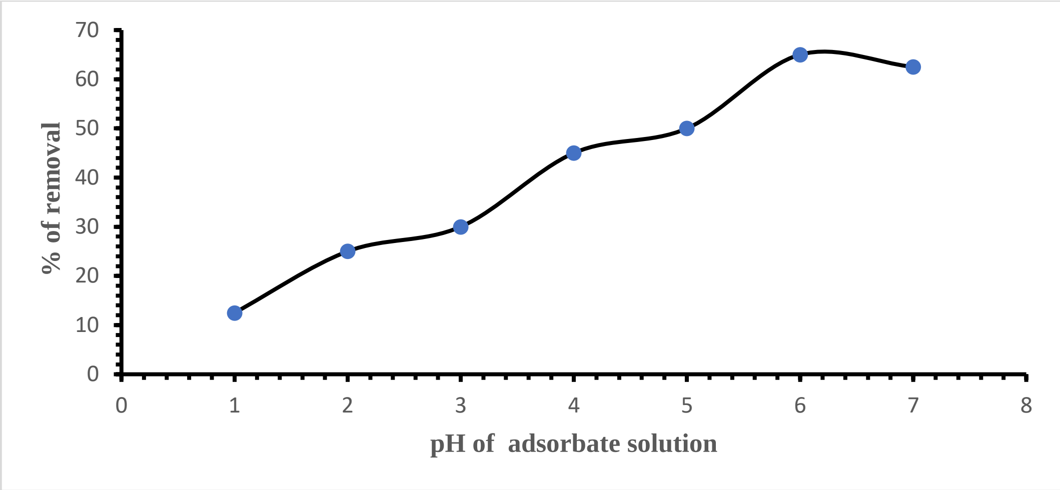

Figure.1. The impact of chromium solution pH on the percentage of Cr (VI) ions removed.

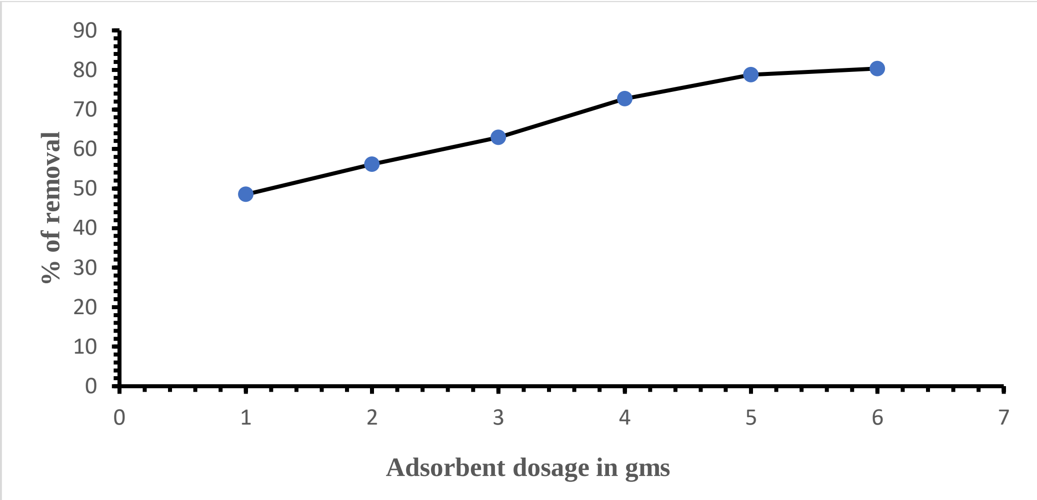

Figure 2. Impact of adsorbent dosage on % of removal of chromium (VI) ion.

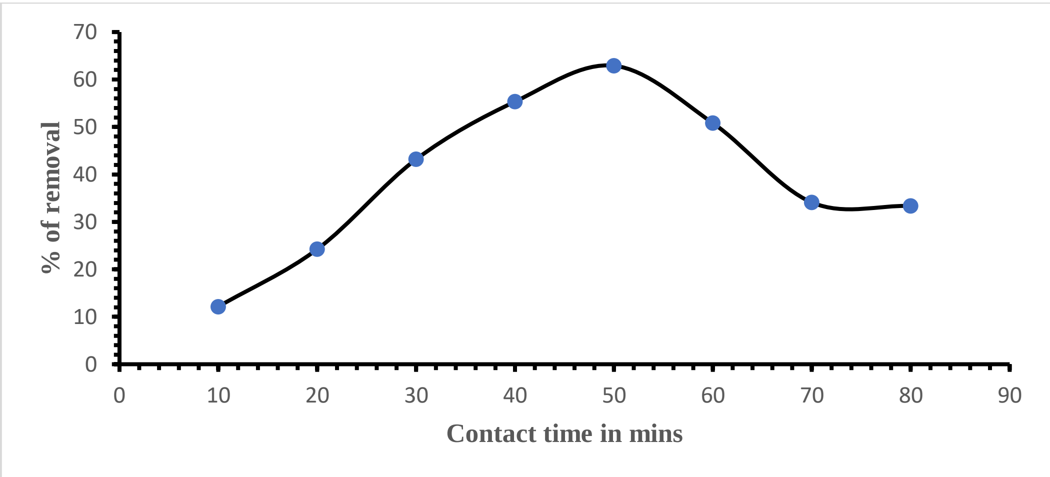

Figure 3. Impact of duration of contact on % of chromium (VI) ion removal.

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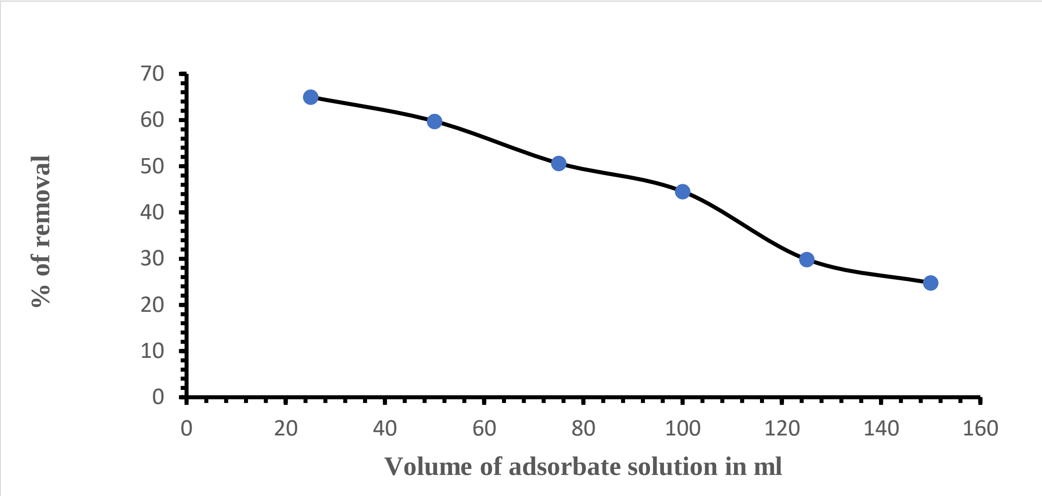

Figure 4. Impact of volume of adsorbate solution on % of Cr (VI) ion removal.

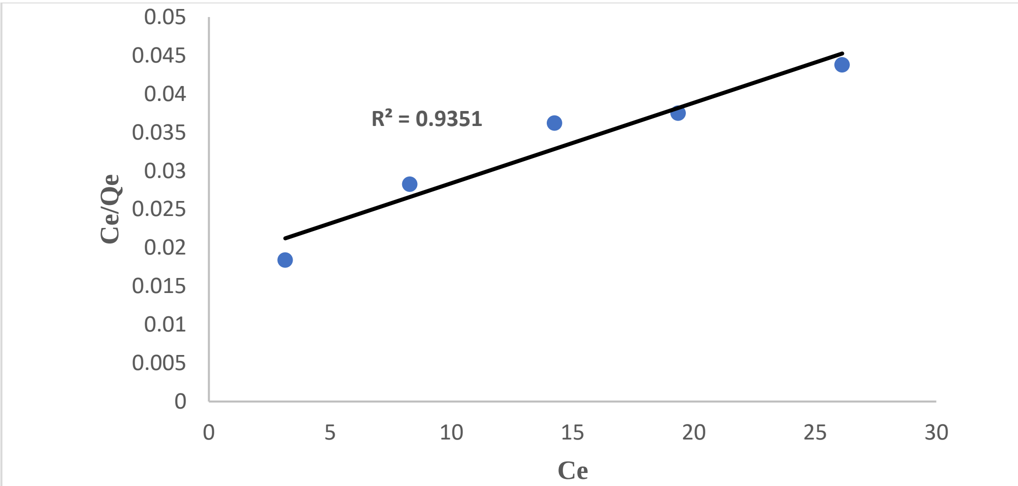

Figure 5. Langmuir isotherm graph of adsorption of chromium (VI)

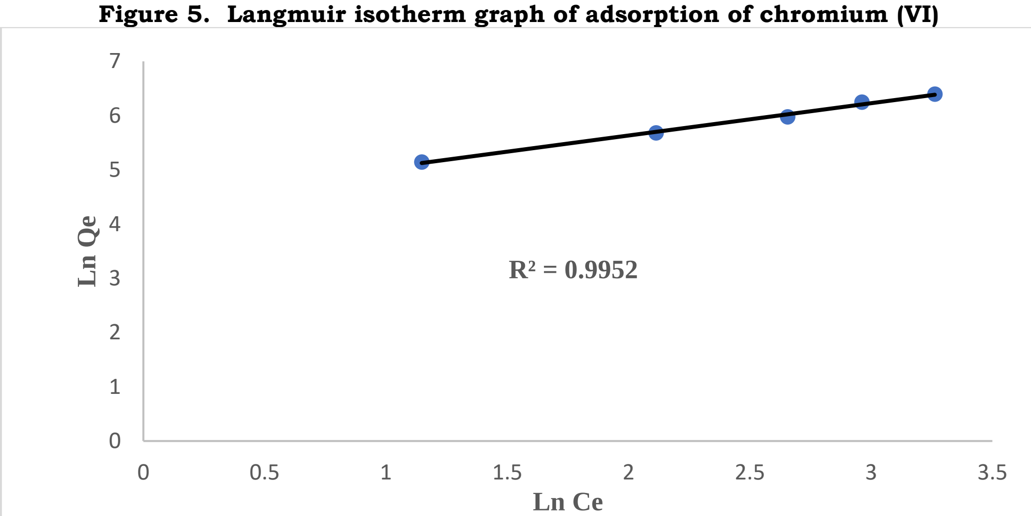

Figure 6. Freundlich isotherm plot of adsorption of chromium (VI).

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