3.3.3 Number of books and chapters in edited volumes/books published and papers published in national/ international conference proceedings per teacher during year

Sl. No.	Name of the teacher	Title of the book/chapters published	Title of the paper	Title of the proceedings of the conference	Name of the conference	National / International	Year of publication	ISBN/ISSN number of the proceeding	Affiliating Institute at the time of publication	Name of the publisher
1	Dr. K Geetha	Recent Trends in materials	Conference Proceedings	Springer Proceedings in Materials	4th International Conference on Trends in Material Science and Inventive Materials	International	2022	ISBN:978-981-10-5395-8	JCTCET	Springer
2	Sureshkumar.P	Electrical & Electronics in Automotive System					2021	9789354580642	JCTCET	ThePencilapp.com
3	Sureshkumar.P	Automobile Virtualization Guidelines					2021	9781638730422	JCTCET	Notion press
4	Sureshkumar.P	Retail,Service & Repair Automotive Training					2021	9781638734987	JCTCET	Notion press
5	Sureshkumar.P	Mentorship for Students					2021	9789354586729	JCTCET	ThePencilapp.com
6	Dr.S.Kavitha		Removal of contaminants from waste water by using Murrayakoenigii Nanoparticle	Materials today : Proceedings		National	2021	ISSN-2214-7853	JCTCET	ELSEVIER
7	Dr.S.Kavitha		Remediation of Cr(VI) from waste water using biochar of Indian Grass	IOP Conf.Series: Material Science and Engineering		National	2021	ISSN-1757-899X	JCTCET	IOP Publishing

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12	Dr. K Geetha	International conference on Intelligent Cyber Physical Systems and Internet of Things	Conference Proceedings	Springer	International conference on Intelligent Cyber Physical Systems and Internet of Things	International	2022	2731-5002	JCT	Springer
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Removal of contaminants from waste water by using Murrayakoenigii nanoparticles

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ABSTRACT

Today nanoparticles and nanocomposite are used for removal of metals and biological substances. Magnetic oxide nanoparticles are a class of engineered materials with very small size and which can be operated under the influence of external magnetic field. This is mainly due to their very efficient contaminant removal capacity, fast reaction rate and most importantly due to magnetic properties which enables its easy recovery. These magnetic nanoparticles are commonly synthesized by different methods. These preparation methods have several limitations in terms of operating cost production rates and risk to the environment and humans. In addition to these, magnetic nanoparticles lose their reaction rate due to macromolecules formation and magnetic property and dispensability on exposure of atmosphere. Green synthesis of magnetic nanoparticles has remained a comparatively new research area. The problem of treating waste water is being very severe, particularly in developing countries with disposal of untreated waste water. The release of untreated waste water with nutrients and metal concentration leads to worldwide ecological problem in water bodies. The present study revealed Murrayakoenigii (curry leaves) used for producing magnetic nanoparticles in green synthesis method and these magnetic nanoparticles have the potential to remove nutrients like Phosphate ion and Nitrate ion from wastewater and magnetic nanoparticles were characterised by FTIR,XRD and SEM Techniques.

Selection and peer-review under responsibility of the scientific committee of the International Chemical Engineering Conference 2021 (100 Glorious Years of Chemical Engineering & Technology).

1. Introduction

Nano research is a wide area that surrounds the formation of innovative nanomaterial's and detection and removal of pollutions from waste water [1]. Several approaches are used to produce nano-materials but the nano substance is characterized by physical, chemical and biological methods than their normal size particles [2]. Nanomaterials can easily combine with other methods and change any active scientific concept, so it is called as a innovative current technology. The use of nanomaterials in the opportunity is estimated to maximize several industrial uses and to decrease manufacturing costs by reducing waste water pollution and increase the nanomaterials production rate in industrial purposes [3]. The difficulty of treating contaminants containing waste water is being very severe, mainly in developing countries with disposal of untreated contaminants waste water. In India, only around 30% of total waste water gets treated and the discharge of untreated waste water has highly poisonous contamination of 75% of surface water bodies. The wastes highly rich in biological pollutants result in the reduction of dissolved oxygen and in revolve harmfully affect the water environment. Green synthesis is cost effective, environmental friendly and it can be easily scaled up as compared other. In recent times waste water membrane filter produced from nanomaterials [4,5]. Nanoparticles and other nanomaterial have been widely used in bio-treatment and also dis-infect. This particular study is to remove the Nitrate and phosphate present in the waste water.

2. Material and methods

2.1. Materials

Green synthesis of Nano size particles is a variety progress where the main reaction occurring is reaction mechanism. The reducing properties of curry leaves extracts are usually responsible

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for the removal of waste into their respective properties of nanoparticles. The magnetic nanoparticles has been synthesized from Murrayakoenigii (curry leaves) family of Rutaceae. These leaves were cut in to small pieces and washed with water and the leaves were dried. These dried samples have been powdered for treatment of synthetically prepared waste water. The leaf extract was prepared by taking 20 g of curry leaf powder in 1000 ml of de-ionised water. Then the solution has been heated up to 100 °C in the water bath to get the leaf extract. The curry leaves extract were collected and filtered shown in Fig 1. The filtered leaf extract solution stored in a clean, dried beaker for further use

2.2. Methods

2.2.1. Green synthesis of magnetic nanoparticles

The magnetic nanoparticles has been synthesized by adding 0.01 M Ferric chloride and the curry leaf extract in 1:1 proportion in a 250 ml flask. After addition of 100 ml leaf extract and 100 ml of 0.01 M Ferric Chloride the resulting solution was black in colour. The solution was centrifuged at 500 rpm and the solution was filtered and the supernatant was discarded. After filtration the obtained pellets were washed with de-ionized water and the solution was centrifuged again to remove any other impurities present in the solution after centrifuged the residue was dried and dry weight was estimated. The magnetic nanoparticles were effectively produced in an easy and eco-friendly way by using the curry leaves (Murrayakoenigii) extract as a reducing agent and percentage adsorption Phosphate and Nitrate was calculated as follows

$$Percentage(\%) = \frac{(Initialconcentration - Finalconcentration)}{InitiaalconcentrationC_o}x100 \quad (1)$$

2.2.2. Preparation of phosphate- nitrate solution

In this experiment, the percentage removal rate of nitrate and phosphate were examined. In this regard, various concentrations of nitrate solution the ranging from 0 to 25 mg/Land phosphate solution ranging from0 to 25 mg/L were prepared and treated with different dosage of magnetic nano particles with different time intervals. After the remaining amount of nitrate and phosphate in the solutions were measured with measuring jar. The removal percentage was calculated by using the above formula. The phosphate and nitrate ion solution were prepared from potassium di hydrogen phosphate (KH_2PO_4) and potassium nitrate (KNO_3) solution. The mixture of nano particles solution was adjusted by HCL (0.01 M) solution. The pH of the solution was fixed at different pH ranging from2 to 8 by 0.1 M HCL and buffered by adding 0.2 M of CH_3COOH.

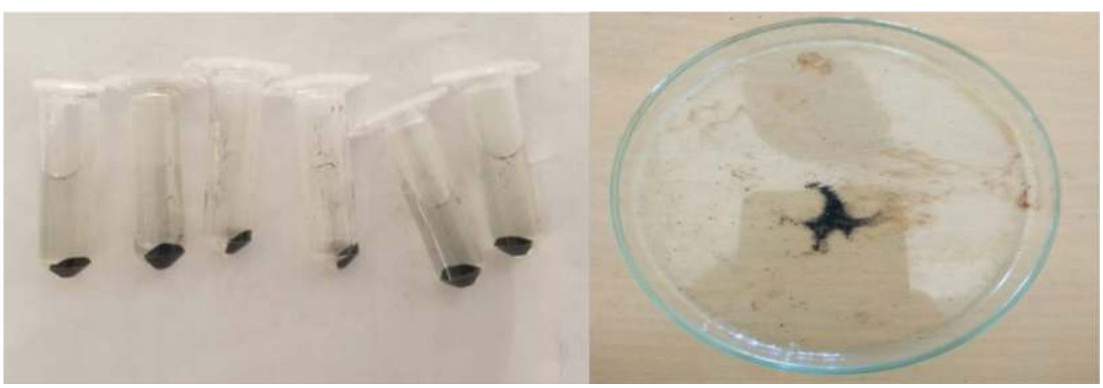

Fig. 1. Magnetic nanoparticle after centrifugation.

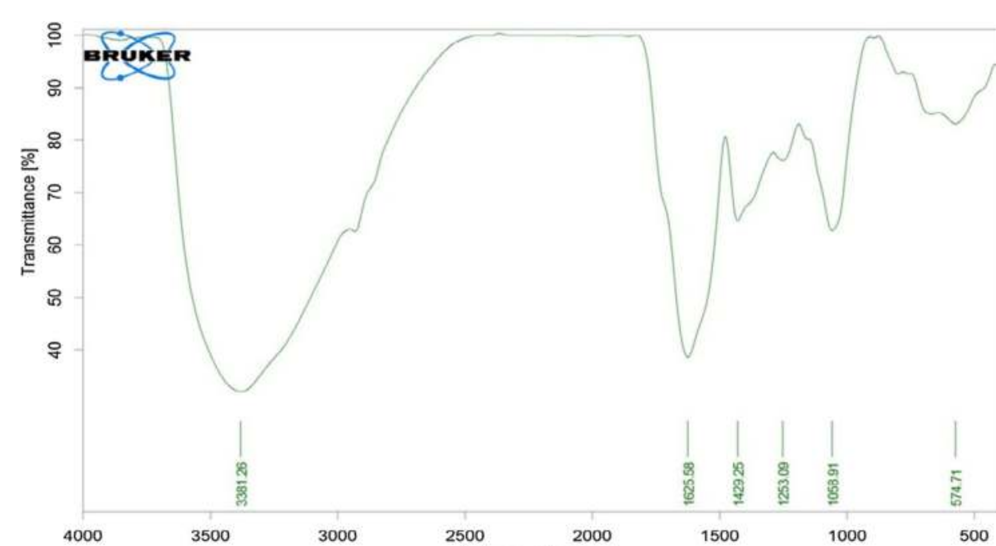

Fig. 2. FTIR spectrum.

2.2.3. Removal percentage of nutrients (phosphate and nitrate) in solution

The percentage reduction of phosphate and nitrate using nanoparticles as was examined. In this regard, various solutions with different concentrations of nitrate and phosphate were prepared and treated with different time intervals and pH. The remaining amount of phosphate and nitrate in the solution was calculated. The phosphate and nitrate ion concentrations were measured by using UV–Vis spectrophotometer ranging from 220 nm to 820 nm. After measuring the initial and final concentrations of phosphate and nitrate solution the difference between the initial and final concentration of phosphate and nitrate was used to determine the removal percentage.

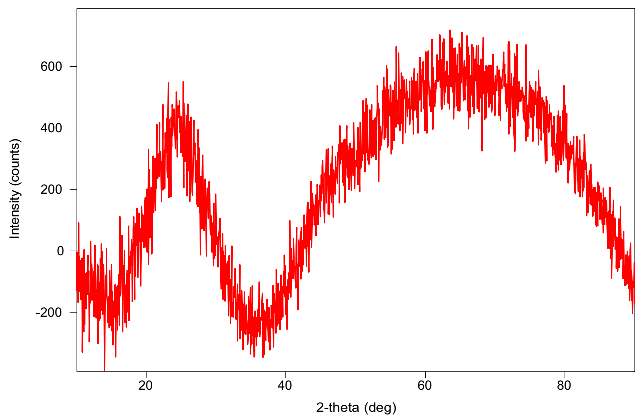

Fig. 3. XRD results of the sample.

3. Results and discussion

3.1. Characterization analysis on curry leaves magnetic nanoparticles

3.1.1. FT-IR analysis

Study of magnetic nanoparticles adsorbent functional groups, the FT - IR analysis were carried out in an adsorbent. As per the standard procedure the samples were powdered and placed in KBr in a mortar for FTIR analysis [6]. The nanoparticles spectra wave numbers were measured. FTIR analysis of synthesized magnetic nanoparticles stretches the vibrations at 3341.20 cm^{-1}, 1625.50 cm^{-1}, 570.71 cm^{-1} within the region of 500–3500. The peaks found at 1625 cm – 1 can be attributed to the C–C in alkenes rings and C=C stretch of aromatic rings. Depending on above observation, it can be assumed that the stabilization was achieved by the aromatic compounds present in the leaf extract.The functional groups were shown in Fig 2

3.2. XRD analysis on magnetic nanoparticles

X-Ray Diffraction (XRD) is a test method used to discover the main constituents and their phases in the given magnetic nanoparticles sample. X-Ray Diffraction (XRD) analysis was noted with a

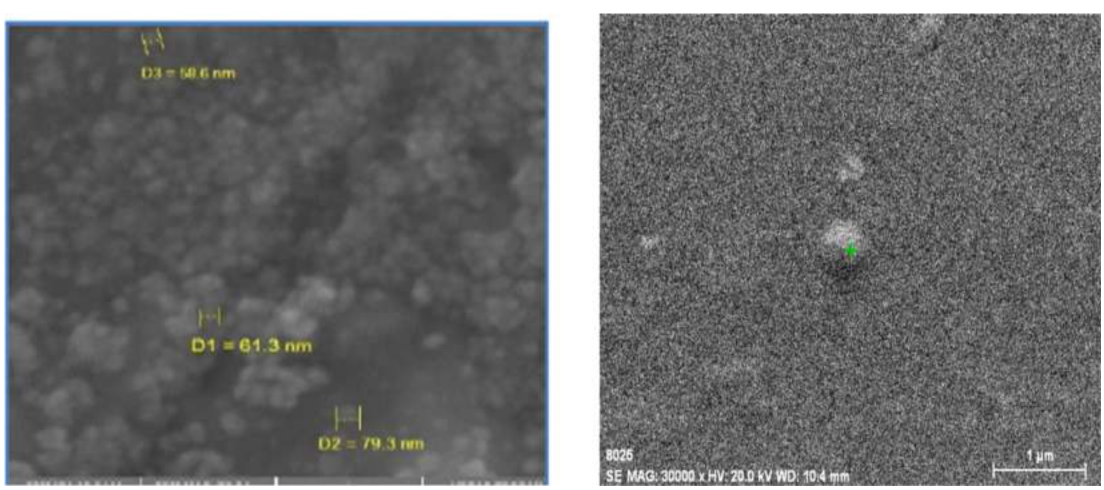

Fig. 4. FESEM result of sample before and after the experiment.

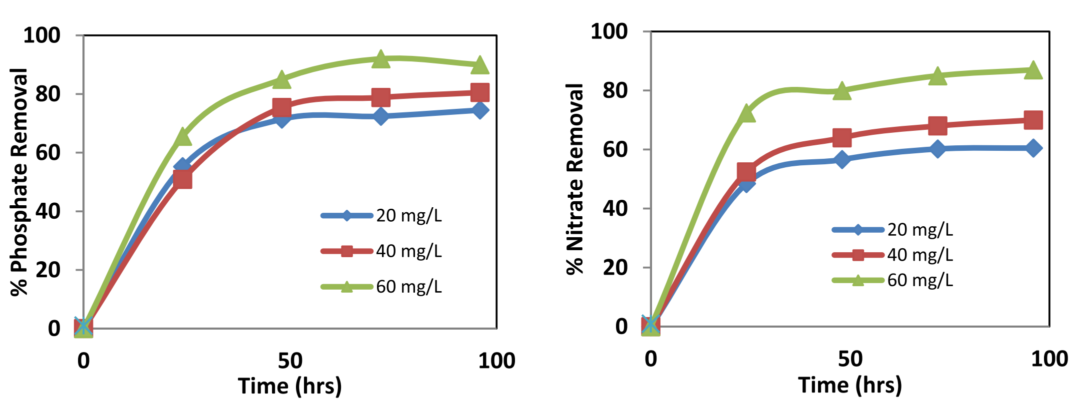

Fig. 5. Effect of Contact time.

Step size of 0.01 and scan speed 0.5° 2 h/minute, the peaks were shown in Fig 3 are similar with the main components [7]. All the peaks could be indexed to rhombohedra structure, for curry leaves magnetic nanoparticles

3.3. SEM analysis on curry leaves magnetic nanoparticles

In order to study the morphological dimensions shown in Fig. 7 of synthesized magnetic nanoparticles using the SEM [8]. The study confirmed that the nano particlessize was ranging between 58 and 79 nm, and similar report has been given by Nidhin and Raiza [9]. From the study of FTIR and SEM it could able to predict the functional groups and size of the magnetic nanoparticles [10]. The curry leaves contains large amount of Poly phenols which acts as a reducing agent (Fig 4).

4. Result analysis

4.1. Effect of contact time on magnetic nanoparticles

The experimental study results show the phosphate and nitrate ion removal percentage was slow from the beginning and slowly

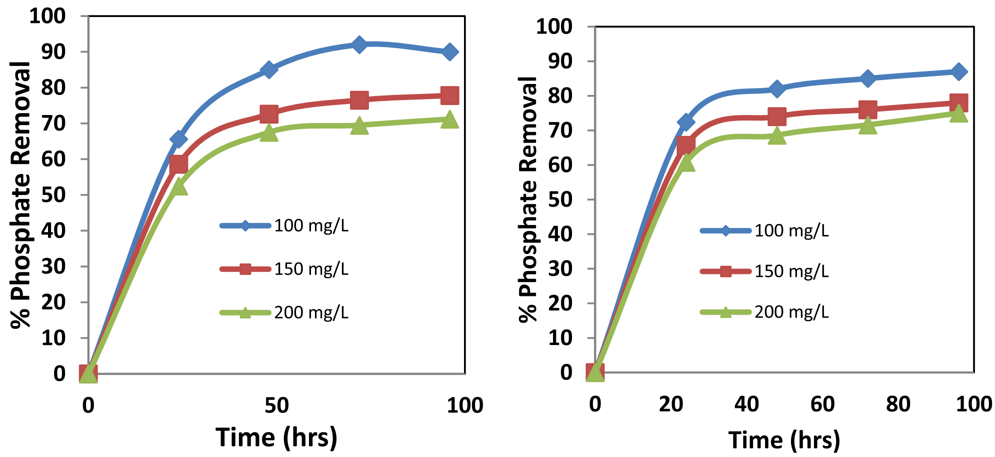

Fig. 6. Effect of Initial Concentration.

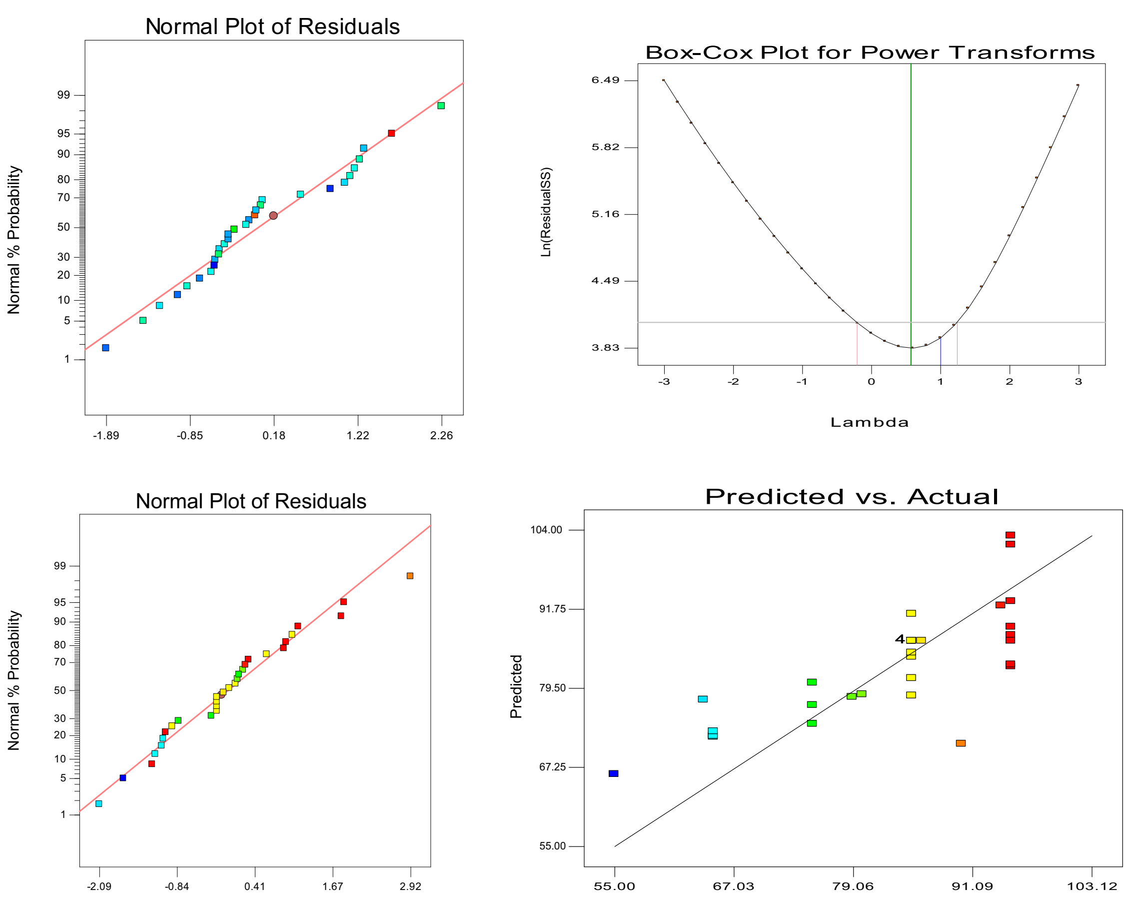

Fig. 7. Response surface model for actual va predicted and Box Cox plot.

reached maximum [11]. The process parameters such as contact time, dosage of substrate and temperature solution were kept stable at 48 hrs, 30 °C and 20 mg/L. The experimental results were calculated from the percentage adsorption was increased for the first 24 hrs followed by slower adsorption for remaining hours. The removal percentage of phosphate ion and nitrate ions were gradually increased from 12 hrs and steady state reached at 48 hrs.The effect of contact time on magnetic nanoparticles were shown in Fig. 5.

4.2. Effect of initial concentration on magnetic nanoparticles

The effect of initial concentration of phosphate and nitrate in the curry leaves magnetic nanoparticles adsorption process. For the fixed dose of magnetic nanoparticles 60 mg/L of adsorbent, initial concentration of magnetic nanoparticles with phosphate and nitrate solution was varied from 100 to 200 ppm. From the graph shown in Fig. 6, It is cleared that as initial concentration increases, the adsorption percentage for the fixed dose decreases, but the uptake increases [12].

5. Process optimization using response surface methodology (RSM) for nutrients removal

Response surface methodology (RSM) is a mathematical calculation used to calculate the relations between experimental variables and calculate the optimal experimental values for the variables based on experimental process runs. In this work, the Response Surface Methodology(RSM) used to employing Central Composite design (CCD) and used to calculate the optimized values

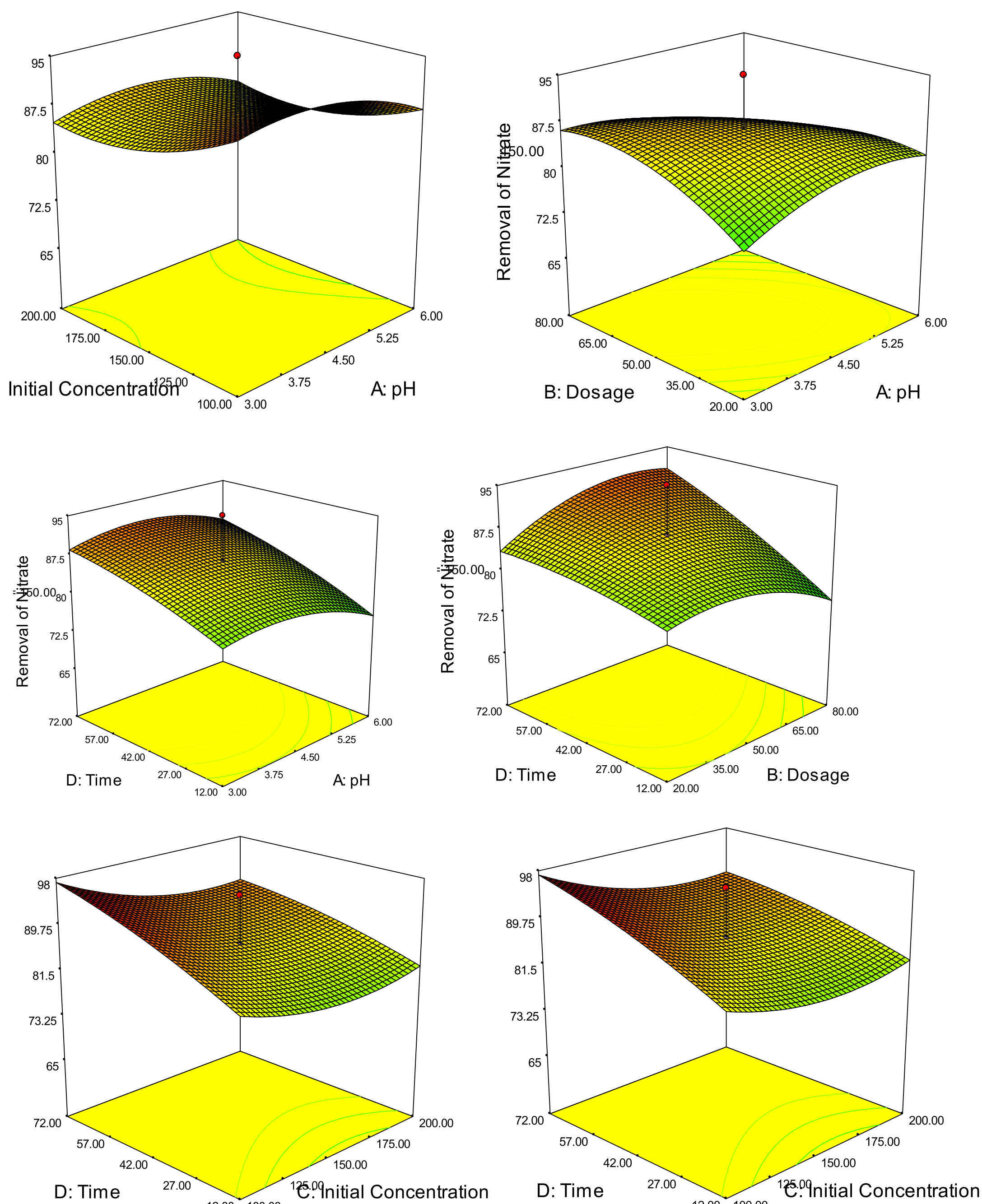

Fig. 8. Three dimensional response plot for Nitrate removal using curry leaves nanoparticles.

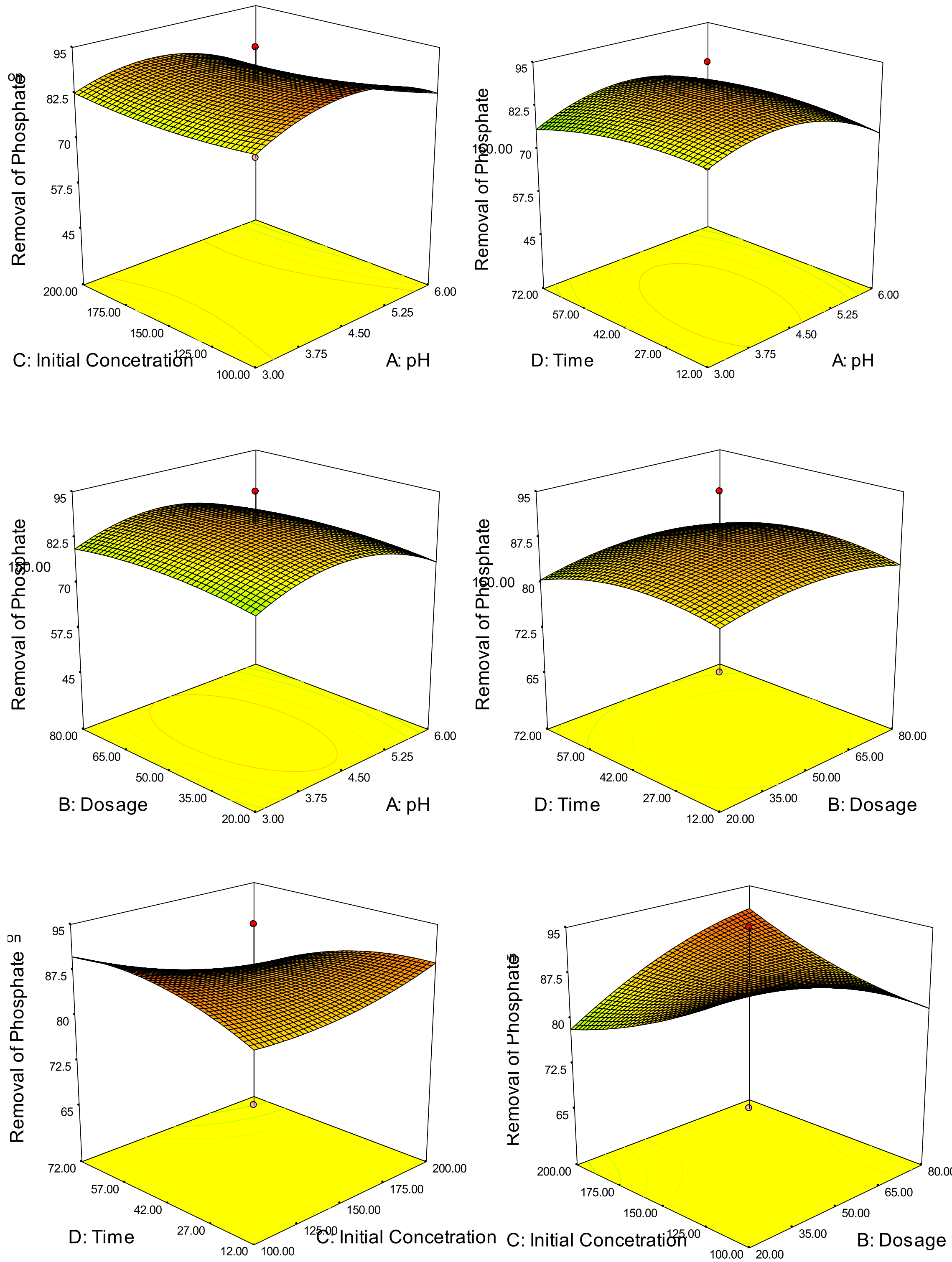

Fig. 9. Three dimensional response plots for Phosphate removal using curry leave nanoparticles.

in Design Expert statistical software. The values for each process variable for constructing the Central Composite design (CCD) were obtained from the software. The main advantage of Central Composite design (CCD) is that it results in a lowest count of runs than Box - Behnken Design(BBD).Removal experiments were calculated according to Central Composite design (CCD) with four factors at three levels that were implemented to the interactive effect of the experimental variables considered for phosphate and nitrate removal using curry leaves nanoparticles. The experimental parameters pH (3 to 6, X1), curry leaves nanoparticles dosage (20–80 mg, X2), Initial nutrients concentration (100–200 ppm, X3), and Time (12–72 h, X4) were used as independent variables. A second-degree polynomial equation equalling to the effect involving the experimental variables were used to calculate the removal rate of phosphate and nitrate using curry leaves nanoparticles.Three dimensional response plots for nitrate and phosphate removal using curry leave nanoparticles were shown in Fig. 8 and Fig. 9.

5.1. Normal probability plot of residuals

Normality of the experimental data is very significant in statistical design methods. The data points are reflected to be normally distributed if response points fall properly close to straight line [13]. Accordingly, to explore the normality of data, normal probability curve of the residuals was generated. From the curve, it was experiential that utmost of the data points are fairly near to the straight line and it shows that the experiments come from a normally distributed population. Thus, our assumption of normality is valid. Apart from this three dimensional response plot for both Nitrate and phosphate has been created.Response surface model fot actual vs predicted and BOX - COX plot were shown in Fig. 7.

6. Conclusion

The experimental studies of synthesis of iron oxide nanoparticles using traditional plant murraykoeinjii (curry leaves) has been explored and it has been used to remove the phosphate and nitrate of different dosages. Batch adsorption process were experimented to study the effect of process parameters like process time and initial concentration on the removal of phosphate ion and nitrate ion from the solutions has been investigated. The removal efficiency has been related with all the process parameters. The magnetic nanoparticles were found to be highly stable and potential to remove phosphate and nitrate ions. The magnetic nanoparticles capable to remove the 95% phosphate and 90% nitrate.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

[1] C. Zhang et al., Appl. Microbiol. Biotechnol. 98 (2014) 6679–6687.
[2] Y.H.P. Zhang, J. Hong, X. Ye, Methods Mol. Biol. 581 (2009) 213–231.
[3] G.L. Miller, Anal. Chem. 31 (1959) 426–428.
[4] D. Sivaramakrishna, J.S. Musti, J. Chem. Sci. 127 (2015) 1627–1635.
[5] G.T.N. Muthu, R. Suganya, Inter. J. Pure Appl. Mathe. 119 (2018) 6515–6524.
[6] M. Nidhin, R. Indumathy, K.J. Sreeram, B.U. Nair, Bull. Mater. Sci. 31 (2007) 93–96.
[7] R. Rasheeda, V. Meera, Procedia Tech. 24 (2016) 210–216.
[8] W. Wang, T. Archbold, J.S. Lam, et al., microbiota, Sci. Rep. 9 (2019) 13630.
[9] B. Ucar, A. Guvenc, U. Mehmetoglu, Hydrol. Cur. Res. 2 (2011) 1–8.
[10] J. Jiang, G. Oberdorster, P. Biswas, J. Nanopart. Res. 11 (2009) 77–89.
[11] S. Behnam, K. Karimi, M. Khanahmadi. Nutr. Food Sci. Res. 6 (1) (2019) 27–34, doi: 10.29252/nfsr.6.1.27.
[12] A. Mražíková, O. Velgosová, J. Kavuličová, S. Krum, J. Malek, Acta Polytech. 58 (2018) 365–369.
[13] D.I. Desai, B.D. Iyer. (2017), doi: 10.1007/s12649-016-9567-4.

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Remediation of Cr(VI) from wastewater using biochar of Indian Grass

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Remediation of Cr(VI) from wastewater using biochar of Indian Grass

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Abstract
Chromium is extremely noxious unneeded for any living organism and its occurrence is unusual in nature. Many industrial activities such as mining, metal plating, wood preservation, dyes, pigments, tanning and textile industries makes pollution which cause major health hazards. The present study explores the possibilities using biochar from any carbonized material to use as source to remove the toxic material from any industrial effluent and particularly for Cr(VI). Batch process was accomplished to examine the outcome of various parameters to eliminate the Cr (VI) from the solutions. The rate of adsorption has been interrelated with all the parameters. The Cr(VI) adsorbed bio-char may be used as a fuel in Ferrochrome industry**.** From the study, it was experimental that adsorption kinetics obeys the pseudo second order kinetics. Experimental data follows the Langmuir isotherm. Intra-particle diffusion is most sluggish steps which determine the rate.

Keywords: Cr(VI),Biochar, uptake, kinetics, isotherm;

1. Introduction
The chromium is important material is used commonly in metallurgy, electroplating and other manufacturing units and that release the chromium into the environment [1-3]. Adsorption process is right process for the elimination of toxic metal when the unwanted metal concentration is lower in quantity [4-5]. A essential character of good adsorbent is their large surface area and high porosity.
From the literature, it is evident that bio-sorbents have high Cr(VI) uptake capacity as compare to other adsorbents. However, the disadvantages with the bio-sorbent is that, the uptake is higher at lesser pH, treatment at lesser pH requires neutralization steps which are not economic and environmental friendly and regeneration is not possible because of adsorption cum reduction mechanism [6]. Therefore, the present study aimed at finding an alternative adsorbent i.e. biochar to eradicate the Cr(VI) from the wastewater and use this chromium adsorbed biochar. The researchers indicated that the potential for 18-40% mitigation of CO2. Apart from the CO2 reduction, the charcoal based iron making reveals following benefits to the process. Biochar contains less sulphur and phosphor content than coke.

1. Low ash content compared to coke. .
2. As because of high porous with more surface area which improves combustion rate. .

Biochar addition is very small percentage so the effect of cost will be negligible. To explore the result of various factors on adsorption, batch studies were done by changing the parameters to eliminate of Cr(VI) from the solutions by using this Biochar.

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2. Methods

The batch adsorption experiment was conducted in a beaker at isothermal condition using a magnetic agitator with speed regulator. The required samples were collected under dynamic condition at standard time intermissions and filtered through a filter paper. Percentage adsorption (E%) and uptake (qe) of Cr(VI) has been analysed by UV spectrophotometer and determined by using following equations (1) and (2),

$$E\% = \frac{(C_o - C_t)}{C_o} x\, 100 \quad (1)$$

$$q_e = \frac{V(C_o - C_e)}{W} \quad (2)$$

3. Result and Discussion

3.1. Outcome of contact time

The batch process is carried out to obtain the equilibrium interaction time. The batch processes executed for 10 hours and kept all other parameters were constant during the experimentation. The outcomes are shown in Figure 1 shows that adsorption was very rapid for first 45 minutes and almost 80% adsorption has been reached during this phase as because of available surface area. Once free surface is occupied, adsorbed Cr molecules penetrate to the pores present in the adsorbent. Equilibrium is achieved within 10 hours in this process and so the left over studies were executed for 10 hrs.

3.2. Outcome of Initial pH of Solution

The initial pH is a greatest influential parameter disturbing the adsorption process [7]. Under the constant stirring speed, pH has been varies between 2 and 4.0 to study the impact on percentage of adsorption. The outcomes are shown in Figure 2 below. From the experiments, it is clear that percentage adsorption as well as the uptake capacity of the adsorbent increases with decrease in pH. The reason behind in increasing in adsorption capacity with decrease in pH may be due to at low pH, the surface turn into more positive because of presence of large number of H+ ion.

The percentage adsorption as well as Cr(VI) uptake capacity was maximum at pH 1.0 however, the effluent after adsorption is highly acidic pH of 2.2. Acidic effluent is not environmental friendly and hence required acid neutralization steps. Further, neutralization of effluent can lead to increase in total solid and this may not be cost effective process.

It was perceived that the maximum removal (100 %) was at pH of 2.0 and 2.5. The uptake capacity increased from 10.7 mg/g at pH of 4.0 to20 mg/g at pH of 2.0. Even though, maximum capacity observed to be at pH 2.0, but the effluent from the process will be highly acidic and hence required acid neutralization steps which may not be cheap to run and environmental welcoming [8]. Further, the used adsorbent may not be suitable for recycle to the ferrochrome industry, if the treatment carried out at such lower pH. Therefore, the remaining studies were done at pH of 3. The final pH of the effluent of the process increased to more than 5.

3.3. Effect of Initial Cr(VI) Concentration

The concentration at the beginning of Cr (VI) is also another major factor affects the percentage of adsorption and also the uptake. The outcomes were shown in Figure 3. It is experiential that, by increasing the initial concentration, the percentage of adsorption is increasing, as because of more active sites present in the adsorbent. The adsorption increases the maximum to 100% at 10 ppm has decreased to

94% at 100 ppm of initial Cr (VI) concentration. But the uptake is increased from 2 mg/g at 10 ppm to 18.9 mg/g at 100 ppm as because of increase in the energetic dynamism to conquer all the resistances among the solution and solid phases.

3.4. Effect of Adsorbent Dose

The adsorbent dose also varied under the concentration of initial Cr (VI) solution was 10 ppm for all further studies, remaining all other adsorption parameters were kept constant under constant stirring speed. The outcomes were depicted in Figure 4. From the graph it is observed, the kinetics was rapid in the beginning 30 minutes, after that adsorption becomes slower. During the rapid phase, 90% of the removal has taken place. The process reached steadiness within 360 minutes, after that not much changes in concentration. The percentage of removal was increased from 59% at dose of 1 g/L to 100 % at 10 g/L as because initially more active sites present in the adsorbent were exposed [9,10]. The uptake has reduced from 5.9 to 1.42, once the dose increased from 1 g/L to 10 g/L

4. Kinetic Model

In order to design a continuous column for the removal of Chromium form effluent it is essential to find the rate at which adsorption proceeds. In the present study batch data has been fitted with various [11] kinetic models i.e. Lagergren's model, Ritchie's model, First Order Reversible and Pseudo second order were used.

These model equations are extensively applied in the adsorption in heterogeneous adsorption particularly for in a liquid solution by using kinetic equations [12] given as in Equations 3- 6

$$\ln(q_e - q) = \ln q_e - k\,t \tag{3}$$

Ritchie model equation

$$\frac{q_e}{q_e - q_t} = 1 + kt \tag{4}$$

For the reversible reaction, this generally expressed as

$R \leftrightarrow P$

$$\ln(1 - V_t) = -(k_{forward} + k_{\mathrm{backward}})t \tag{5}$$

Pseudo second order kinetics

$$\frac{t}{q} = \frac{1}{k_2 {q_e}^2} - \frac{t}{q_e} \tag{6}$$

The constant values together R^2 are assessed and stated in Table 1. It is clear from the table it follows pseudo second order model. The kinetic parameter and R^2 has been tabulated in Table 1.

5. Equilibrium Adsorption Isotherm

The mechanism of adsorption by the biochar was studied through the data were fitted to various isotherm models. The experimental data have been used to fit in Langmuir isotherm, Freundlich isotherm [12] and Temkin isotherm [13]. This is outlined below given as in Equations 7- 9

.

$$\frac{C_e}{q_e} = \frac{1}{Q_0 K} + \frac{C_e}{Q_0} \tag{7}$$

$$\log q_e = \log K_F + \frac{1}{n} \log C_e \quad (8)$$

$$q_e = \frac{RT}{b} \ln A + \frac{RT}{B} \ln C_e \quad (9)$$

All the constant value and interpreted values are stated in the Table 2. From that it obeys the Langmuir model based on the R^2 values and also the mechanism of the process.

6. Rate Controlling Mechanism

The rate controlling mechanism on spongy nature of adsorbents is controlled in four steps. The first step is bulk diffusion i.e. movement of Chromium in solution to solid adsorbent. Then followed by that is film diffusion which is mass transfer controlling step. Third one is surface diffusion. Finally, the intra-particle diffusion is takes place. Out of these either one or multi steps may control the rate. The experiment was carried out in enough speed so, bulk and film diffusion may not be a controlling steps. The adsorbent used in our experiment is permeable. The diffusion takes place in porous structure [14-15]. can be construed as below

$$q_t = k_{id} t^{1/2}$$

where q_t is adsorbent uptake and k_{id} is intra-particle diffusion coefficient. The graph between q_t versus $t_{1/2}$ gives the value of k_{id}. Results of all tests were tabulated Table 3.

7. Conclusion

The adsorption capacity of the many of the bio-sorbent is low at higher pH. Further the bio-sorbent neither can be regenerated nor can be used directly in any industrial process. Therefore, in the present study explore usage of adsorbent biochar for the treatment of Cr (VI). The advantages of using Biochar as an adsorbent is that the used Biochar can be reused in a ferrochrome industry as a source of carbon i.e. fuel. Further, the adsorbed Cr (VI) can be used as a raw material for the ferrochrome production. Therefore, no regeneration or disposal of the adsorbent is required which may create environmental problem and hence can be treated as clean treatment technology [16]. The adsorption experiments were carried by varying different parameters to find out their effects on the percentage adsorption as well as uptake of the adsorbent. As usual, the adsorption capacity and percentage adsorption increases with decrease in pH. The percentage adsorption increases with increase in adsorbent dose whereas, the uptake capacity decrease with increase in adsorbent dose. In case of increase in adsorbate concentration, the percentage adsorption decreases whereas the uptake capacity increases. The entire process followed second order kinetic model and Langmuir isotherm. The surface diffusion is found to be the rate limiting step.

From the literature few adsorbents were chosen and results were related in Table 4 and can be concluded that current adsorbent is similar with numerous adsorbents stated in the literature.

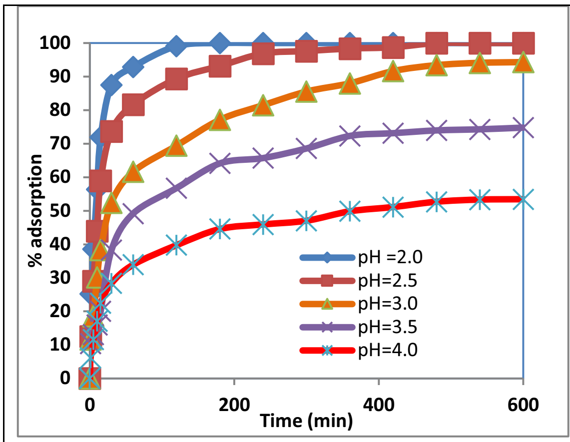	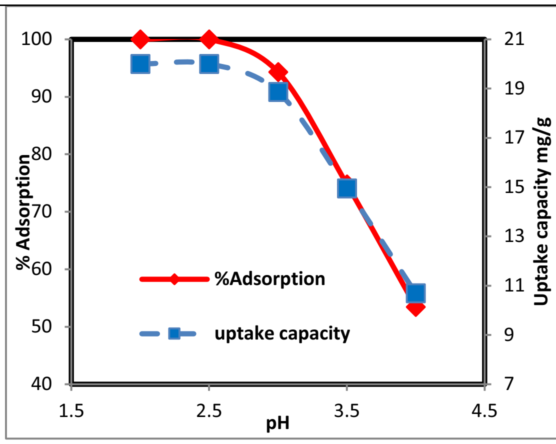
Figure 1. Effect of contact time Condition: Concentration:100 ppm, Dose: 5 g/L, Temp:30°C	**Figure 2.** Effect of pH Condition: Concentration: 10 ppm, Dose: 5 g/L, Temp: 30°C
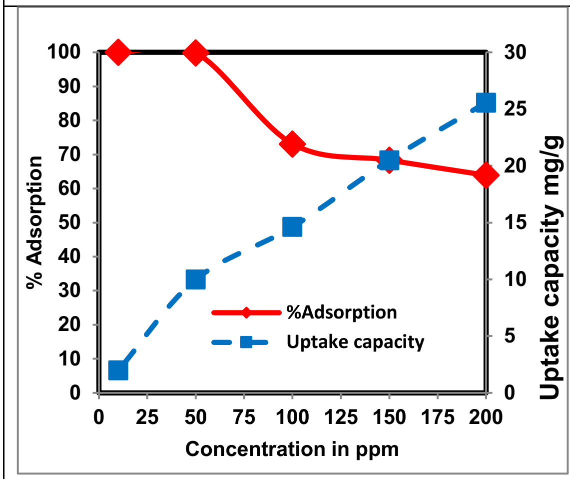	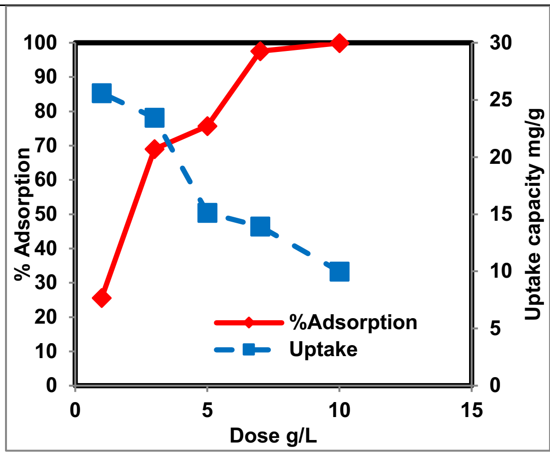
Figure 3. Effect of Initial Cr(VI) Concentration. Condition: pH 3.0, Dose: 5 g/L, Temp: 30°C.	**Figure 4.** Effect of Adsorbent Dose. Condition: pH 3.0, Concentration: 100 ppm, Temp: 30°C

Table 1. Adsorption Kinetic models parameters

Parameter	Values	Pseudo 1st order		Richie's 2nd order		Pseudo 2nd order		First order reversible		
		k	R^2	k	R^2	k	R^2	k1	k2	R^2
Dose (g/L)	1	0.316	0.87	0.08	0.61	0.0400	0.973	0.026	0.180	0.740
	3	0.360	0.904	0.16	0.53	0.1300	0.995	0.047	0.200	0.790
	5	0.640	0.97	1.1	0.74	0.2530	0.999	0.470	0.050	0.921
	7	0.511	0.833	0.45	0.91	0.5000	0.999	0.070	0.360	0.860
	10	0.640	0.91	0.952	0.81	1.0200	0.999	0.050	0.304	0.910
pH	2	0.67	0.88	0.853	0.87	0.0030	0.999	0.040	0.002	0.890
	2.5	0.42	0.99	0.17	0.94	0.0020	0.999	0.012	0.001	0.826
	3	0.4	0.88	0.4	0.42	0.0030	0.997	0.010	0.002	0.932
	3.5	0.39	0.95	0.19	0.697	0.0050	0.998	0.004	0.006	0.977
	4	0.38	0.85	0.413	0.36	0.0090	0.996	0.010	0.007	0.903
Initial Concentration(ppm)	10	0.661	0.97	1.1	0.74	0.2530	0.999	0.020	0.002	0.810
	25	0.4	0.98	1.3	0.33	0.0420	0.999	0.010	0.002	0.840
	50	0.4	0.923	0.3	0.64	0.0100	0.997	0.008	0.002	0.960
	100	0.4	0.88	0.400	0.42	0.0030	0.997	0.008	0.002	0.930

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Table 2. Adsorption isotherm models parameters

Parameter	Values	Freundlich Isotherm			Langmuir Isotherm		Temkin Isotherm	
		Slope(1/n)	log K_f	R^2	$1/q_{max}$	R^2	RT/b	R^2
Dose (g/L)	1	0.116	0.64	0.84	0.17	0.999	1.39	0.799
	3	0.094	0.65	0.78	0.342	0.999	0.590	0.756
	5	0.027	0.002	0.614	0.5	0.999	0.216	0.734
	7	0.023	0.1	0.565	0.7	0.999	0.344	0.900
	10	0.020	0.17	0.632	1.000	0.999	0.181	0.945
pH	2	0.264	1.414	0.638	0.05	0.999	3.19	0.760
	2.5	0.33	1.46	0.620	0.05	0.999	3.52	0.800
	3	0.266	1.34	0.510	0.053	0.999	2.67	0.680
	3.5	0.35	1.27	0.645	0.067	0.999	2.63	0.770
	4	0.270	1.03	0.490	0.094	0.999	1.51	0.660
Initial Concentration(ppm)	10	0.161	0.144	0.635	0.50	0.999	0.216	0.730
	25	0.211	0.64	0.68	0.203	0.999	0.685	0.780
	50	0.21	0.97	0.602	0.103	0.999	1.27	0.740
	100	0.197	0.970	0.491	0.05	0.999	2.28	0.623

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Table 3. Rate controlling mechanism

Parameter	Values	q_t vs $t^{1/2}$		q_t/q_e vs $t^{1/2}$		ln (1-(qt/qa)) vs t		
		k_{id} mg/g min$^{(1/2)}$	R^2	D_1 mm^2/time 10^{-6}	R^2	D_2 Π/a^2	D_2 mm^2/time 10^{-3}	R^2
Adsorbent dose (g/L)	1	1.480	0.974	0.92	0.87	0.160	0.279	0.950
	3	1.484	0.98	1.55	0.984	0.340	0.593	0.990
	5	0.710	0.97	0.88	0.972	0.340	0.593	0.934
	7	0.650	0.95	1.72	0.99	0.380	0.663	0.980
	10	0.370	0.9	1.72	0.993	0.340	0.593	0.954
pH	2	0.91	0.66	8.07	0.97	1.300	2.267	0.900
	2.5	1.13	0.78	5.78	0.95	0.400	0.698	0.950
	3	1.23	0.912	5.78	0.995	0.564	0.984	0.930
	3.5	1.05	0.883	5.78	0.92	0.550	0.959	0.980
	4	0.69	0.915	4.78	0.99	0.980	1.709	0.910
Initial Concentration(ppm)	10	0.084	0.69	4.78	0.94	0.900	1.570	0.980
	25	0.23	0.79	5.07	0.98	0.390	0.680	0.995
	50	0.55	0.91	3.29	0.983	0.690	1.203	0.994
	100	1.235	0.91	5.47	0.99	0.564	0.984	0.930

Table 4. Assessment of the Biochar with several adsorbents stated in literature

S.No	Adsorbent	Time (min)	pH	Adsorbate conc. (mg/L)	Dosage(g/L)	Temp.^{0}C	% Ads.	Uptake (mg/g)
1	Bael shell	240	2	50	10	30	92	17.27
2	Basillus Biomass	480	2	100	1	30	15	14.9
3	Rice Husk	360	1.5	25	10	25	90	11.39
4	Rice Straw	180	2	25	10	25	95	12.17
5	Magnetite nanoparticle	60	2.5	50	5	25	99.8	15.3
6	Neem leaves	240	2	25	10	25	75	15.95
7	Sulfonated Lignite	60	2	50	2.8	25	80	27.87
7	Bromide micellar	60	2	30	2	30	100	17.89
9	Indica bark	482	6.5-7	4-5	1	30	78-80	20
10	Neem bark	240	3	50	10	25	95	19.6
11	Husk of Pomegranate	180	1	150	3	25	52	35.2
12	Coconut shell	240	2	25	10	25	95	18.69
13	***Biochar (Present study)***	***600***	***3***	***100***	***5***	***30***	***94***	***18.9***

References

1. Gupta V.K., Rastogi A., Nayak A., Removal of Cr(VI) from aqueous solutions by adsorption onto hazelnut shell activated carbon:kinetic and equilibrium studies, *Bioresour. Tech*., **91** (2004) 317–321.
2. Saroj Sundar Baral , Kavitha Mohanasundaram & Surendran Ganesan, Selection of suitable adsorbent for the removal of Cr(VI) by using objective based multiple attribute decision making method, *Preparative Biochemistry & Biotechnology*, 69-75, 20 Jul 2020, https://doi.org/10.1080/10826068.2020.1789993
3. Sharma I., Dinesh G., Kinetic modeling: Chromium(III) removal from aqueous solution by microbial waste biomass, *J. Scientific Ind. Res.* **68** (2009) 640-646.
4. Surendran,G., & Baral, S.S. Biosorption of Cr(VI) from wastewater using *Sorghastrum Nutans L. Nash*. *Chem. Ecol*. **34(8)** (2018) 762-785.
5. A. Saravanan, V. Brindha, R. Manimekalai, S. Krishnan, An evaluation of chromium and zinc biosorption by a sea weed (Sargassum sp.) under optimized conditions, *Ind. J. Sci. Technol*. **2** (2009) 53-56.
6. A Netzer, Hughes, D.E. Adsorption of copper, lead and cobalt by activated carbon. *Water Res.* **18** (1984) 927–933.
7. Baral, S.S., Surendran, G., Das, N., Rao, P.V., Statistical design of experiments for the Cr(VI) adsorption on weed *salvinia cucullata, Environ. Engg. Manage.J.,* **12 (**2013) 465-474.
8. Goel R.P., Smelting Technologies for Ferrochromium Production-Recent Trends, Ferro Alloy Industries in the Liberalised Economy, (1997) 37-50.
9. Ariyama T., Murai R., Ishii J., Sato M., Reduction of CO_2 emissions from integrated steel works and its subjects for a future study, *ISIJ Int*., **45** (2005) 1371–1378.
10. Matheickal J.T., Yu Q., Bio-sorption of lead from aqueous solutions by marine algae Ecklonia radiate, *Water Sci. Technol.,* **34** (1996) 1–7.
11. S, D., & H, A. (2019). AODV Route Discovery and Route Maintenance in MANETs. 2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS). doi:10.1109/icaccs.2019.8728456
12. H. Anandakumar and K. Umamaheswari, An Efficient Optimized Handover in Cognitive Radio Networks using Cooperative Spectrum Sensing, Intelligent Automation & Soft Computing, pp. 1–8, Sep. 2017. doi:10.1080/10798587.2017.1364931
13. Ho Y.S., Review of second-order models for adsorption systems, J. Hazard. Mater., 36 (2006) 681-689.
14. Davis T.A., Volesky B., Mucci A., A review of the bio-chemistry of heavy metal bio-sorption by brown algae, *Water Res*. **37** (2003) 4331-4330.
15. Pearse C.I., Lloyd J.R., Guthrie J.T., The removal of colour from textile waste water using whole bacterial cells: a review*, Dyes Pigments*, **58** (2003) 179-196.
16. Baral S.S., Das N., Chaudhary R.G., Das S.N., A preliminary study on the adsorptive removal of Cr(VI) using seaweed, Hydrilla Verticillata, *J. Hazard. Mater*, **171** (2009) 358-369.

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2

Evaluation and Impacts of Minimum Energy Performance Standards of Electrical Motors in India

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Abstract

The demand for electricity is rapidly increasing, posing a significant challenge to the entire power industry in meeting the unprecedented demand. The inefficiency of the low-quality motors leads to increased electric power consumption and the associated energy cost. As a result, improving the motor's efficiency must be a component of any overall energy saving strategy. Induction motors are widely employed as driving power in most industries, accounting for over 65% of total power utilization. These motors' energy-efficient design saves a lot of energy and lowers operating costs. The majority of energy consumed in industries is used to power various motors, which consumes a considerable amount of energy that may be greatly decreased by replacing the normal motor with a high efficiency motor. The goal of this study is to shed light on India's existing Minimum Energy Performance Standards (MEPS) for asynchronous motors by applying IS 12615: 2018, which is founded on the International Test Standard IEC 60034-2-1. This document also looks at the Indian government's energy-saving programs, such as the National Motor Replacement Program (NMRP), as well as the challenges that must be addressed and the path forward to implement this mission.

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A Study on Energy Efficiency of Agriculture Pumpsets in India

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Abstract: **In India, there is an increasing demand for electrical energy to meet irrigation needs. Many states electrical utilities have been experiencing severe power outages, causing farmers to become dissatisfied. It has been observed that underground water levels have dropped dramatically over the last few decades, while cultivated land has increased due to forest clearing. As a result, demand for electrical energy for irrigation is increasing. Agriculture receives free electricity in many Indian states. So, despite the fact that there is a lot of savings potential in pump sets, the poor farmer has no interest in replacing inefficient pump sets, incorporating capacitors, or spending money on existing pump sets other than rewinding burnout motors, etc. Subsidized or free power greatly encourages this mindset to choose a slightly more expensive efficient pump set. This paper examines the various factors that can impact a pump set's efficiency, as well as initiatives undertaken by the Indian government to improve energy efficiency in the agricultural sector. The article also discusses obstacles/difficulties encountered while replacing inefficient pump sets with energy efficient pump sets, as well as policy recommendations for improving overall efficiency in this sector.**

Keywords: Energy Efficiency, Agriculture pumps, Energy Consumption, BEE-initiatives

I. INTRODUCTION

In 2020, agriculture data was reported as 228,172.000 GWh. This is up from the previous year's total of 213,409.000 GWh. Agriculture data is updated on an annual basis, with an average of 80,487.000 GWh from March 1971 to March 2020,based on fifty observations. The statistics peaked at 228,172.000 GWh in 2020 and a low of 4,470.000 GWh in 1971.Agriculture data is still active in the Census Economic Information Center (CEIC) and is reported by the Central Statistics Office. There are approximately 21 million network- connected agricultural pump systems in India, consuming about 187 billion units of energy annually, representing approximately 18 percentage of the total energy consumption in the country. Between (2.5 – 5) lakh new pump sets are installed every year. The pumping industry is predicted to consume a huge amount of energy by 2022. India's power companies are having a hard time managing agricultural load. Unfortunately, these pump sets have a dismally poor end-use efficiency. Two factors for inefficient power use in the farm sector are the heavily subsidized or free power accessible to farmers, and a large part of it is not metered. Second factor is the reluctance of loss-ridden State utilities to act. Agricultural consumers contribute very little to utility revenue due to subsidized tariffs. Farmers who pay flat rates based on HP regardless of their electricity usage perceive zero marginal cost for electricity use and, which provide no incentive for farmers to put money into more expensive, more efficient pump sets. Because of their minimum cost, inefficient pumps, the existing pumps utilized in agriculture are inefficient in terms of energy efficiency. As a result, each state's yearly subsidy expenditure has risen to over Rs.65,000 crore per year. According to the literature, the current average overall efficiency of pumps in the agricultural sector is estimated to be between 25 and 40 percent. The usage of low- quality pumps has been highlighted as one of the key causes of poor operational performance in the agricultural pumping segment. According to statistics, using Energy Efficient pump sets in the agriculture industry can save between 30 and 40 percent of energy. As a result, upgrading existing pumping systems is an immediate need, and it should be given top priority. The implementation of this task is critical because thegovernment pays the energy bills for agricultural pump sets through subsidies. As a result, energy savings benefit the government and Distribution Company (DlSCOM) directly [1]. This paper will thoroughly examine the various factors that affect the performance and thus the efficiency of pump sets, as well as the policy level recommendations to improve the overall efficiency of pump-sets.

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II. AFFECTIVE FACTORS ON THE PERFORMANCE OF PUMP SET'S

There are numerous parameters that can influence the performance of the pump set's efficiency. The parameters that have been identified as potentially influencing pump performance are a) Pump sets that consume a lot of energy b) Ineffective choice and usage of pumps c) Pipes that are not sized correctly d) Variations in suction head and long discharge lengths e) Low voltage profile f) Motor rewinding g) Variations in water tables h) Discharge Pipe Selection and i) Many additional causal elements that occur often [2-10].

a) *Pump sets that consume a lot of energy:* Because of a short of information about kWh consumption and a cheap tariff system for the formers, consumers will choose low-cost, locally manufactured pumps. This situation creates a large market for low-quality pumps.

b) *Ineffective choice and usage of pumps:* Due to lack of understanding of pump selection and pump operation technology of farmers, results in inefficient operations and energy waste. The efficiencies of the pump sets are less than optimal because they do not operate in the high-efficiency flow and head span. This is due to the pump's ability to handle a wide range of suction and discharge heads.

c) *Pipes that aren't sized correctly:* The efficacy of a pumping system is determined by the effectiveness of the system components and the efficiency of the piping. Another critical issue affecting the overall efficiency is pipe sizing, which is inversely proportional to pipe diameter and frictional loss. Undersized pipes in the system save money during erection but increase head loss. Although a bigger pipe diameter lowers frictional loss, it increases the initial investment and energy consumption. The pump's operating curve will be affected if the pipe diameter is not properly selected.

d) *Variations in suction head and long discharge lengths:* The suction head changes with the seasons. Seasonal variations are more significant than annual water level reduction. To avoid mud from clogging the pump, the manufacturer recommends placing it 20 feet away from the bore well's total depth. The length of the discharge pipe is more important. Farmers extend the discharge pipe to satisfy their needs without taking into account the result on pump competence. The pipe ought to be large enough and made of the right material to minimize friction loss.

e) *Low voltage profile*: The efficiency of a pump set is also affected by the voltage applied to it. Motor burnouts are common as a result of a lack of power, resulting in several hours of downtime for maintenance and repair. So, agricultural pump motors are always designed for a wide voltage range. We can greatly enhance pump set competence and comprehend energy conservation by completely adopting the high voltage distribution System, which improves power quality in terms of frequency and supply voltage.

f) *Motor rewinding:* Rewinding burnt-out motors is a common occurrence. Rewinding with care can sometimes restore motor efficiency, but we won't get back to the original efficiency level in most circumstances. However, if sufficient safeguards are taken after rewinding, efficacy of the machine could be preserved, and in certain cases, improved.

g) *Variations in water tables:* The efficiency of all existing agriculture pump sets will be severely influenced by the shift in water table. In terms of total pump-set efficiency, selecting pump sets based on water levels/head is crucial. The graph shown in Fig.1 depicts a Head Vs Efficiency range for a 3-kW submersible pump. According to the graph, the pump efficiency is highest (75%) at water levels/heads between 22 m and 26 m. The efficiency on the graph represents the pump's efficiency, not the submersible pump's overall efficiency. The overall efficiency is calculated by multiplying it by the motor efficiency.

h) *Discharge Pipe Selection:* In order to reduce pressure, fall and pipe resist, it is always cheaper to use a Polyvinyl chloride pipe with a diameter one size greater than the pump discharge size. Choose a pipe diameter that can sustain a water velocity of 3 - 5 feet per second as a general rule.

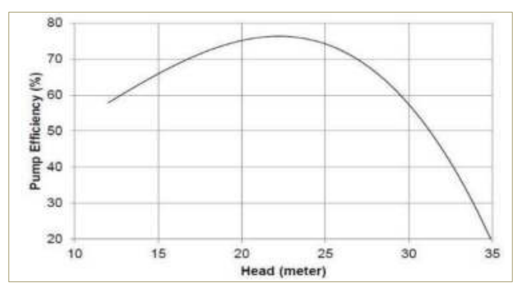

Fig 1: Change in efficiency as a function of watertable

i) *Many additional causal elements that occur often:* Aside from the aforementioned factors, there are a slew of additional that might affect the pump set's efficiency. The following are some of the most prevalent reasons for poor performance and how to fix them:

- Improper performance is also caused by faulty impellers: Three common causes of impeller damage are cavitation (the boiling of pumped water at a low temperature), sand

A Review of Indian Scenario on Energy Conservation in Ceiling Fans Powered by BLDC Motors

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***Abstract*-In 2016, the residential sector consumed 24 percent of total electricity in India. This figure is predicted to more than eightfold by 2050, attributable mostly to appliances and equipment's. Ceiling fans are one of the appliances responsible for this exponential increase in electrical usage. Ceiling fan demand has been rapidly expanding due to a number of causes, including improved access to power and greater disposable income. India produced roughly 40 million ceiling fans in 2015, representing 10% year-on-year increase. This article gives an overview of the energy conservation opportunities in ceiling fans that can be realized by replacing the conventional single phase induction motor with an energy efficient Brushless Direct Current Motor (BLDC Motor). The payback period of a BLDC ceiling fan was compared to that of a traditional ceiling fan. This study also discusses the Indian government's energy conservation programmes, notably the Standards & Labeling programme launched by the Bureau of Energy Efficiency (BEE) for ceiling fans**

Keywords: Energy conservation, Ceiling fan, Induction motor, BLDC motor, BEE-Star rating

I. INTRODUCTION

The Ministry of Power reports that India's electricity consumption increased by 0.88 percent in February 2021 to 104.73 billion units up from 103.81 billion units in February 2020 [1].The predicted power usage increased by 6.74 percent from 2010-11 to 2019-20, from 6, 94,392 GWh to 12, 91,494 GWh. Industry consumed the most electricity (42.69%) in 2019-20(P), followed by domestic (24.01%), agriculture (17.67%), and commercial sectors (8.04%) [2]. Residential electricity consumption is expected to rise from 259 TWh in 2016-2017 to 533 TWh in 2027 [3-4], putting strain on energy supplies and increasing GHG emissions. Demand for ceiling fans is increasing as the housing sector expands, particularly in developing countries. The governments of several growing countries have established a goal of supplying power to distant rural areas, which would likely influence ceiling fan demand in the near future. For example, the Government of India recently proposed developing 100 smart cities that would generate at least 5 million new homes in order to address overcrowding issues and relieve pressure on existing metros. These initiatives will help to strengthen the real estate, hospitality, and retail sectors, which will augur well for the electric fan business. By 2030, the urban population is expected to reach 38.9 percent [5].

In India, fans are the second most prevalent item in households after lighting and are a low-cost technique of providing thermal comfort for all. While most people focus on lights when considering electricity savings, fans contribute significantly extra to electricity expenses, accounting for up to 30-40% of total electricity bills. In contrast to lights that are only turned on in the evening, ceiling fans are on most of the day and even at night. In addition, ceiling fans use more energy than tube lights. The Bureau of Energy Efficiency (BEE) star rating method of the Indian government includes ceiling fans for this reason. Ceiling fans with energy-efficient AC induction motors that are 5-star rated by the Indian government use roughly 50 watts, compared to 70-75 watts for fans that do not have a star certification. Super-efficient ceiling fans have huge potential energy savings for consumers seeking smart solutions in a tropical country like India, where household appliances are used continually throughout the year. The 32W ceiling fan with an energy-efficient Brushless Direct Current Motor (BLDC) saves 50 % more energy than a traditional 75W fan, setting a new standard in the segment. The fans built on the BLDC platform provide a number of advantages over traditional motor-based fans, including reduced wear and tear, reduced electromagnetic interference, noiseless operation, increased efficiency, better dependability and a longer lifespan. The importance and benefits of BLDC motors used in ceiling fans have already been adequately documented. Despite this, the paper provides an in-depth examination of the electrical motors used in ceiling fans, as well as energy conservation prospects in ceiling fans using BLDC motors rather than other motors, in conjunction with Indian government's most recent legislation to improve ceilingfan energy efficiency.

II. A REVIEW OF ELECTRIC MOTORS USED IN CEILING FANS

Ceiling fans rely on electric motors for their operation. The two types of motors utilized in ceiling fan applications are AC induction motors (ACIM) and Brushless DC Motors (BLDC). BLDC motors are used in highly energy efficient ceiling fans, whilst ACIM motors are used in regular fans. The operation of both the fans will be discussed in the following sections.

A. AC Induction Motors:

1) Operation: A starting or auxiliary winding, situated electrically 90 degrees apart from the main winding and coupled to a running capacitor, is used to make a ceiling fan self-start. Both windings are parallelly connected. Fig. 1 depicts a terminal with a winding supply. A capacitor is used in the circuit ensures that I_M and I_A are 90° out of phase with each other (ideal case), allowing for the creation of a revolving or rotating magnetizing flux. When a supply is provided, a rotating flux is established in the stator, which rotates at synchronous speed N_S and is given by $N_S = (120*f) / P$. Where f denotes the frequency of supply and P denotes the number of poles. Due to induction, this flux generates a voltage in the rotor. Because this rotor is initially stationary, torque is created, causing the rotor to revolve and the rotor speed to increase. The direction of rotation is same as the direction of the rotating flux. $T \alpha SV^2$ represents the torque developed. Where S denotes the slip speed and V denotes the supply voltage. This Torque is now proportional to voltage squared. As a result, the fan's speed can be adjusted by varying the voltage supply across it. The mechanical force of the motor efficiently utilizes the law of aerodynamic with the help of blades on a ceiling fan, which is attached to the housing of the rotor. As the blades rotate anticlockwise, the air moves downward. The curvature of the fan blade collides with the air particles and pushes them downward as it rotates [6-7].The circuit diagram of 1- phase induction motor shown in Fig.1.

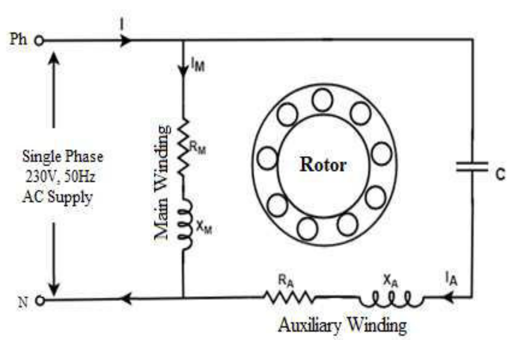

Fig.1: Permanent Capacitor type 1-Phase Cage Induction Motor

2) Fan Regulator: The amount of power required is determined by the motor's speed. The motion of the ceiling fan can be governed by a regulator. With the help of a regulator, the voltage can be regulated. The applied voltage can be varied to change the fan's speed. There are four different kinds of Fan Regulator: i) Resistive regulators ii) Electronic regulators (or) Phase angle controlled regulators, iii) Inductive type regulators, and iv) Capacitive type regulators.

i). Resistive regulators: This is the most commonly used ceiling fan in homes. It functions by offering several taps on a wire wound resistor linked in series with the fan. It is a cost effective method. Keeping the resistor at slot 1 would allow the fan to move slowly and the remaining energy consumed in the form of electrical energy got wasted and hence there was no saving of power in terms of electrical energy. Energy consumption was not a dependent upon the changing of resistors. This technology has several disadvantages, including high I^2R loss as heat, especially at low speeds, making it unproductive and using a lot of energy [8].

ii). Electronic regulators: Electronic fan controllers are not the same as resistance or contemporary capacitor controllers. They use triacs and diacs to cut the AC waveform on both sides of polarity in each cycle, lowering effective voltage across the fan.

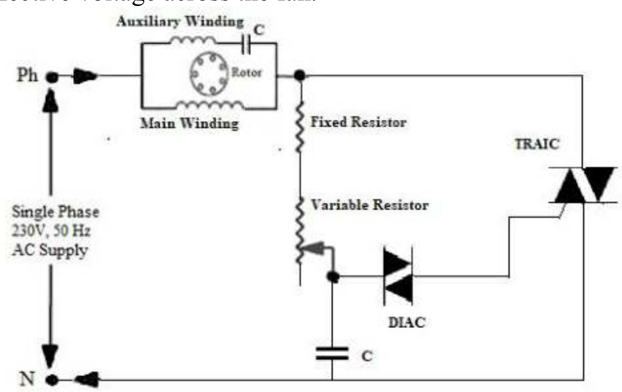

Fig. 2: Electronic regulators

Variable resistance is used to change the chopping angle, and this can be done repeatedly throughout the cycle. As a result, speed is changed by moving the knob in a step less fashion. The circuit diagram for an electronic fan regulator is shown in Fig. 2. The consumption in the regulator is minimal in electronic type of regulators compared to resistive regulators and using them definitely saves electrical energy in reduced speed mode of a fan but they are more expensive.

In fact, there is a significant saving of about 30-40% from full speed to minimum speed. The speed control in these types of regulators is not linear; they produce a humming noise while in operation. Because active devices are sensitive to power supply transients, failure rates are high. EMI/RFI interference in these regulators causes disruptions in televisions and radios [9].

iii). Inductive type regulators: The winding of the transformer is tapped on an inductive type fan regulator, and the inductive reactance (X_L) is changed to accomplish speed

4th International Conference on Trends in Material Science and Inventive Materials ICTMIM 2022

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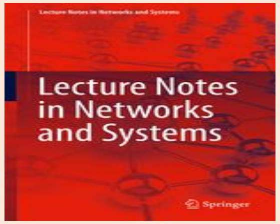

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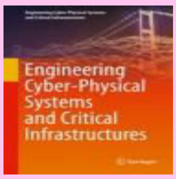

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