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Removal of Acid Blue 80 using Industrial Waste Carbon

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Abstract: ***Industrial Waste colors are produced from material ventures, piece of clothing processing plants, and tanneries and these colors end up in streams and lakes around the businesses. They will at that point seriously harm the oceanic life and agribusiness in the zones where they're released. It is critical to discover proficient techniques for treatment for such squanders. For our analyses we have chosen the color: Acid Blue-80. There is a lot of carbon squander that gets produced from businesses consistently. This carbon waste makes a great deal of damage nature without anyone else's input. Hence, we have used this carbon waste to treat the mechanical waste color, so as to make an effective and efficient strategy for treatment. For our analyses, we have chosen carbon squander from the manufacturing enterprises. The technique for treatment that we have chosen is initiated carbon adsorption. The carbon has less surface territory and less adsorption properties, so we have utilized ball processing so as to set it up for the treatment. We have decided the auxiliary attributes of the processed example by utilizing X-beam diffraction. We have led adsorption isothermal and pH thinks about on the adsorbent.***

Index Terms: ***Industrial Waste, Acid Blue-80, carbon waste, X-ray diffraction. .***

I. INTRODUCTION

Industrial Waste is a tremendous inconvenience to our nation. Mechanical strong waste methods strong waste created by assembling or modern procedures that is definitely not a perilous waste managed under caption C of RCRA. Such waste may incorporate, yet isn't constrained to, squander coming about because of the accompanying assembling forms: electric power age; manure/farming synthetic substances; nourishment and related items/side-effects; inorganic synthetic concoctions; iron and steel fabricating; cowhide and calfskin items; nonferrous metals producing/foundries; natural synthetic compounds; plastics and gums producing; mash and paper industry; elastic and transportation hardware; and water treatment The essential factor behind air contamination is smoke from production lines. Harmful substances like Carbon-monoxide are discharged into the air with this smoke. Block furnaces are responsible for both deforestation and air contamination from the smoke. People and different creatures alike are under overwhelming danger because of air contamination. Expanded industrialization has brought about expanded spontaneous urbanization. One of the biggest elements worsening an unnatural weather change is modern manufacturing plants. In this way, the environmental change impact is quick sending and floods, tornados, waves and so forth have all expanded in number and quality because of environmental change. Mechanical Waste Carbon and Industrial color squanders are two such squanders that hugy affect nature. There is a ton of carbon squander that is being made by Industries it has no utilization and regularly makes mischief to the earth independent from anyone else. On the off chance that we can use the carbon waste produced in these enterprises, explicitly the Forging Industries, to treat the effluents made by another segment then we can incredibly limit our expenses and make a successful and effective technique for treating nature. Squanders released from processing plants are additionally contaminating our streams and other water bodies with synthetic substances. Colors from pieces of clothing processing plants and waste from tanneries land in the waterways. Because of these harmful synthetic substances, the significant casualties of water contamination are creatures of land and water and dolphins. A lot of creatures of land and water that chase creepy crawlies inside our farmlands are ceasing to exist. Because for this, few types of fish and oceanic plants are imperiled today. A lot of significant plants are vanishing a direct result of dangerous synthetic compounds inside the water. This damages the creatures subject to these plants. Fishes lose their reproducing grounds and damage the general environment. This dangerous water is likewise included our farmlands by water system and this is the reason, the harmful synthetic substances are advancing into our nourishment and cause illnesses. Now and again, woodlands are chopped directly down to make space for these processing plants. This has caused living space misfortune for a great deal of creatures. Modern colours can without much of a stretch foul wastewater treatment frameworks. Colours by their inclination are exceptionally thought and exceedingly receptive, which can even for all time harm the wrong filtration forms. There are explicit strategies to expel colors, yet they shift contingent upon the precise profile of the different colors to be evacuated.

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Normally, this is a wide pre-treatment framework to make the wastewater reasonable for the standard framework. Here is a precedent: suppose that one of the colors being referred to is a profoundly thought and responsive natural color. The initial step may be to include the right natural coagulant, pursued next by an oxidation specialist. Hence treated the water must be painstakingly observed to be prepared for the customary wastewater treatment. On account of the unsafe impacts mechanical waste has on the earth, it is important to regard them as effectively as could reasonably be expected. One such effective way that we are trying is: treating modern color waste utilizing initiating enacted carbon which is additionally another type of mechanical waste. In this manner we can use a modern waste to evacuate another mechanical waste. The strategy we have decided for the treatment is enacted carbon adsorption. Enacted carbon (or here and there known as dynamic carbon) is an adsorption procedure utilized in both water and wastewater treatment applications. Adsorption procedures are regularly utilized in civil drinking water treatment to evacuate engineered natural mixes (SOCs), taste and smell causing, shading shaping organics, and sanitization side-effect (DBP) forerunners. Mechanical waste streams regularly contain numerous contaminations, for example, disintegrated and undissolved substances, effectively degradable or determined natural substances, overwhelming metals, and salts. Initiated carbon dispenses with these undesirable substances and is regularly utilized in a last treatment venture as a last 'clean.' The material which we have acquired from the fashioning business: carbon, has exceptionally low surface region and does not have any adsorption qualities. In this way, so as to make it as an adsorbent, we have to enact the carbon utilizing some physical or synthetic procedures. The procedures which we have picked are the physical procedures of warming, drying, and ball processing the carbon. Ball milling is a granulating strategy that toils nanotubes into very fine powders. During the ball processing process, the impact between the modest unbending balls in a disguised holder will produce restricted high weight. Generally, fired, rock stones and treated steel are utilized. So as to further improve the nature of scattering and present practical gatherings onto the nanotube surface, chose synthetics can be incorporated into the holder during the procedure. The variables that influence the nature of scattering incorporate the processing time, rotational speed, size of balls and balls/nanotube sum proportion. Under certain preparing conditions, the particles can be ground to as little as 100 nm. The subsequent carbon test which we get from ball processing is tried utilizing the diffraction procedure to see if it is appropriate for adsorption. The diffraction which we utilized is X-Ray diffraction. The wavelength of x-beams is a lot littler than that of noticeable light. Unmistakable light goes from about 400nm to 700nm (nm, nanometer, is 10−9m10−9m) while x-beams go from 1nm to 0.01nm, a lot littler. Examining the diffraction of x-beams gives profound data about the nuclear structure of issue and, along these lines, is an extremely valuable apparatus for a wide scope of examinations. UV-Vis Spectroscopy is utilized in quantitative examination to decide the obscure convergences of a given example. It is fundamental so as to check the effectiveness of the adsorbent used to treat the color squander. UV-Vis is frequently called a general method in light of the fact that most atoms will assimilate in the UV-Vis wavelength run. The UV stretches out from 100–400 nm and the obvious

II. LITERATURE REVIEW

A . Activated Carbon Adsorption:

Initiated carbon is a type of carbon which has little molecule size and low volume pores which increment the surface region accessible for adsorption. For the most part, the surface territory of actuated carbon is about 3000m2/gm. The carbon which we got from manufacturing industry is in mass structure and we needed to enact it utilizing different methods which incorporate Ball processing and warming. Physical adsorption is the essential methods by which actuated carbon attempts to expel contaminants from fluid or vapor streams. Carbon's enormous surface zone per unit weight takes into consideration contaminants to hold fast to the initiated carbon media. The tremendous inside surface locale of carbon has a couple of appealing forces that work to attract various particles. These forces appear thusly as gravitational power; in like manner, contaminants in water are adsorbed (or pursued) to the outside of carbon from an answer on account of differentiations in adsorbate concentration in the game plan and in the carbon pores. Physical adsorption occurs in light of the way that all particles apply charming forces, especially molecules at the outside of a solid (pore dividers of carbon), and these surface iotas attempt to hold quick to various molecules. The broke up adsorbate moves from the course of action through the pore channels to accomplish the area where the most grounded engaging forces are found. Contaminants adsorb in light of the way that the interest of the carbon surface for them is more grounded than the engaging forces that keep them separated in game plan. Those exacerbates that display this inclination to adsorb can do as such when there is sufficient vitality on the outside of the carbon to beat the vitality expected to adsorb the contaminant. Contaminants that are natural, have high atomic loads, and are unbiased, or non-polar, in their compound nature are promptly adsorbed on actuated carbon. For water adsorbates to turn out to be physically adsorbed onto enacted carbon, the two of them must be broken down in water with the goal that they are littler than the proportion of the carbon pore openings and can experience the carbon pores and total. Other than physical adsorption, blend reactions can occur on a carbon surface. One such reaction is chlorine removal from water including the compound reaction of chlorine with carbon to shape chloride particle particles.

B. Acid Blue 80:

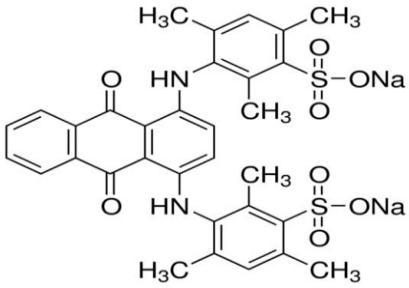

Fig 1: Structure of acid blue 80

Table 1 Physical properties of acid blue 80

Formula	$C_{32}H_{28}N_2Na_2O_8S_2$
Exact Mass	678.108 g/mol
Molecular mass	678.682g/mol
Color	Dark Blue
Nature	Solid

C. Ball Milling:

Ball Milling is a technique for creation of Nanomaterials. This procedure is utilized in delivering metallic and earthenware Nanomaterials. It very well may be utilized to make Carbon Nanotubes. It wears down the rule of impact and unfaltering misfortune: measure decline is done by impact as the balls drop from near the most elevated purpose of the shell. Different granulating applications have exceptional necessities. A portion of these necessities are since a portion of the devastating media will be in the finished thing. Others are arranged in how the media will react with the material being ground. Low defilement is significant, so the crushing media might be chosen for simplicity of division from the completed item (for example steel residue created from tempered steel media can be attractively isolated from non-ferrous items). An option in contrast to division is to utilize media of a similar material as the item being ground. Combustible items will in general become hazardous in powder structure. Steel media may start, turning into a start hotspot for these items. Either wet-pounding, or non-starting media, for example, earthenware or lead must be chosen. A few media, for example, iron, may respond with destructive materials. Thus, tempered steel, fired, and stone crushing media may each be utilized when destructive substances are available during pounding. There are a few metals which can be considered "the most grounded". Obviously, this depends significantly on the expected utilization of the metal. Another thought is the different composites that can be shaped with each metal. Steel, Titanium, Tungsten, Inconel are said to be most grounded metals for processing.

D. UV Spectroscopy:

Brilliant and self-evident (UV-Vis) spectroscopy is the estimation of the reducing of a light outflow after it experiences a model or after reflection from a precedent surface. Osmosis estimations can be at a singular wavelength or over a comprehensive powerful range. It is commonly used strategy in Analytical science for the Quantitative confirmation of different analytes. The standard connected with it is at whatever point a light emanation light is experienced an answer with an immersing substance, the decreasing rate of the radiation power close by the thickness of the holding course of action is relating to the gathering of the game plan and the event radiation.

E. X-Ray Diffraction:

X-beam crystallography is a technique used for choosing the atomic and sub-nuclear structure of a valuable stone, in which the crystalline structure causes a light outflow X-beam to diffract into various specific course. It relies upon the twofold wave/particle nature of X-beam to gain information about the structure of crystalline materials. A fundamental usage of the technique is the distinctive confirmation and depiction of blends subject to their diffraction structure.

The staggering effect that happens when a scene light emanation X-beam coordinates with a target material is scattering of those X-beam from atoms inside the goal material. In materials with standard structure (for instance crystalline), the dispersed X-beams experience supportive and risky impedance. This is the method of diffraction. The diffraction of X-beams by valuable stones is depicted by Bragg's Law, $n\lambda=2d\sin\theta$. The orientation of potential diffractions depend upon the size and condition of the unit cell of the material. The powers of the diffracted waves depend upon the sort and strategy of particles in the valuable stone structure. Regardless, most materials are not single jewels, yet are made out of various minor crystallites each possible way called a polycrystalline aggregate or powder. Exactly when a powder with discretionarily arranged crystallites is set in a X-beam bar, the bar will see all possible interatomic planes. In case the exploratory edge is efficiently changed, all possible diffraction tops from the powder will be perceived. The Para focusing (or Bragg-Brentano) diffractometer is the most generally perceived geometry for diffraction instruments. This geometry offers the upsides of high objectives and high bar power examination to the detriment of outstandingly accurate game plan necessities and intentionally masterminded models. Likewise, this geometry requires that the source-to-test detachment be enduring and comparable to the guide to-marker expel. Course of action bungles much of the time lead to inconveniences in stage separating evidence and stupid estimation. A mis-arranged model can incite unacceptable precedent expulsion botches. Test levelness, brutality, and arranging goals obstruct in-line test estimation. Besides, standard XRD systems are as often as possible established on monstrous equipment with high power essentials similarly as using amazing X-beam sources to grow X-beam movement on the precedent, in this way extending the recognized diffraction signals from the model. These sources furthermore have gigantic excitation districts, which are every now and again disadvantageous for the diffraction examination of little precedents or little model features. X-ray diffraction utilizing X-ray optics has been connected to a wide range of kinds of utilizations including dainty film examination, test surface assessment, checking of crystalline stage and structure, and examination of test anxiety

F. Adsorption:

Adsorption is the hold of iota's, particles or iotas from a gas, liquid or separated solid to a surface. This technique makes a film of the adsorbate outwardly of the adsorbent. It alludes to gathering of atoms by the outside surface or inside surface (dividers of vessels or hole) of solids or by the outside of fluids. Adsorption can be either physical or synthetic in nature. Initiated Carbon is generally utilized adsorbent due to it's high porosity and non-polar nature Adsorption is accessible in various normal, physical, common and substance structures and is comprehensively used in present day applications, for instance, heterogeneous catalysts, started charcoal, getting and using waste warmth to give cold water to cooling and distinctive methodology requirements (adsorption chillers), designed saps, growing limit cutoff of carbide-decided carbons and water cleansing.

Adsorption, molecule exchange and chromatography are sorption frames in which certain adsorbates are explicitly moved from the fluid stage to the outside of insoluble, unbendable particles suspended in a vessel or stuffed in a portion. Pharmaceutical industry applications, which use adsorption as an approach to attract out neurological introduction to express prescriptions.

III. MATERIALS & METHODOLOGY

A, Materials used:

Various materials used in our paper include Industrial waste, carbon Acid blue 80, Toluene, ethanol etc, UV spectrometer, X-ray Diffractor, and Ball mill. A Ball plant comprises of an empty round and hollow shell pivoting about its hub. The pivot of the shell might be either level or at a little edge to the flat. It is somewhat loaded up with balls. The granulating media is the balls, which might be made of steel (chrome steel), treated steel, clay, Tungsten or elastic. The internal surface of the tube shaped shell is normally fixed with a scraped area safe material, for example, manganese steel or elastic. The length of the plant is roughly equivalent to its width

Fig 1: Ball Mill and Zirconium Container

A. UV Spectroscopy:

The instrument utilized in bright noticeable spectroscopy is known as an UV/Vis spectrophotometer. It gauges the force of light going through an example (I) and looks at it to the power of light before it goes through the example (I0). The proportion (I/I0) is called transmittance which is communicated as (%T). The Absorbance (An) is determined dependent on Transmittance.

$$A = \log_{10}(I_0/I) = \varepsilon c L,$$

Where ε is a steady known as the molar absorptivity or termination coefficient, L is the way length through the example and c is the centralization of the engrossing species.

Fig 2. Schematic view of UV Spectrometer

B. Adsorption:

Adsorption is characterized as the testimony of atomic species onto the surface. The atomic species that gets adsorbed superficially is known as adsorbate and the surface on which adsorption happens is known as adsorbent. Normal instances of adsorbents are dirt, silica gel, colloids, metals and so forth.

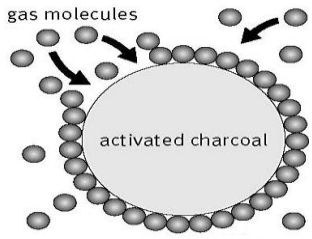

Fig 3. Figure showing adsorption process

C. Adsorption Isotherms

The procedure of Adsorption is generally contemplated through diagrams know as adsorption isotherm. It is the chart between the measures of adsorbate (x) adsorbed on the outside of adsorbent (m) and weight at steady temperature. Distinctive adsorption isotherms have been Freundlich, Langmuir hypothesis.

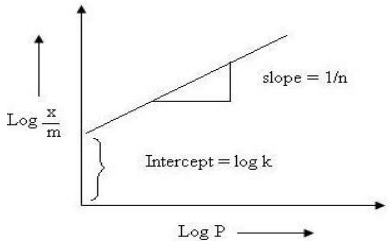

Fig 4: Freundlich Isotherm

IV. EXPERIMENTS & SPECIFICATIONS

In this paper we are going to include the details of all equipment which we have used along with their specifications and the procedure regarding operation of those equipment. Various equipment we used for project includes Ball mill, UV spectrometer, X-ray diffractometer and Adsorption related apparatus.

A. Milling:

Ball milling is a technique used to reduce the particle size of a particular material. The equipment which we used for our project belongs to Mechanical Engineering department, Nit Warangal. The capacity of the equipment which we used is 5kgs. We have gone for wet milling since our material have explosive character. Following are the details of our experiments

Table. 2 Specifications used in Ball milling

Type of milling	Wet milling
Balls used	Tungsten
Ball to Material ratio	10:1 (not required for wet milling)

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Medium used	Toluene (helps to lower the surface energy of the particles)
Type of container	Zirconium
Mass of balls + Material	35 g (approx)
Speed	400rpm
Duration	Different time periods (2hr, 4hr, 7hr, 10hr)
Diameter of balls	3mm

B. X-ray Diffraction:

X-ray diffraction is now a common technique for the study of crystal structures and atomic spacing. X-ray diffraction is based on constructive interference of monochromatic X-rays and a crystalline sample. These X-rays are generated by a cathode ray tube, filtered to produce monochromatic radiation, collimated to concentrate, and directed toward the sample.

Table .3: Specifications used in XRD

Anode material	Copper (Cu)
Ratio K-Alpha2/K-Alpha1	0.5
Divergence slit	Fixed
Monochromator usage	No
Scan Axis	Gonio
Scan step size	0.0083556
Scan Type	Continuous
No.of Points	10054

C. UV Spectrometer:

UV analysis is a simple experiment which is used to determine the unknown concentration of a given sample. Whenever we go for adsorption, we need to get the concentrations of various samples before and after adsorption in order to determine the efficiency of Adsorbent. And for this purpose, we will go for UV analysis. We have used UV spectrometer form CAI building and Biotechnology department for our experimental purpose. Whenever we need to do UV analysis, we need to calibrate the results. Firstly we need to determine the Standard Curve equation of a given sample by preparing samples of known concentrations and determining their absorbance values. We need to establish a graphical relationship between the concentration and absorbance values so that we can easily interpolate the concentration for any value of absorbance.

V. RESULTS & DISCUSSION

In this chapter we are going to present all the results we have obtained in our project and interpretation of data which we got, the inferences which we infer from results etc.

Standard Curve equation for Acid blue 80:

In order to determine unknown concentration, we need to determine standard curve first. The UV analysis of acid blue 80 has given the following results:

Table 4: Absorbance of Acid blue 80 for various concentrations

Concentration(ppm)	Absorbance
5	0.241
10	0.269
15	0.285
20	0.299

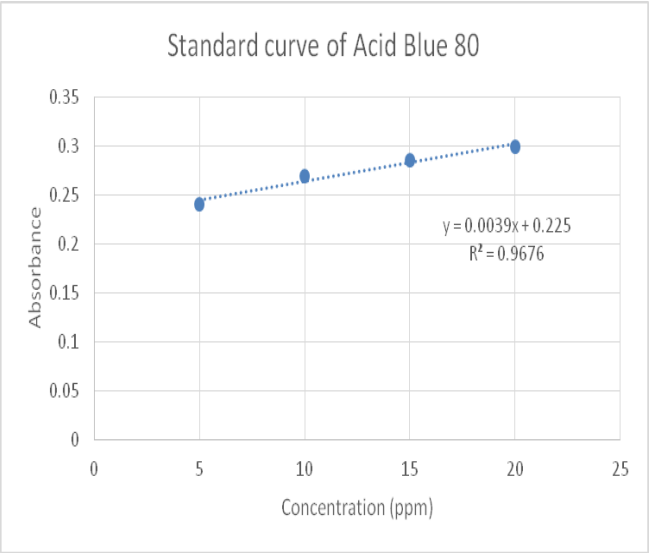

Fig 5: Graph showing the standard curve equation of Acid blue 80

From the graph the standard equation of concentration curve is $y = 0.0039x + 0.225$

where y - Absorbance value of sample and x - Concentration of sample(ppm)

We can also infer that the value of regression coefficient is very close to 1 indicating the accuracy of UV analysis done.

X-ray Diffraction: X-beam diffraction is utilized to decide crystalline structure of a material. Though the results are very complex, perfect analysis gives an idea about the crystalline size and structure of material

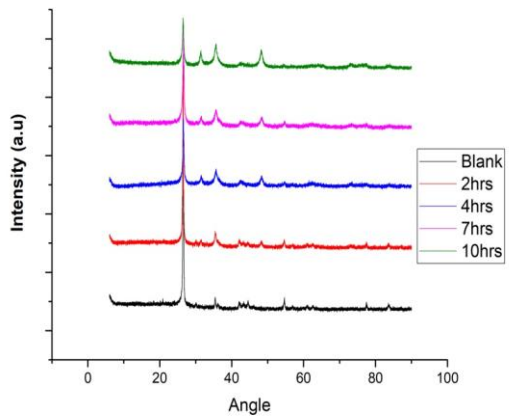

Fig 6: Results of XRD analysis

Adsorption Studies:

Adsorption studies are carried out using activated carbon as adsorbent and acid blu 80 as an adsorbate and the results are tabulated according to the variables

Equilibrium concentration is defined as the concentration beyond which no adsorption tales place significantly. From the experiments we have done, we have concluded that a time period of 180 minutes is enough to attain equilibrium for various concentrations of adsorbate.

Hence adsorption studies are carried out for a duration of 3 hours (expect for pH studies where we found a time of 2 hours is enough).

Case 1. Effect of varying dosage of Adsorbent on Adsorption:

Experiments are carried out with varying dosage of adsorbent keeping the concentration of adsorbate as 15ppm(approx.) . Experiment lasted for 3 hours at a constant pH of 7 and samples are taken for study at various intervals each and the results obtained are as follows

Table 5: Table showing the effect of varying dosage of adsorbent on adsorption

Time (min)	Dosage of adsorbent (g/lit)				
	0.21 g/lit	0.28 g/lit	0.35 g/lit	0.42 g/lit	0.49 g/lit
0	15.164	15.164	15.164	15.164	15.164
30	10.974	11.453	8.212	5.106	6.160
60	9.525	5.541	6.503	3.925	4.751
120	6.549	6.870	4.468	9.076	7.252
180	5.557	7.637	5.234	6.069	6.313

Graphs are drawn for the above mentioned data so as to think about the impact of expanding measurement of adsorbent on adsorption. We The graphs obtained, though differ slightly from the standard ones are as follows

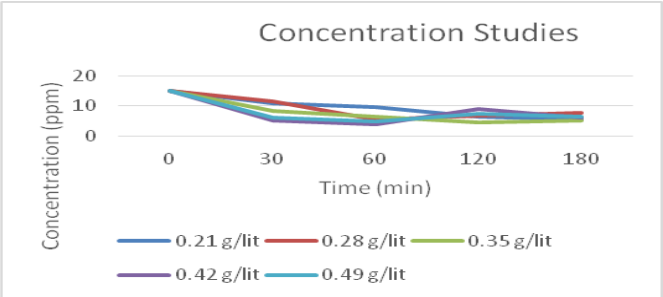

Fig 7: Plot of Concentration v/s Time with varying adsorbent dosage

Graphs are drawn for the values obtained so as to decide the impact of centralization of adsorbate on adsorption and the outcomes are as per the following:

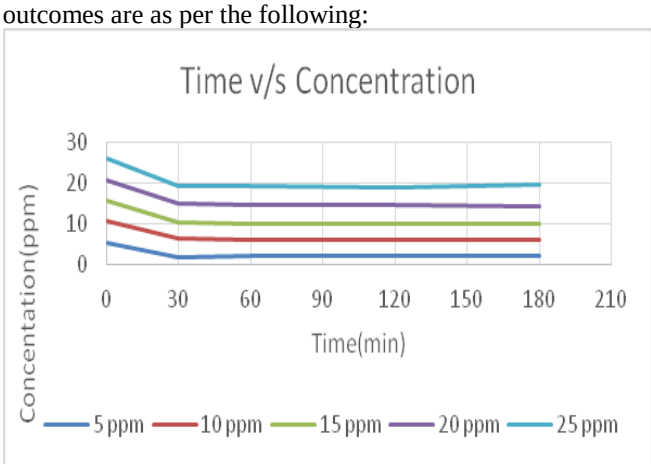

Fig 8: Plot of concentration v/s Time at different initial concentrations of adsorbate

Graphs are drawn using the values obtained as above and the results are as follows:

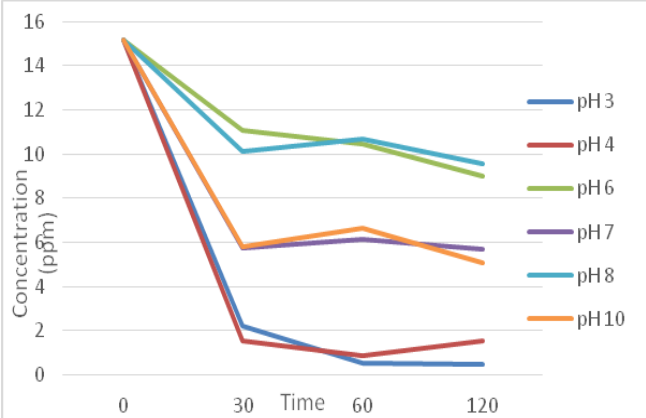

Fig 9: Graphical plot of time v/s Concentration of adsorbate at different pH

From the above graph and values we can clearly infer that as pH deviates from normal pH of 7 both percentage removal and Adsorption capacity increases i.e.,as we reduce pH from 7 to some lesser value, both removal and adsorption capacity increases. Similar is the case with increasing pH but lesser efficient than decreasing pH. Low pH prompts an expansion in H+ particle focus in the framework and the outside of the enacted carbon obtains positive charge by engrossing H+ particles. As the carbon surface is emphatically charged at low pH, a fundamentally solid electrostatic fascination shows up between the decidedly charged carbon surface and anionic color atom prompting greatest adsorption of color. As the pH of the framework expands, the quantity of contrarily charged locales increments and the quantity of emphatically charged destinations diminishes. An adversely charged surface site on the carbon does not support the adsorption of anionic color particles because of the electrostatic shock. Moreover, lower adsorption of the immediate colors in antacid medium is likewise due the challenge from abundance OH− particles with the anionic color atom for the adsorption destinations. In basic medium, the degree of color shading expulsion is expanded as the pH is expanded from 8 to 9.

This is predictable with the view that at pH ≥ 9, developments of little coagulated mass of color shading have been watched. This adds to the degree of color shading expulsion at pH 9.

Adsorption isotherm studies:

The procedure of Adsorption is typically examined through diagrams know as adsorption isotherm. It is the chart between the measures of adsorbate (x) adsorbed on the outside of adsorbent (m) and weight at steady temperature. Diverse adsorption isotherms have been Freundlich, Langmuir and BET hypothesis. n the procedure of adsorption, adsorbate gets adsorbed on adsorbent

Langmuir Adsorption Isotherm :

It's the most widely recognized isotherm condition to use because of its effortlessness and its capacity to fit an assortment of adsorption information. It depends on four suppositions:

The majority of the adsorption destinations are identical, and each site can just oblige one atom.

The surface is enthusiastically homogeneous, and adsorbed particles don't cooperate

There are no stage advances.

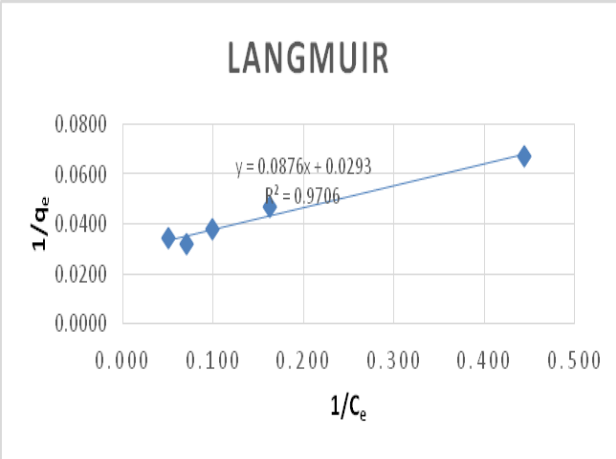

Fig 10: Plot showing Langmuir Adsorption Isotherm

From the above graph we can observe that the equation is y = 0.087x + 0.029 which is in the form of $1/q_e = 1/q + 1/(bq*c_e)$. Comparing it with the original equation we have found out the values of q & b as

q = 34.48 & b = 0.33 with a regression coefficient of 0.97 which is very close to unity. Hence we can infer that the adsorption which we have done is in par with Langmuir Adsorption Isotherm

Freundlich Isotherm:

Freundlich isotherm gives an observational articulation speaking to the isothermal variety of adsorption of an amount of gas adsorbed by unit mass of strong adsorbent with weight Graphs are drawn for the above-mentioned values after determining q_e and c_e which represents Freundlich Isothermal studies.

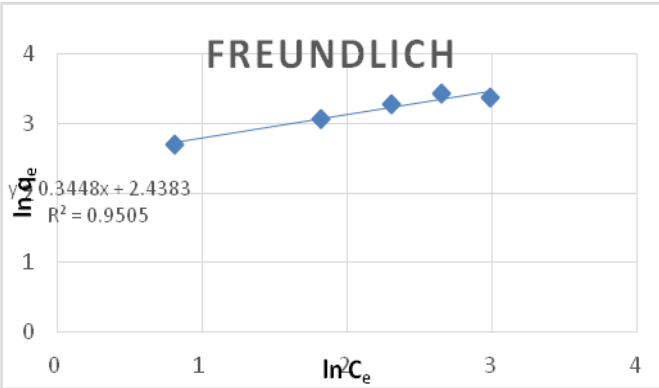

Fig 11: Plot showing Freundlich Adsorption isotherm

From the graphs the values of Freundlich constants are determined as

K_f = 11.45 & n = 2.91 with a regression coefficient of 0.95 indicating similarity with Freundlich isothermal studies.

VI. CONCLUSION

Industrial waste carbon which we have collected has no adsorption characteristics but as soon as we have done ball milling and heating it acquired high surface area and showed adsorption properties. So, we can conclude that ball milling do impart Adsorption properties to Carbon. Adsorption studies have shown that the removal of Acid blue 80 can be done very effectively using Activated Carbon. Impact of pH on rate of adsorption is considered. It very well may be presumed that as pH diminishes rate of adsorption increments because of that it upgrades anionic color adsorption. Also increase in pH results in effective removal of dye due to coagulation of dye particles. Impact of beginning centralization of adsorbate on adsorption is examined. It can be concluded from the results that as the initial concentration increases the rate of adsorption increases but the percentage removal remains almost constant at equilibrium.Similarly effect of varying dosage of adsorbent is also studied. It can be concluded that as the dosage of adsorbent increases, rate of adsorption increases. Adsorption isotherm studies are carried out and similarity of adsorption isotherm with Langmuir and Freundlich is determined. From the results it is clear that adsorption occurred based on Langmuir's assumptions.Langmuir's constants and Freundlich's constants are determined and are compared with standard values. Langmuir's constants matched with the standard values but freundlich's constants differed slightly from standard values. Percentage removal of dye is studied and it is concluded that adsorption is high at very low pH of 2.

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