ADSORPTION OF METHYLENE BLUE ONTO SHELLS OF SNAIL (*Bellamya bengalensis)* AND ITS ISOTHERM STUDY

PROJECT WORK SUBMITTED TO THE

DEPARTMENT OF CHEMISTRY

CENTRAL CAMPUS OF TECHNOLOGY

INSTITUTE OF SCIENCE AND TECHNOLOGY

TRIVUBAN UNIVERSITY NEPAL

FOR THE AWARD OF

BACHELOR IN SCIENCE (BSc) **IN CHEMISTRY**

BY

AKASH RIJAL

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TU REGISTRATION No: **5-2-8-67-2018**

[JUNE 2023]

RECOMMENDATION

This is to recommend that **Akash Rijal** (Symbol No**500080018**, T.U. Registration No**5-2-8-67-2018**), has carried out project work entitled "**Adsorption Of Methylene Blue Onto Skeleton Of Snail (*Bellamya bengalensis*) And Its Isotherm Study**" for the requirement to the project work in Bachelor of Science (B.Sc.) degree in Chemistry under my/our supervision in the Department of Chemistry, Central Campus Of Technology, Institute Of Science And Technology (Iost), Tribhuvan University (T.U.), Nepal.

To my knowledge, this work has not been submitted for any other degree.

He has fulfilled all the requirements laid down by the Institute of Science and Technology (IoST), Tribhuvan University (T.U.), Nepal for the submission of the project work for the partial fulfilment of Bachelor of Science (B.Sc.) degree.

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Assistant Prof.Mr Manoj Khanal
Supervisor
Department of Chemistry
Central campus of technology
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[3 June 2023]

DECLARATION

This project work entitled "**Adsorption of Methylene Blue onto Skeleton of Snail Shell and Its Isotherm Study**" is being submitted to the Department of chemistry, central campus of technology Campus, Institute of Science and Technology (IoST), Tribhuvan University (T.U.), Nepal for the partial fulfilment of the requirement to the project work in Bachelor of Science (B.Sc.) degree in bsc chemistry. This project work is carried out by me under the supervision of Mr Manoj Khanal and in the Department of Bsc Chemistry Central Campus Of Technology, Institute of Science and Technology (IoST), Tribhuvan University (T.U.), Nepal. This work is original and has not been submitted earlier in part or full in this or any other form to any university or institute, here or elsewhere, for the award of any degree.

Aakash

Akash rijal

Symbol No.:500080018

T.U. Registration No5-2-8-67-2018)

[JUNE 2023]

LETTER OF FORWARD

[3 June, 2023]

On the recommendation of Mr Manoj Khanal, this project work is submitted by Akash Rijal, Symbol No. **500080018**, T.U. Registration No **5-2-8-67-2018**, entitled **Adsorption Of Methylene Blue Onto Skeleton Of Snail (*Bellamya bengalensis*) And Its Isotherm Study**" is forwarded by the Department of Chemistry, Central Campus of Technology Campus, for the approval to the Evaluation Committee, Institute of Science and Technology (IoST), Tribhuvan University (T.U.), Nepal

He has fulfilled all the requirements laid down by the Institute of Science and Technology (IoST), Tribhuvan University (T.U.), Nepal for the project work.

Lalita

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BORD OF EXAMINER AND CERTIFICATE OF APPROVAL

This project work (PRO-406) entitled "**ADSORPTION OF METHYLENE BLUE ONTO SKELETON OF SNAIL (BELLAMYA BENGALENSIS) AND ISOTHERM STUDY** " by Akash Rijal (Symbol No500080018 and T.U. Registration No 5-2-8-67-2018)) under the supervision of Mr Manoj khanal in the Department of Chemistry, Central campus of Technology-Campus, Institute of Science and Technology (IoST), Tribhuvan University (T.U.), is hereby submitted for the partial fulfillment of the Bachelor of Science (B.Sc.) degree in Chemistry. This report has been accepted and forwarded to the Controller of Examinatio Institute of Science and Technology, Tribhuvan University, Nepal for the legal procedure

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ABSTRACT

This research study investigates the adsorption properties of Snail Shell as an adsorbent material for removing contaminants. Various parameters such as contact time and adsorbent dose were examined to determine their influence on the adsorption process and removal efficiency. The study also employed Langmuir and Freundlich isotherm models to analyse the equilibrium data.

The results of the experiments revealed that the percentage removal efficiency of Snail Shell increased as the contact time and adsorbent dose increased. However, it decreased with higher concentrations of the dye being adsorbed. The isothermal analysis indicated that the Langmuir model provided the best fit for the equilibrium data, as evidenced by a high correlation coefficient value (R2 = 0.8648) for the Snail Shell adsorbent (*Bellamya bengalensis).*

Further analysis of the data plotted in Excel demonstrated that the percentage removal efficiency of Snail Shell increased with higher masses of the adsorbent. Moreover, the use of a higher adsorbent dose resulted in comparable adsorption performance to that of charcoal, a commonly used adsorbent material.

Overall, this study highlights the adsorption properties of Snail Shell and its potential as an effective adsorbent for contaminant removal. The findings suggest that Snail Shell exhibits favourable adsorption characteristics, with improved performance observed at longer contact times and higher adsorbent doses. The Langmuir model provides a suitable representation of the equilibrium data, indicating the formation of monolayer adsorption on the Snail Shell surface. The research contributes to the understanding of Snail Shell's adsorption behaviour and offers insights into its practical application in water treatment and other environmental remediation processes.

Key word: methylene blue, Snail shell, Charcoal, %removal, Adsorbent.

शोधसार

यस अनुसन्धान अध्ययनले दूषित पदार्थहरू हटाउनको लागि एक शोषक सामग्रीको रूपमा स्नेल शेलको शोषण गुणहरूको अनुसन्धान गर्दछ । विभिन्न प्यारामिटरहरू जस्तै सम्पर्क समय र adsorbent खुराक सोखन प्रक्रिया र हटाउने दक्षता मा तिनीहरूको प्रभाव निर्धारण गर्न जाँच गरियो । अध्ययनले सन्तुलन डेटाको विश्लेषण गर्न langmuir / Freundlich isotherm मोडेलहरू पनि प्रयोग गर्यो।

प्रयोगको नतिजाले पत्ता लगायो कि स्नेल शेलको प्रतिशत हटाउने दक्षता सम्पर्क समय र शोषक खुराक बढ्दै जाँदा बढ्यो। यद्यपि, डाईको उच्च सांद्रताले सोस्ने भएकोले यो घट्यो। आइसोथर्मल विश्लेषणले संकेत गर्‍यो ls Langmuir मोडेलले सन्तुलन डेटाको लागि उत्तम फिट प्रदान गर्‍यो, जुन स्नेल शेल शोषक (Blleamya bengalensis) को लागि उच्च सहसम्बन्ध गुणांक मान (R2 = 0f\.8648) द्वारा प्रमाणित भयो।

एक्सेलमा प्लट गरिएको डाटाको थप विश्लेषणले देखाएको छ कि स्नेल शेलको प्रतिशत हटाउने दक्षता शोषकको उच्च जनसमूहसँग बढेको छ । यसबाहेक, उच्च शोषक खुराकको प्रयोगले चारकोलको तुलनात्मक सोखन कार्यसम्पादनमा परिणत गर्‍यो, एक सामान्य रूपमा प्रयोग हुने शोषक सामग्री।

समग्रमा, यस अध्ययनले स्नेल शेलको शोषण गुणहरू र दूषित पदार्थ हटाउनको लागि प्रभावकारी शोषकको रूपमा यसको सम्भावनालाई हाइलाइट गर्दछ । निष्कर्षहरूले सुझाव दिन्छ कि स्नेल शेलले अनुकूल शोषण विशेषताहरू प्रदर्शन गर्दछ, सुधारिएको प्रदर्शनको साथ लामो सम्पर्क समय र उच्च शोषक खुराकहरूमा अवलोकन गरिन्छ । ल्याङ्मुइर मोडेलले स्नेल शेल सतहमा मोनोलेयर शोषणको गठनलाई संकेत गर्दै सन्तुलन डेटाको उपयुक्त प्रतिनिधित्व प्रदान गर्दछ । अनुसन्धानले स्नेल शेलको अवशोषण व्यवहारको समझमा योगदान पुर्‍याउँछ र पानी उपचार र अन्य वातावरणीय उपचार प्रक्रियाहरूमा यसको व्यावहारिक अनुप्रयोगमा अन्तर्दृष्टि प्रदान गर्दछ।

मुख्य शब्दस् मेथिलीन नीलो, स्नेल शेल, चारकोल, % हटाउने, Adsorbent ।

LIST OF ABBREVIATIONS

Fig	:	Figure
gm	:	Gram
Ml	:	Millli litre
nm	:	Nanometre
MB	;	Methylene Blue
Mg/g	:	Milligram per gram
No	:	number
AC	:	Activated carbon

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CHAPTER 1

INTRODUCTION

1.1 Background

Various industries, such as textiles, paper mills, leather, dye synthesis, printing, food, and plastics, utilize a diverse range of dyes. Unfortunately, these colours pose risks to human well-being and the ecosystem due to their harmful nature (Weng & Pan, 2007). The toxic and carcinogenic properties of these dyes have detrimental effects on the environment. Consequently, industries produce significant quantities of wastewater containing these dyes. Discharging such industrial effluent into water bodies leads to contamination of natural water sources and adversely affects aquatic ecosystems.(El Qada et al., 2006)

The exponential growth of industrialization has led to a surfeit of dyes being discharged into water reservoirs. The continuous release of such copious amounts of industrial effluent is progressively exacerbating water pollution (Kumar et al., 2019). Water pollution stands as a formidable global environmental challenge, with the textile industry playing a significant role in exacerbating the issue. Dyes and pigments are extensively employed in this industry to impart vibrant colours to their products. With a staggering array of approximately 100,000 commercially available dyes, the sector generates an astonishing annual volume of over 7 million tonnes of these substances. Alarmingly, an estimated 10% to 15% of the dyes utilized end up being discharged into wastewater(Pathania et al., 2017) . The textile industry produces substantial amounts of wastewater primarily due to the washing, bleaching, dyeing, and finishing processes involved in working with natural fibres. The complexity and diversity of chemicals present in these operations, stemming from the use of various fibres, dyes, and process aids, pose significant challenges for conventional wastewater treatment facilities. The diverse range of fibres, including cotton, wool, and silk, require different treatments and processes, leading to a wide variety of pollutants being present in the wastewater. Additionally, the use of different dyes and process aids further contributes to the chemical complexity of the wastewater. These contaminants include organic compounds, heavy metals, surfactants, and other potentially harmful substances.

Traditional wastewater treatment plants are not designed to effectively handle such a diverse and chemically complex wastewater stream. As a result, the inadequately treated or untreated textile industry wastewater is often discharged into water bodies, leading to environmental pollution and potential harm to aquatic ecosystems. Addressing the challenge of textile industry wastewater requires the development and implementation of advanced treatment technologies that can effectively remove the wide array of pollutants. Furthermore, sustainable practices, such as water recycling and the use of eco-friendly dyes and processes, are essential to minimize the environmental impact of the textile industry and ensure the responsible management of wastewater.. (Vandevivere et al., 1998) The untreated discharge of colours into water has resulted in eye injuries, carcinogenicity, and skin toxicity. It can lead to a variety of health issues such as cancer, skin disorders, high blood pressure, and so on. Even tiny amounts of colour have a negative impact on eyesight and general healing(Kumar et al., 2008). Methylene Blue (MB) is a positively charged dye utilized in various fields, including chemistry, biology, medicine, and dyeing. Prolonged exposure to this dye can lead to symptoms such as vomiting, nausea, anaemia, and high blood pressure (Foo & Hameed, 2012)). According to Gosh and Bhattacharya, MB is not only extremely dangerous, but it also has negative consequences on living creatures. As a result, removing MB from wastewater is a critical duty. There are major negative effects with far-reaching repercussions that have been linked to MB. (Ghosh & Bhattacharyya, 2002) Aquatic autotrophs are adversely affected by the presence of certain substances that limit their photosynthetic efficiency. These substances, often characterized by their colour, restrict the amount of sunlight penetrating the water. Moreover, these substances have a toxic nature that extends up the food chain, impacting various organisms. Additionally, they can persist in the environment for prolonged periods, posing risks to animal and human health. The colour of these substances acts as a barrier, reducing the amount of sunlight available for photosynthesis by autotrophs. This restriction in light penetration inhibits the autotrophs' ability to produce energy through photosynthesis, thereby hindering their growth and overall productivity. Furthermore, these substances possess toxic properties, causing harm to organisms in the ecosystem. As they move through the food chain, the toxins accumulate and magnify in concentration, potentially affecting higher trophic levels. The toxicity can have detrimental effects on the health and well-being of aquatic organisms, including fish, invertebrates, and even mammals that rely on these organisms as a food source. Moreover, these substances have the ability to persist in the environment for extended periods of time. This persistence can lead to bioaccumulation in organisms, as well as bio magnification throughout the food chain, resulting in increased concentrations of these harmful substances in animals and humans who consume contaminated organisms. Consequently, long-term exposure to these substances can have adverse effects on the health of both animals and humans, ranging from acute toxicity symptoms to chronic illnesses. In summary, these substances with their colour, toxic nature, and persistence in the environment pose significant threats to aquatic autotrophs, impacting their photosynthetic efficiency. Furthermore, their poisonous effects extend throughout the food chain, and their long-term presence can lead to detrimental effects on animal and human health.. (Marrakchi et al., 2016)

Extensive research has been conducted on various water treatment methods, including filtration, precipitation, ion exchange, reverse osmosis, solvent extraction, membrane separation, and adsorption. Among these techniques, adsorption has emerged as an effective and cost-efficient approach for the removal of color and soluble organic contaminants from water, such as organic dyes and pesticides. Adsorption involves the attachment of contaminants to a solid surface, typically an adsorbent material. This process relies on the affinity between the adsorbent and the target contaminants, allowing for their selective removal from the water. Adsorbent materials commonly used in water treatment include activated carbon, zeolites, and various types of nanoparticles. One of the advantages of adsorption is its versatility and adaptability to different types of contaminants. Organic dyes and pesticides, known for their solubility and resistance to degradation, can be effectively adsorbed onto the surface of the adsorbent material. This leads to their separation from the water phase, resulting in improved water quality. Adsorption is not only efficient but also cost-effective. The adsorbent materials used are often readily available and affordable, making the overall treatment process economically viable. Additionally, adsorption can be easily integrated into existing water treatment systems or applied as a standalone treatment method. The extensive studies conducted on adsorption have contributed to the development of optimized adsorbent materials and processes. Researchers have explored various parameters, such as contact time, adsorbent dosage, pH, and temperature, to enhance the adsorption efficiency and maximize contaminant removal. In conclusion, water treatment procedures encompass a wide range of methods, with adsorption standing out as an efficient and low-cost approach for the removal of color and soluble organic contaminants like organic dyes and pesticides. Ongoing research continues to advance the understanding and application of adsorption in water treatment, providing sustainable solutions for the purification of water resources.(Kumar et al., 2008). Adsorption is a surface phenomenon that refers to a molecule's attachment to the surface. It is based on the fact that some solids selectively pick up other solutes from solutions and deposit them on their surfaces, Adsorption is considered as an effective and efficient way of separating numerous industrial and home contaminants. This technology is widely used to reduce the concentration of chemical pollutants in wastewater and to eliminate them. (Mohammad-Khah & Ansari, 2009). It has desirable properties and may be utilized as a sample chemical in adsorption investigations. (Hameed, Din, et al., 2007).

Charcoal has a high capacity for adsorption of many chemical compounds. Because charcoal is made by heating it at a very high temperature, it is incredibly porous and rapidly absorbs moisture. When the charcoal has been activated and finely ground. The surface area of the carbon particles is greater. These have a high adsorption compatibility with colours, insecticides, germicides, and other chemicals.. (McCarty, 1996). Charcoal may be made from a variety of plant materials, including choerospondiesaxillaris (lapsi) seeds, coconut plant, evergreen trees, and deciduous trees. Oak and pine (Khanal et al., 2020)

1.2 Statement of problem

The release of industrial effluent into the surroundings plays a substantial role in causing harm to the environment. Inhalation of methylene blue leads to temporary instances of fast or laboured breathing, while ingestion of this substance results in an unpleasant burning sensation, along with various negative symptoms like nausea, vomiting, excessive sweating, and cognitive disorientation. The effluent discharged from industrial activities poses a significant threat to the environment. Methylene blue, when inhaled, induces short episodes of rapid or difficult respiration, temporarily impacting the individual's ability to breathe comfortably. Moreover, if consumed orally, this substance triggers an unpleasant burning feeling in the mouth, throat, and digestive system. Ingestion of methylene blue can lead to further adverse effects, including bouts of nausea, vomiting, profuse sweating, and mental confusion or disorientation. These hazardous consequences emphasize the importance of mitigating the release of such industrial effluents into the environment. The inhalation and ingestion of methylene blue, a commonly used substance in various industries, can have detrimental impacts on human health. Implementing effective measures to prevent or minimize the discharge of this and other harmful substances is crucial for safeguarding human well-being and reducing the ecological impact caused by industrial activities..(Appusamy et al., 2014). This problem has had a significant influence on the overall quality of the environment. To solve this issue, several adsorbents are used in wastewater treatment. However, these adsorbents are frequently costly. Locally accessible raw materials may be used to efficiently remove toxic chemicals from wastewater, providing an inexpensive option. Here we have snail shell and charcoal, both of which may be obtained in our immediate surroundings. It is readily available land that may be used as a low-cost adsorbent substitute.

1.3 Objective

- The general objective is to explore the adsorbent characteristic of snail shell.
- The specific objective is to

1. To study the adsorption isotherms
2. to compare the adsorbent removal percentage between Snail shell and charcoal

1.4 Rationale

The primary objective of this research is to economically treat wastewater by utilizing locally accessible resources. Most commonly employed adsorbents for wastewater treatment are costly and not readily accessible. However, in the tarai region, snail shells are abundantly available. Therefore, the snail shell can be utilized as a cost-effective adsorbent for effectively removing effluent..

CHAPTER 2

LITERATURE REVIEW

2.1 Background

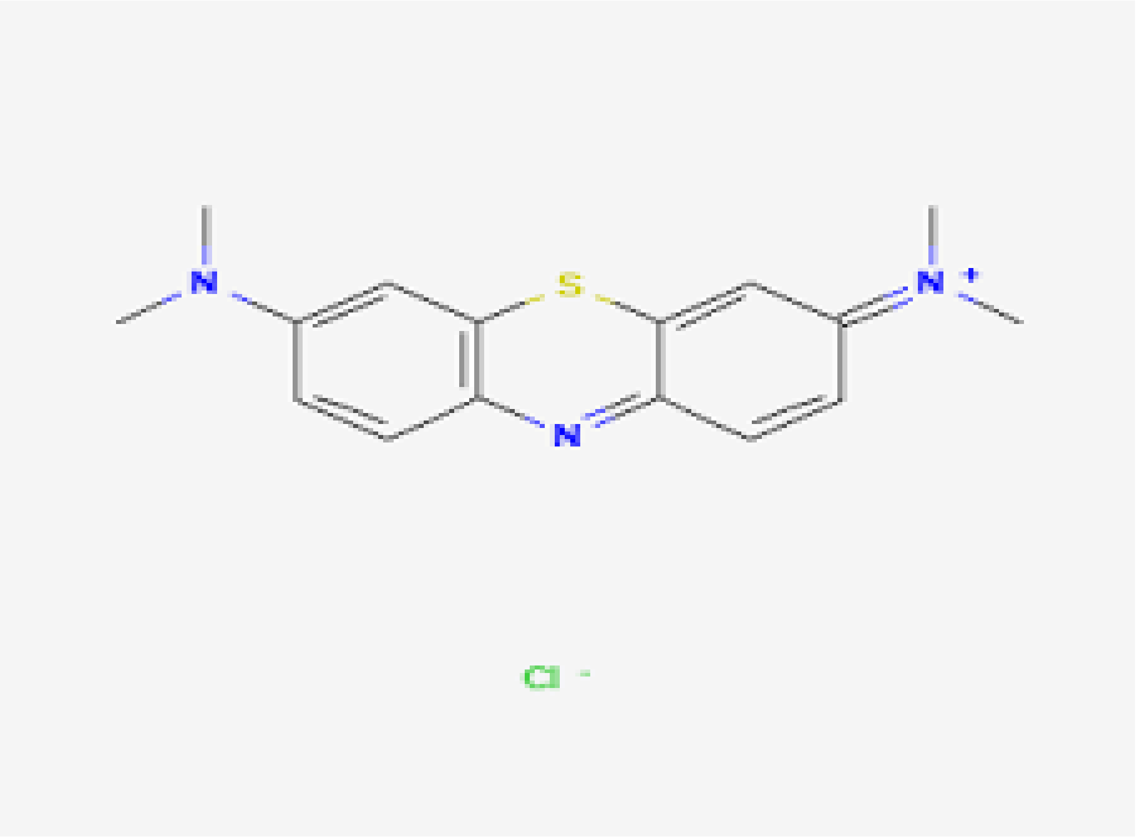
Adsorption, known for its affordability, simplicity, eco-friendliness, minimal health hazards, and positive impact, stands out as a highly recognized technique for eliminating contaminants from wastewater. This method is widely acknowledged due to its cost-effectiveness, user-friendly nature, and environmentally conscious approach. Additionally, it poses minimal risks to human well-being and operates without any detrimental effects. The process of adsorption, which involves the adhesion of pollutants to a solid surface, is extensively utilized for wastewater treatment purposes. Its popularity stems from the fact that it offers an economical solution while being easy to implement, ensuring the protection of the environment and maintaining a low potential for negative consequences. Thus, adsorption remains a prominent choice in the arsenal of strategies employed for the efficient removal of pollutants from wastewater (Balasundram et al., 2017)). Activated carbon (AC) plays a crucial role in enhancing the efficiency of the adsorption process by facilitating the elimination of various pollutants, including colorants, prescription medications, and other potentially carcinogenic substances, from aqueous solutions. AC, derived from water-based solutions, proves to be highly effective in the removal of a diverse range of contaminants. By incorporating AC into the adsorption process, the ability to target and capture harmful chemicals is significantly improved. This powerful adsorbent is particularly adept at trapping and removing colorants, prescription medications, and other hazardous substances, making it a valuable tool in wastewater treatment. The presence of AC in the adsorption process not only aids in the removal of a wide array of pollutants but also contributes to the overall efficacy of the treatment method, ensuring the purification of water and safeguarding human and environmental health (Din et al., 2017).

Activated carbon (AC) is a type of carbon-based material that possesses a solid, non-crystalline structure, notable porosity, and a significant surface area. Its surface is rich in various oxygenated functional groups, including carboxylic acids, phenols, carbonyls, and lactones. AC is characterized by its amorphous form, which ensures its stability, and its porous structure allows for the retention of a substantial volume of gases or liquids. The high surface area of AC enables effective adsorption of molecules and compounds. The presence of oxygenated functional groups on the AC surface enhances its adsorption capabilities, as these groups can interact with different types of pollutants. This unique combination of structural properties and oxygenated functional groups makes AC a versatile and efficient material for adsorption processes. It provides an ideal platform for capturing and removing various contaminants from liquids or gases, making it a valuable tool in water and air purification applications (Benedetti et al., 2018). Numerous inexpensive and easily accessible agricultural or plant-derived substances have been utilized as raw materials to produce activated carbon, aiming to remove textile dye effluents. Examples of such materials include silk cotton hull, sawdust from coconut trees, banana pith, maize cobs, sawdust from rattan, jute fibres, pistachio shells, palm kernel shells, rice bran, coir pith, rice husks, mango seed kernel powder, and palm fibres. These readily available resources have been harnessed for their suitability in the production of activated carbon. By transforming these agricultural or plant-based materials into activated carbon, they offer a sustainable and eco-friendly solution for treating textile dye effluents. This approach not only addresses the issue of wastewater pollution but also maximizes the utilization of abundant agricultural by-products, promoting a more environmentally conscious and cost-effective means of wastewater treatment in the textile industry(Geçgel et al., 2013) .Our university has no records of getting carbons from snail shell by chemical or physical activation techniques. As a result, the adsorption of dye (methylene blue) onto locally accessible snail shell and the comparison of its removal percentage with charcoal were researched in this work.

2.2 Methylene Blue

Methylene blue has se applications in human and veterinary medicine, including stain in bacteriology, redox colorimetric agent, and melanoma targeting agent, antihaemoglobinaemic, antidote, antiseptic, and disinfectant. (O'Neil .According to IUPAC, methylene blue is known as [7-(Dimethylamine) phenothiazine-3-ylidene]-dimethylazanium chloride. Basic blue 9(8CI) and Calcimine blue ZF are other names for it. Swiss blue, tetra methylene blue, methylthionine chloride In 2008, the National Toxicology Program (NTP) identified a compound called methylthioninium chloride, which belongs to the phenothiazine-5-ium family. The compound has the chemical formula 3.7-bis,(dimethylamine)-, chloride.(Kim et al., 2019).. It is also used in malaria treatment and as an aquarium fungicide.

(Schirmer et al., 2011).



Fig;1 structure of Methylene blue dye (MBD) (CI No. 52015) (anhydrous form) ((Kim et al., 2019))

UV-Vis spectroscopy is an analytical technique used to measure the absorption or transmission of UV or visible light by a sample. By determining the number of distinct wavelengths of light absorbed or transmitted, this technique enables the identification of substances present in the sample and provides information about their concentrations. In essence, UV-Vis spectroscopy allows for the characterization and quantification of the components within a sample based on their interactions with specific wavelengths of light in the UV and visible regions of the electromagnetic spectrum.

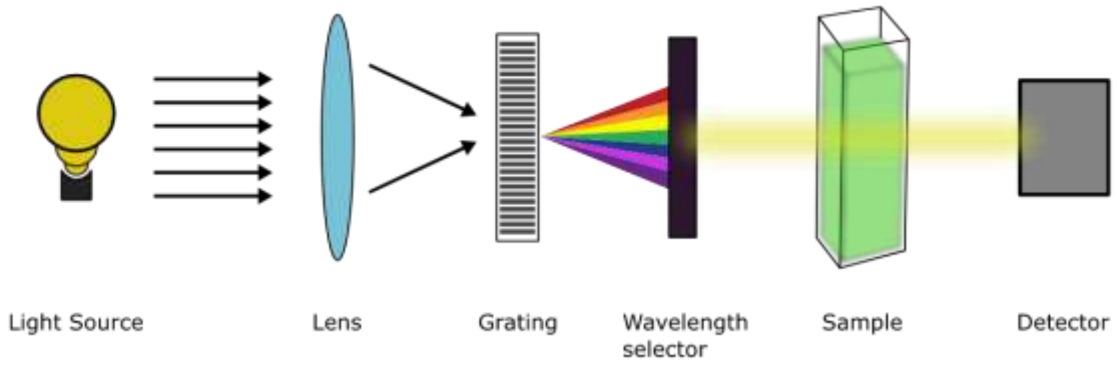


Figure 1: instrumentation of UV-Visible spectrophotometer

a) The light source:

To achieve high-intensity light in the visible and UV spectra, a xenon lamp is frequently used. For optimal performance and seamless transitions in scans ranging from 300 to 350 nm, regular switching of the light source is necessary. It's worth noting that xenon lamps can be expensive and are necessary for scanning both UV and visible wavelengths'

b) Wavelength selection:

In sample inspection, selecting the suitable wavelengths of light is vital, considering the sample and the analyst's detection requirements, amidst the wide range emitted by the light source. Monochromators are widely employed for wavelength selection due to their versatility. To enhance measurement precision and increase the signal-to-noise ratio, filters such as absorption filters, interference filters, cut-off filters, and band pass filters are frequently combined with monochromators. This complementary utilization of filters and monochromators enables the refinement and accuracy of sample analysis, leading to more reliable results.

c) Sample analysis:

The spectrophotometer selects a specific wavelength and allows the light to pass through the sample being analysed. In every analysis, a reference sample, referred to as a "blank sample," is measured. This blank sample typically consists of a cuvette filled with a solvent similar to the one used in the sample preparation process.

2.3 Snail Shell

Snails, which are considered pests in rice fields, have a tendency to flourish in such environments. As part of the food chain, snails are often utilized as a source of nutrition for animals, notably ducks. However, once the extraction of the snail flesh is complete, the leftover snail shells are carelessly discarded, leading to a significant waste problem that contributes to the pollution of both land and air. The accumulation of abandoned snail shells poses a threat to the environment. When left untreated, they can contaminate the soil, causing potential harm to plants and other organisms residing in the area. Additionally, the degradation process of the snail shells releases harmful substances into the air, further exacerbating air pollution concerns. It is imperative to address this issue and implement effective waste management practices to mitigate the environmental impact of snail shell waste. By embracing sustainable approaches, such as recycling or repurposing snail shells, we can minimize their detrimental effects. For instance, snail shells can be transformed into valuable resources, such as calcium-rich fertilizers or supplements. These alternative uses not only reduce waste but also provide economic and environmental benefits. Active engagement in the entire waste management process is vital. By adopting responsible practices like proper collection, segregation, and processing of snail shells, we can mitigate pollution risks. This approach requires collaboration among stakeholders, including farmers, waste management authorities, and relevant industries. Furthermore, raising awareness about the environmental consequences of snail shell waste and promoting responsible disposal practices is crucial. Educating the public and encouraging individuals to incorporate sustainable habits can lead to a positive change in behaviour, ultimately reducing the pollution caused by snail shells. In conclusion, snail shell waste resulting from the extraction of snail flesh presents a significant environmental challenge. However, through sustainable waste management practices, including recycling and repurposing, we can minimize pollution, protect the environment, and create a more sustainable future.. (Sawai, 2011).

The shell is composed of approximately 95% crystalline $CaCO_3$ and 5% organic materials by weight. The shell is composed of approximately 95% crystalline $CaCO_3$ and 5% organic materials by weight.. Snail shells have a high calcium concentration in molluscs. Snail shells have a high calcium concentration in molluscs. (Akram et al., 2014). This is an issue for the environment since snails are a pest of rice, producing waste in the shape of shells. It is, nevertheless, a great source of bio calcium for a variety of uses, including the conversion of shell waste to hydroxyapatite (HAp), $Ca_{10}(PO_4)_6(OH)_2$.)(Ibrahim et al., 2015). Organic waste like mammalian bones, marine creature bones or scales, shells, plants, algae, and minerals such as limestone can all serve as sources for the production of natural hydroxyapatite (HAp). (Vickers, 2017). As a result, research is needed to synthesis HAp from snail shells as a calcium source for MMC reinforcement. The production of hydroxyapatite (HAp) from natural waste brings about both economic prosperity and environmental sustainability. This success stems from the utilization of affordable, natural, and underutilized resources, resulting in cost-effective manufacturing processes. Furthermore, it embraces a comprehensive waste management approach, actively engaging in every stage of the process. This commitment contributes to significant advancements in various aspects. In simpler terms, the concept involves repurposing solid waste that would otherwise accumulate and contribute to pollution, posing risks to human health, animals, and plants. By recycling this waste, it is transformed into valuable products that are in high demand, leading to economic benefits. Additionally, this approach aligns with sustainable practices by minimizing waste generation, reducing reliance on virgin materials, and promoting resource conservation.

Moreover, the manufacturing of HAp from natural waste serves as an eco-friendly solution that addresses the challenges of waste accumulation and environmental pollution. It effectively tackles these issues by repurposing waste materials and preventing them from becoming hazards. Consequently, it contributes to the overall well-being of society and the environment. Ultimately, this innovative approach demonstrates the potential for achieving significant progress by efficiently utilizing natural waste, supporting economic growth, and promoting sustainable waste management practices.(Zuliantoni et al., 2022). Waste is made more usable by converting it to calcium oxide or calcium hydroxide. Snail shell trash is used as a renewable natural resource and adds value to organic waste as a useful material. (Fatimah et al, 2018) .

CHAPTER 3

MATERIAL AND METHDOLOGY

3.1 Material

3.1.1 Adsorbate

In the adsorption studies, a cationic dye called methylene blue (MB) was selected as the adsorbate. It has a molecular weight of 337.9g/mole. However, the MB obtained from Eureka International Enterprises was not adequately purified for the intended purpose.

3.1.2. Adsorbent

3.1.1.1 Sample

- Snail shell collected from itahari.
- Charcoal collected from laboratory of chemistry.
- Distilled water use for the preparation of reagent and solutions.

3.1.1.2 Collection of samples

Snail was obtained at the Itahari market, and charcoal was obtained from the chemical lab of the central campus of technology. The charcoal had already been purchased from a market for use in the laboratory.

3.1.1.3 Purification of sample

About 2000gm of snail along with shell was boiled and by removing the inner portion of the snail portion, shell was allowed to dry .and finally the unwanted impurity was removed and got crushed into crusher. Similarly the charcoal was already in the form of purified so it didn't needed to be.

3.1.3 Instrument

- UV-Visible spectrophotometer
- Digital balance
- Hot air oven
- Centrifuge
- Shaker

3.1.4 Glassware

- Beaker
- Measuring cylinder
- Glass rod
- Watch glass.
- Conical flask
- Volumetric flask
- Pipette
- Funnel
- Sampling bottles

3.3 Calibration curve

- Different concentration of MB dye solution were prepared.
- At different wavelength absorbance was measured of all prepared solution.
- At 665nm maximum wavelength was found.
- Standard curve was plotted know as calibration curve.

3.3 Characterization

3.2.1 Ash Content

A crucible was employed to contain a 15-gram sample, which was subsequently subjected to heating in a furnace at 500˚C for 1.5 hours. Following the cooling of the sample to ambient temperature, its weight was re-measured. The discrepancy in weight was then used to calculate the ash content of the sample, resulting in a determination of 1.267%.

3.2.2 Determination of Moisture Content

A sample weighing 10 grams was dried in an oven at 150˚C for a duration of 4 hours. The moisture content of the sample was determined using a specific equation.

$$X_0 = \frac{W_1 - W_2}{W_1} \times 100$$

Where X_0 = moisture content on wet basis, W_1 = initial weight of sample in grams, W_2 = final weight of sample (in grams) after drying.

Therefore, the moisture contain in shell was found to be 1.3.

3.2.3 Pre-Treatment of Waste Snail Shells

Prior to conducting the carbonization and activation experiments, waste snail shells were procured from local market traders in Itahari. The shells underwent a series of steps, starting with washing them using warm water, followed by rinsing with distilled water. They were then dried at 105˚C for 3 hours and subsequently cooled in desiccators, ensuring their preparedness for subsequent experimentation..

3.4 Experimental procedure

The laboratory work, including all tests and experiments, was carried out at the Technology Central Campus in Dharan. To ensure the analysis could be replicated, all experiments were conducted in triplicate, meaning they were repeated three times.. (Olaosebikan et al., 2022)

The procedure was completed as by following steps:

1. Collection of sample: about 90gm of charcoal and 2kg of sample was collected which were allowed for purified.
2. A solution with a concentration of 200ppm of MB was created by dissolving 50mg of MB powder in 250ml of distilled water. This solution was used to establish a calibration curve. Necessary concentrations of the dye solution were prepared and absorbance of each was measured by using a UV-Visible Spectrophotometer at maximum wavelength A max = 665nm and standard curve was plotted which is known as calibration curve. The equation of the curve was used to calculate the concentration of various absorbance in all the tests. The maximum wavelength was calculated from different concentrations of MB.
3. Effect of adsorbent dosage:

   The mass of snail shell and charcoal were measure separately as 1gm,2gm,3gm,4gm,and 5gm and was kept in different 250ml conical flask containing MB solution and the conical flask were allowed to shaker for enhancing the adsorption process.
4. At the various time of contact as 2hr,4hr and 24hr ,with the different concentration of MB solution as (60ppm,80ppm,100ppm,120ppm,150ppm) the absorbance were calculated by using the UV-visible spectroscopy.

5. Finally after the calculation of residual concentration, ce was determined from the equation of the calibration curve, which was used to calculate the % removal efficiency.
6. For each of the measurement, respective blank solution containing no dye was used.
7. Adsorption isotherms:

   In this study, two kinds of adsorption isotherm models are used which are Langmuir and Freundlich isotherm model. The graph of Langmuir model was obtained by plotting Ce/qe against where 1/0m is the slope and intercept is K. Similarly, the graph of Freundlich model was obtained by plotting log qe vs log Ce where the slope is 1/n and intercept is Kf.
8. Adsorption kinetics:

   The kinetics was studied by the help of two models which are pseudo-first order and pseudo-second order kinetic model. The graph of pseudo- first order kinetic model was obtained by plotting log10 (qe qt) vs time / where the values of ge and KI were obtained from the intercept and slope. Similarly, the graph of pseudo-second order model was obtained by plotting 1/qt vs time t where qe is the slope and K2 is the intercept.

CHAPTER 4

RESULT AND DISCUSSION

4.1 Maximum wavelength:

To determine the maximum wavelength of methylene blue, various solutions of different concentrations of methylene blue were prepared and their absorbance were measured by using UV-Visible Spectrophotometer at different wavelength ranging from 600 to 700nm. According to this study, the maximum wavelength was determined to be 665nm.

Table 1: Data for maximum wavelength

wavelength	absorbance
600	1.128
610	1.406
620	1.347
630	1.305
640	1.635
650	1.817
655	1.97
660	2.11
665	2.121
670	2.004
675	1.785
680	1.303
690	0.609
700	0.23

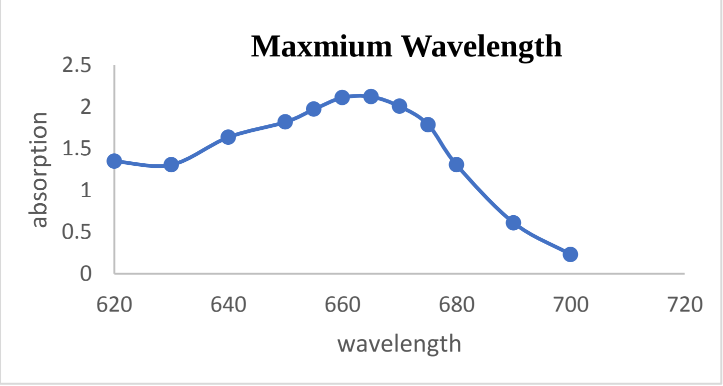


Figure 2: wavelength vs absorbance

4.2 Calibration curve:

After measuring the absorbance of various concentration 1, 2, 3, 4, 6,8ppm of MB dye, a standard curve was plotted and equation was used to calculate the concentration for all the other tests. The data and graph for the calibration curve is given below:

Table 2: Data for calibration curve

concentration	**absorbance**
1	0.27
2	0.48
3	0.66
4	0.912
6	1.35
8	1.666

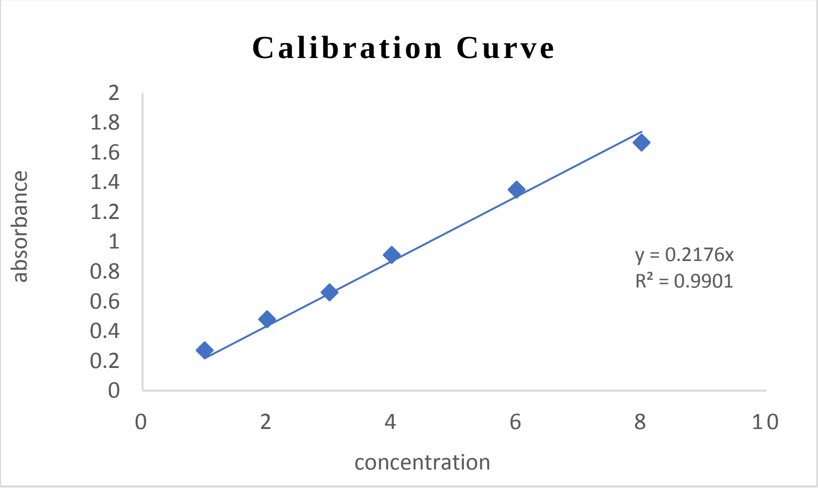


Figure 3: concentration vs absorbance

4. Effect of Adsorbent dose:

The adsorption data for the removal of methylene blue versus adsorbent dose are presented in the given below. From the below graph we can conclude that the removal percentage of the methylene blue will increase with the increase in the adsorbent doge. The removal percentage of MB increases from 94.43 to 96.71 with the increase in adsorbent dose from 1 to 5 gm after keeping in contact with the adsorbent for 4 hr.

Table 3: Data for effect of adsorbent dose on dye removal %

adsorbent dose	**removal%**
1	94.43
2	94.8
3	95.7
4	96.03
5	96.71

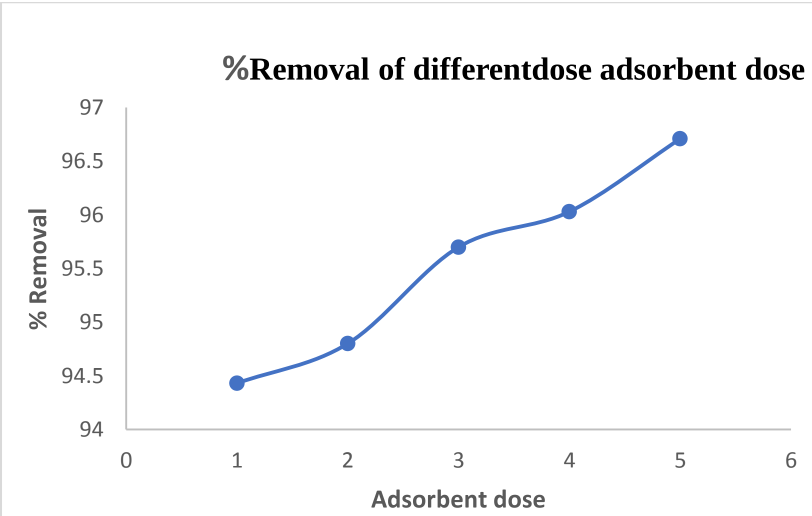


Figure 4: Adsorbent dose concentration vs. % removal*:*

4.4 Effect of contact time:

The presented data shows the adsorption characteristics for the removal of MB dye at different contact times and adsorbent concentrations. The percentage of dye removal has been found to increase with longer contact times. For instance, at a 2-gram adsorbent dosage, the percentage removal increased from 88% to 96%. Similar trends were observed for the removal percentages at 3 grams and 5 grams of adsorbent.

: For 2 gram

Table 4: Data for effect of contact time on dye removal % for 2g adsorbent dose

time	Removal %
2	88
4	94
24	96

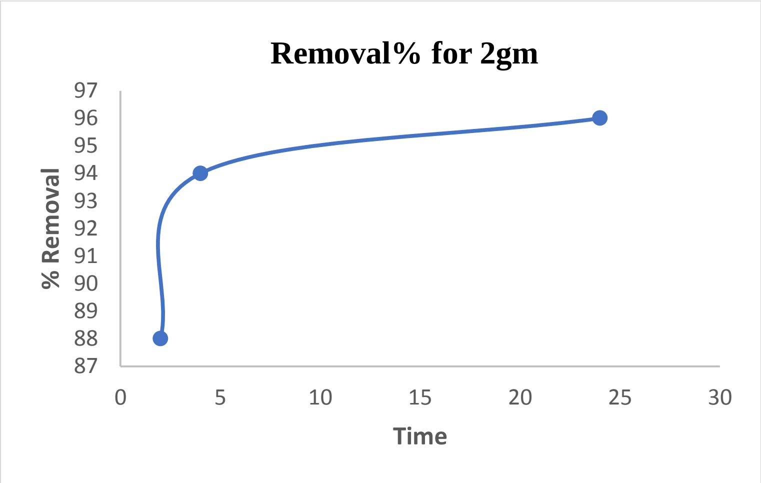


Figure 5: contact time vs removal% for 2gm sample

For 3 gm

Table 5: Data for effect of contact time on dye removal % for 3g adsorbent dose

time	Removal %
2	91.8
4	95.7
24	96.03

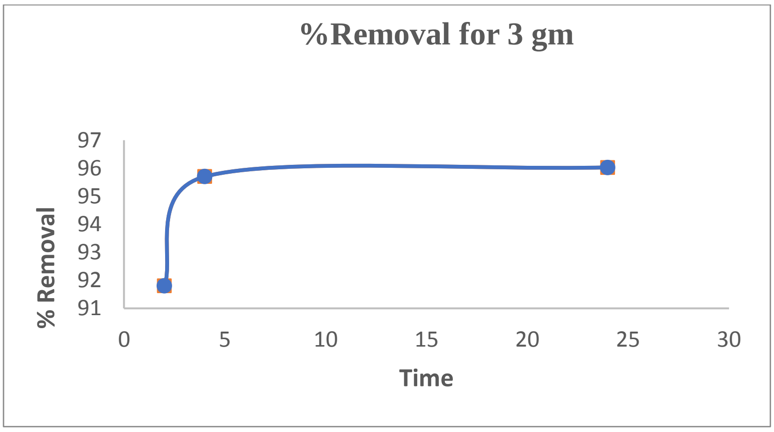


Figure 6: contact time vs removal% for 3gm sample:

For 5gm

Table 6:Data for effect of contact time on dye removal % for 5g adsorbent dose

time	Removal%
2	90.7
4	96.2
24	96.7

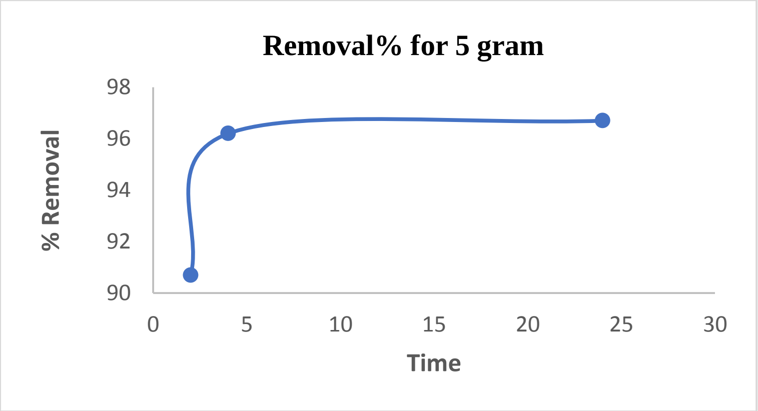


Figure 7: contact time vs removal % for 5gm sample

4.5 Effect of initial dye concentration:

Based on the data, when the initial dye concentration increased from 60 to 120 ppm and the snail shell was in contact with the adsorbent for 24 hours, the removal percentage of MB dye decreased from 96% to 86.6%. This decline in dye removal can be attributed to the limited number of active sites available on the surface of the snail shell as the MB concentration increased. In other words, the higher concentration of MB resulted in a reduced efficiency of dye removal due to the saturation of active sites on the snail shell surface.

Table 7: Data for effect of initial concentration

concentration	**Removal%**
60	96
80	91.1
100	83
120	86.6

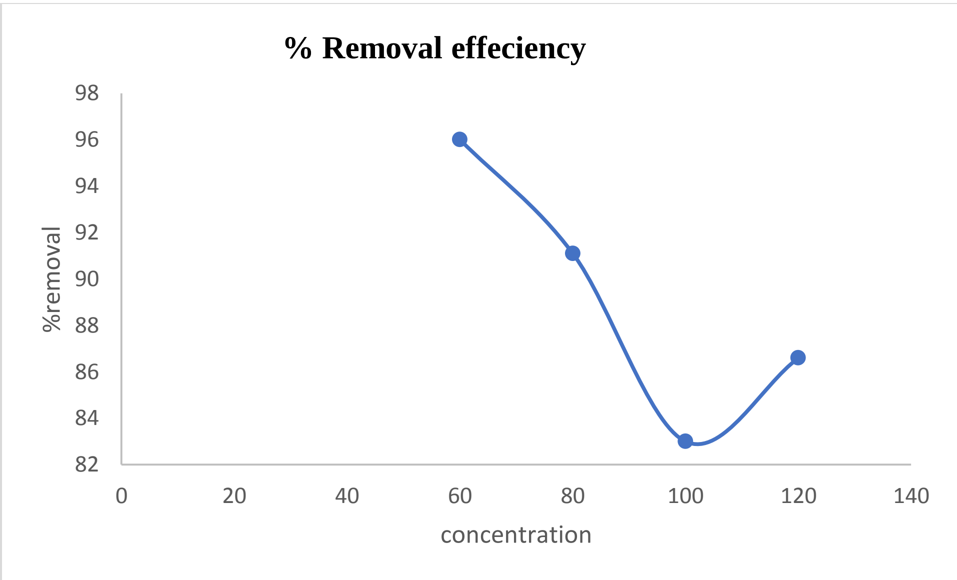


Figure 8: Data for effect of initial concentration:

4.6 Comparision of removal % between snail shell and charcoal:

There are many adsorbent available in the sorrounding but for the comparision of the economically available adsorbent as, charcoal and snail shell ,it was found that, the % removal of the charcoal(97-98.63%) was comparitively greater than that of snell shell (83-96.1%) which is illustrate as below in the given data and graph.

Table 8: comparison of removal % between shell and charcoal

for 24hr of char coal	
1	97
2	97.9
3	98.28
4	98.6
5	98.63

for 24hr of snail	
1	83.7
2	91.1
3	92.6
4	94.2
5	96.1

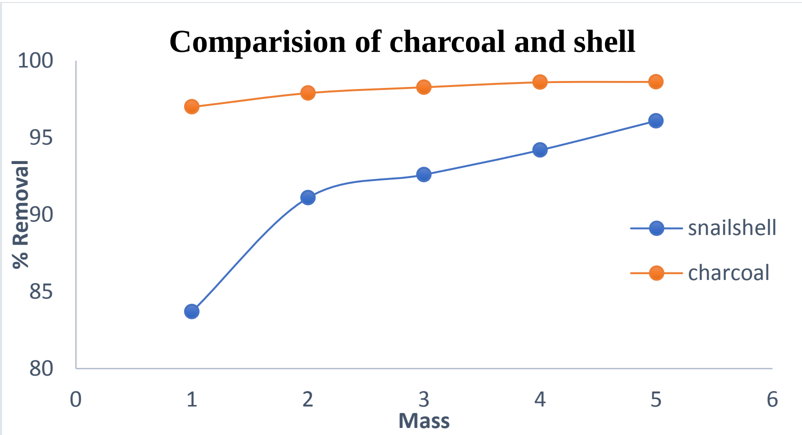


Figure 9: comparison of removal % between shell and charcoal

4.7 Adsorption isotherms

Adsorption isotherms describe and explain the , between the adsorbent and adsorbate, which is crucial for optimizing the adsorption process (Cao et al., 2014)The equations describe the distribution of an adsorbate between the liquid and solid phases as the adsorption processes attains equilibrium (Hameed, Ahmad, et al., 2007)The analysis of equilibrium adsorption data by fitting them to different isotherm model that can be used for design purposes. (Haghseresht & Lu, 1998).

4.8 Langmuir isotherm

The Langmuir model is applicable to surfaces consisting of homogeneous sites where each adsorbate molecule occupies a specific adsorption site. The maximum adsorption occurs when a complete monolayer forms, and once the active sites are covered by dye molecules, further adsorption does not take place. This behavior is described by the Langmuir isotherm model, which can be represented by an equation.,

$1/qe=(1/qm) + (1/kl\ qm\ ce)$,

where qm (mg/g) is the maximum adsorption capacity of the adsorbent and Kl is the Langmuir equilibrium counter-related to bio adsorption energy.

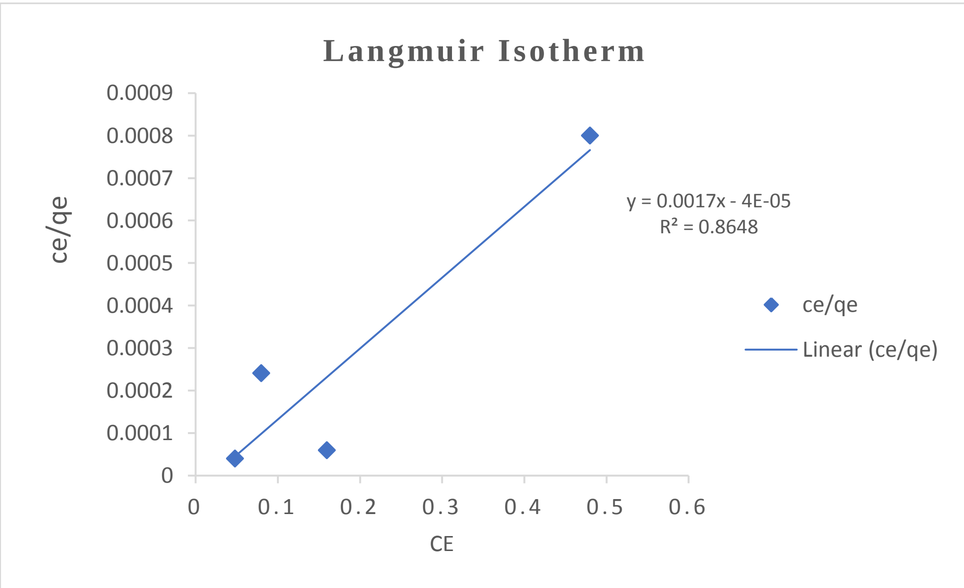


Figure 10: Langmuir isotherm

4.9 Freundlich Isotherm :

The Freundlich model acknowledges the surface's heterogeneity and suggests that adsorption takes place at sites with varying energy levels of adsorption. The Freundlich equation for heterogeneous surface energy system is:-

Logqe=logkf+1/n logce

In the Freundlich model, qe represents the equilibrium adsorption amount (mg/g), Ce is the equilibrium concentration of the adsorbate (MB), and kf and n are Freundlich constants. The value of n indicates the favorability of the adsorption process, while K represents the adsorption capacity of the adsorbent. The parameter Ky can be defined as the adsorption or distribution coefficient, representing the quantity of dye adsorbed per unit equilibrium concentration on the carbon adsorbent. The slope 1/n, ranging between 0 and 1, reflects the adsorption intensity or surface heterogeneity, with a value closer to zero indicating higher heterogeneity.(Haghseresht & Lu, 1998).

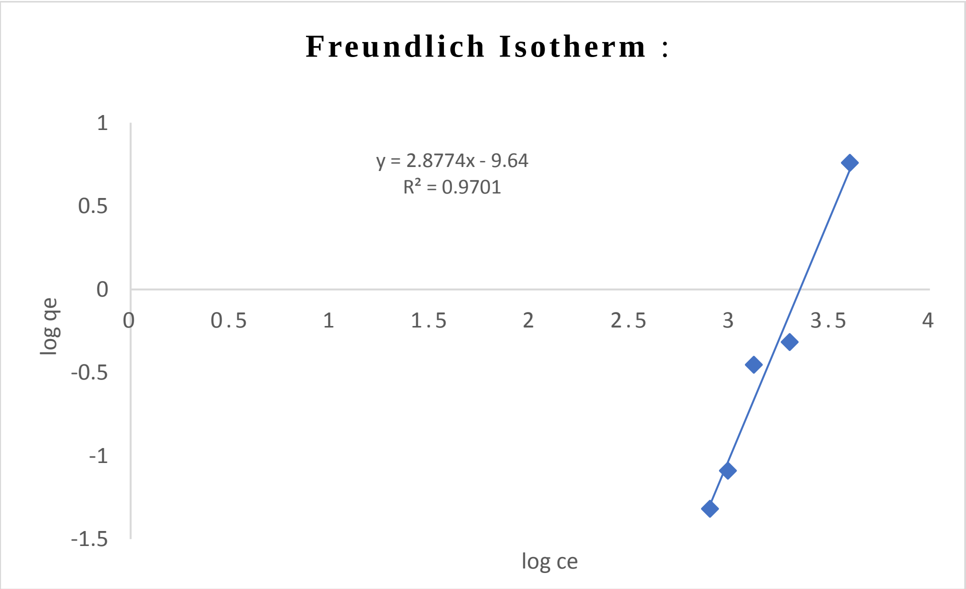


Figure 11: freundlich isotherm

A value for 1/n below one indicates a normal Langmuir isotherm while 1/n above one indicates cooperative adsorption. The plot of log qe versus log Ce gives straight line with slope I/n, which shows that the adsorption of methylene blue also follows Freundlich isotherm.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The results of this study demonstrate that snail shell powder can be utilized as a highly efficient material for removing methylene blue dye from aqueous solutions. The surface of the snail shell exhibited a strong ability to adsorb methylene blue molecules. It was observed that the percentage of dye removal increased with longer contact times and higher doses of the adsorbent. Conversely, as the initial dye concentration increased, the percentage of dye removal decreased. The equilibrium data obtained from the experiments were analyzed using Langmuir and Freundlich isotherm models. The Langmuir isotherm model provided the best fit for describing the adsorption equilibrium data.

These findings suggest that the shell of a snail can serve as an effective adsorbent for the elimination of methylene blue from wastewater. By utilizing snail shell powder, a natural and abundant material, the removal of methylene blue can be achieved in a cost-effective and sustainable manner. This approach has the potential to address the challenges associated with the presence of methylene blue dye in aqueous environments. Furthermore, the successful utilization of snail shell powder as an adsorbent for methylene blue removal highlights the importance of exploring natural waste materials for environmental remediation applications

.5.3 Novelty and National Prosperity aspect of Project work.

Adsorption is a crucial process in wastewater treatment, environmental remediation, and other industrial applications. The quest for sustainable and efficient adsorbents has led researchers to explore unconventional materials, including natural waste products. In this context, the adsorption potential of snail shells, abundant biowaste, has emerged as an intriguing area of study. This noble utilization of snail shells in removing pollutants, such as methylene blue dye, highlights the beauty of nature's inherent ability to provide sustainable solutions.

1)The Significance of Methylene Blue Dye Removal: Methylene blue (MB) is a cationic dye widely used in various industries, including textiles, printing, and paper manufacturing. Due to its harmful effects on aquatic ecosystems and human health, the removal of MB from wastewater is of paramount importance. Traditional treatment methods often fall short, prompting the exploration of alternative adsorbents.

2) Snail Shells as a Natural Adsorbent: Snail shells are composed primarily of calcium carbonate ($CaCO_3$) and exhibit a porous structure, making them suitable for adsorption applications. The intricate architecture of snail shells, characterized by interconnected channels and voids, enhances their surface area and adsorption capacity. The presence of functional groups, such as amino and carboxyl groups, further contributes to their adsorption potential.

3) Adsorption Mechanisms: The adsorption of MB onto snail shells involves various mechanisms, including electrostatic interactions, ion exchange, and surface complexation. The positively charged MB molecules are attracted to the negatively charged surfaces of snail shells, resulting in the formation of adsorption layers. Factors such as initial dye concentration, pH, contact time, and temperature influence the adsorption efficiency.

4) Optimization : Researchers have delved into optimizing the adsorption process by manipulating parameters like pH, temperature, and dosage of snail shell adsorbents

5) Comparative Studies: Comparisons with other adsorbents, both natural and synthetic, highlight the exceptional performance of snail shells in MB adsorption. Their noble efficacy has been demonstrated against activated carbon, zeolites, and other biomaterials. The unique properties of snail shells, coupled with their abundance and low cost, make them an attractive alternative in wastewater treatment.

6) Regeneration and Reusability: One noble aspect of snail shell adsorbents lies in their regenerability. Various desorption methods, such as chemical regeneration and thermal treatment, have been explored to recover MB from spent snail shells. The capacity for multiple regeneration cycles makes snail shells an eco-friendly and cost-effective solution.

Eventually, The utilization of snail shells as an adsorbent for the removal of methylene blue dye presents an elegant example of nature's nobility. This humble waste product offers a sustainable and effective solution to mitigate the environmental impact of dye pollutants. As research in this field continues, the noble potential of snail shells in adsorption processes may extend to other pollutants and inspire innovative applications in wastewater treatment and beyond

1.5 limitation of the study

- The whole project work was carried out at room temperature.
- The purity of distilled water was not identified

5.2 Recommendation

Further study on can be done by activating the snail skeleton powder to find the pseudo first order kinetic and pseudo second order kinetic and also removal% can be calculated due to the change in temperature of adsorbent.

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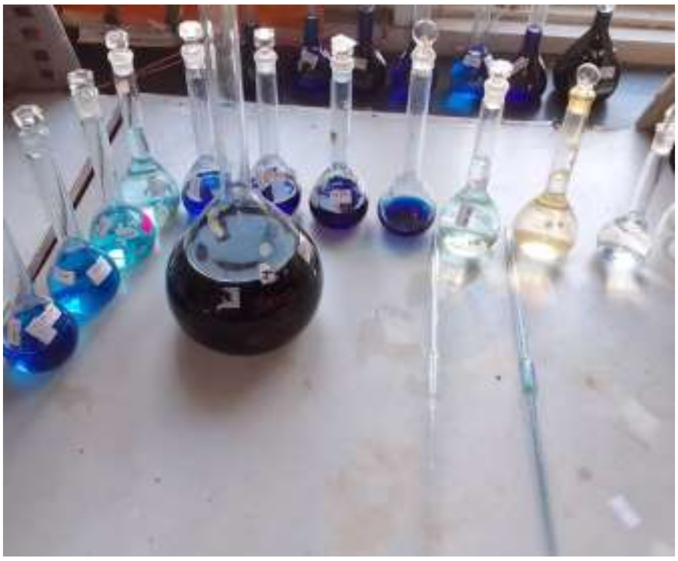
APPENDIX

PHOTOGALLARY

Photograph 1: skeleton of snail

Photograph 2 :crushing form of snail skeleton

Photograph 3: power form of shell



Photograph 4:Methylene blu solution of different concentration

Photograph 5: UV-Vis Spectrophptometer

Adsorption of methylene blue on to skeleton of ...

By: Akash Rijal

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ABSTRACT This research study investigates the adsorption properties of Snail Shell as an adsorbent material for removing contaminants.

Various parameters such as contact time and adsorbent 8

dose were examined to determine their influence on the adsorption process and removal efficiency. The study also employed

Langmuir and Freundlich isotherm models to analyse the equilibrium data. The results **of the** 3

experiments revealed that the percentage removal efficiency of Snail Shell increased as the contact time and adsorbent dose increased. However, it decreased with higher concentrations of the dye being adsorbed. The isothermal analysis indicated that the Langmuir model provided the best fit for the equilibrium data, as evidenced by a high correlation coefficient value ($R2 = 0.8648$) for the Snail Shell adsorbent (Bellamya bengalensis). Further analysis of the data plotted in Excel demonstrated that the percentage removal efficiency of Snail Shell increased with higher masses of the adsorbent. Moreover, the use of a higher adsorbent dose resulted in comparable adsorption performance to that of charcoal, a commonly used adsorbent material. Overall, this study highlights the adsorption properties of Snail Shell and its potential as an effective adsorbent for contaminant removal. The findings suggest that Snail Shell exhibits favorable adsorption characteristics, with improved performance observed at longer contact times and higher adsorbent doses. The Langmuir model provides a suitable representation of the equilibrium data, indicating the formation of monolayer adsorption on the Snail Shell surface. The research contributes to the understanding of Snail Shell's adsorption behavior and offers insights into its practical application in water treatment and other environmental remediation processes. Key word: methylene blue, Snail shell, Charcoal, %removal, Adsorbent. CHAPTER 1 INTRODUCTION 1.1 Background Various

industries, such as textiles , paper **mills, leather, dye synthesis, printing, food, and plastics** 25