EFFECTIVENESS OF ACTIVATED CARBON FROM BAMBOO CHIPS FOR INDUSTRIAL WASTEWATER TREATMENT

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Bachelor's Degree

UNIVERSITI MALAYSIA PAHANG

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NUR HALISSA SYUHADA BT ABDUL RAZAK

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ABSTRAK

Sistem sungai yang mengelilingi kawasan perindustrian Gebeng telah mengalami tekanan berlebihan akibat daripada pertumbuhan pesat pengeluaran di kawasan itu, yang merangkumi pelbagai kilang dan aktiviti perlombongan. Berdasarkan efluen yang dibuang, aktiviti perindustrian berasaskan perlombongan petrokimia dan bauksit telah disenaraikan sebagai penyumbang kepada pencemaran bahan kimia dan logam berat dalam badan air. Logam berat, yang telah terkumpul dalam tanah untuk masa yang lama, berbahaya kepada ekosistem marin. Pencemaran air dengan sebatian organik dan bukan organik seperti logam dan racun perosak telah mendorong penyelidik untuk menambah baik kaedah penulenan dan pengekstrakan seperti penjerapan bahan pencemar menggunakan karbon teraktif. Matlamat kajian ini adalah untuk melihat keberkesanan karbon teraktif cip buluh dalam merawat air sisa tercemar dari kawasan perindustrian Gebeng. Parameter fizikal dan kimia air dianalisis untuk menilai tahap pencemaran awal, yang kemudiannya dibandingkan dengan tahap pencemaran selepas empat minggu rawatan. pH, kekeruhan, jumlah pepejal terampai (TSS), permintaan oksigen biokimia (BOD), permintaan oksigen kimia (COD), serta zink (Zn) dan kuprum (Cu). logam berat (Cu).Selain itu objective project ini adalah untuk mengenal pasti tahap bahan pencemar yang terkandung dalam air sisa kawasan perindustrian Gebeng dan seterusnya untuk menentukan keupayaan karbon teraktif daripada kerepek buluh dalam merawat air sisa. Objective yang terakhir adalah untuk membandingkan prestasi fizikal dengan pengaktifan 500℃ dan 400℃ dalam merawat air sisa. Process untuk mengahasilkan karbon teraktif adalah dengan membakar kerepek buluh kepada dua suhu iaitu 500℃ dan 400℃ dengan mengunakan relau selama beberapa jam. Setelah itu kerepek buluh tersebut disejukkan pada suhu bilik dan dihancur kan menjadi serbuk dan dibahagikan kepada tiga nisbah bagi kedua dua suhu tersebut. Setelah itu setiap nisbah iaitu 20, 30 dan 40g telah dicampurkan dengan zinc kholoride sebanyak 10g. Seterusnya , dipanaskan di plat haba sehingga sebati dan dibilas dengan air suling dan dibakar mengunakan ketuhar dengan suhu diantara 100 ° C dan 110 ° C selama 6 jam. Setelah selesai, karbon teraktif tersebut telah dicampur dengan air buangan dan dibiarkan selama satu semalam untuk melarut dengan sebati dan ditapis untuk diuji bagi setiap nisbah supaya dapat membuktikan kebekesanan kerepek buluh tersebut. Setelah data diambil secara keseluruhan dapat di simpulkan bahawa pada suhu 400° C dan nisbah 40g lebih berkesan berbanding suhu dan nisbah yang lain. Akan tetapi keseluruhan data yang diambil untuk kesemua parameter.

ABSTRACT

The river system surrounding the Gebeng industrial area has experienced excessive stress as a result of the rapid growth of production in the area, which includes various factories and mining activities. Based on the effluent discharged, industrial activities based on petrochemical and bauxite mining have been listed as contributors to the pollution of chemicals and heavy metals in water bodies. Heavy metals, which have accumulated in the soil for a long time, are harmful to marine ecosystems. Water pollution with organic and inorganic compounds such as metals and pesticides has prompted researchers to improve purification and extraction methods such as adsorption of pollutants using activated carbon. The aim of this study was to see the effectiveness of bamboo chip activated carbon in treating polluted wastewater from Gebeng industrial area. The physical and chemical parameters of the water were analyzed to assess the level of initial contamination, which was then compared with the level of contamination after four weeks of treatment. pH, turbidity, total suspended solids (TSS), biochemical oxygen demand (BOD), chemical oxygen demand (COD), as well as zinc (Zn) and copper (Cu). heavy metals (Cu). In addition, the objective of this project is to identify the level of pollutants contained in the wastewater of Gebeng industrial area and further to determine the ability of activated carbon from bamboo chips in treating wastewater. The final objective is to compare physical performance with 500 ℃ and 400 ℃ activation in wastewater treatment. The process to produce activated carbon is to burn bamboo chips to two temperatures of 500 ℃ and 400 by using a furnace for several hours. After that, the bamboo chips are cooled at room temperature and crushed into powder and divided into three ratios for the two temperatures. After that each ratio of 20, 30 and 40g was mixed with zinc chloride of 10g. Next, it is heated on a heat plate until well blended and rinsed with distilled water and baked in an oven with a temperature between 100 ° C and 110 ° C for 6 hours. Upon completion, the activated carbon was mixed with wastewater and left for one night to dissolve thoroughly and filtered to be tested for each ratio in order to prove the effectiveness of the bamboo chips. Once the data are taken as a whole it can be concluded that at a temperature of 400 ° C and a ratio of 40g is more effective than other temperatures and ratios. But the whole data is taken for all parameters.

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LIST OF SYMBOLS

℃	Temperature Celsius
Mg/l	Milligram per liter

LIST OF ABBREVIATIONS

BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
TSS	Total Suspended Solid

CHAPTER 1

INTRODUCTION

1.1 Background of the study

Wastewater is watering whose physical, chemical, or biological qualities have been altered by the application of such chemicals, rendering it inappropriate for certain uses, such as drinking. Wastewater is the liquid waste emitted by residences, businesses, industries, and farms, and it may contain pollutants as a result of wastewater from several sources being mixed. Because man's daily activities are heavily reliant on water and also discharges "waste" into the water. Body waste which is faeces and urine, hair shampoo, hair, food scraps, fat, laundry powder, fabric conditioners, toilet paper, pesticides, detergent, household cleansers, dirt, and microorganisms (germs) are just a few of the substances that can make people sick and harm the ecosystem. It is well recognized that a significant portion of the water supplied ends up as wastewater, making its treatment critical. Wastewater is frequently pure water with a purity of greater than 95%, and depending on the kind and level of contamination, it can be cleaned using a variety of methods. Wastewater treatment is the process and technology through which the majority of pollutants in wastewater are removed in order to safeguard the environment and public health. Making waste water management a non-negotiable subject (Indranil Singh,2020). Thus, wastewater management comprises managing wastewater in a way that is environmentally friendly while also ensuring public health, economic, social, and political stability (Metcalf and Eddy, 1991).

According to the 2010 Census Report from the Department of Statistics (Mat1,2011). Malaysia is a country with a population of 28.3 million. Annually, the municipal and industrial sectors produce an estimated 2.97 billion cubic meters of wastewater. The proportions of population equivalent (PE) covered by various sewerage networks are depicted in Figure 1.1

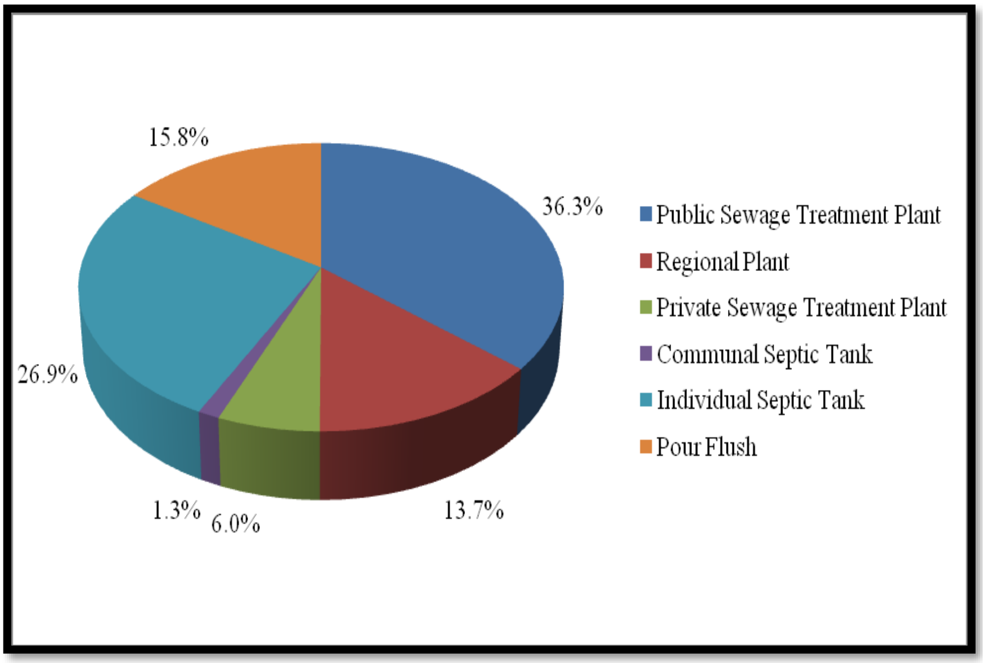


Figure 1.1 Proportions of population equivalent (PE) served by the various sewerage systems.

Source: (Engku Azman Tuan Mat)

According to Indah Water Konsortium which is the country's largest sewerage operator, the most prevalent wastewater treatment methods are preliminary for removal of rags, garbage, grit, oil, and grease), primary (removal of settleable and floatable debris), and secondary treatment (biological treatment to remove organic and suspended solids). Malaysia has no intentions to create tertiary treatment systems at the moment. The major objective has been to provide essential pre-, primary-, and secondary care. Malaysia's principal wastewater treatment constraint is that low sewerage charges cannot pay high operating and maintenance expenses in the existing environment. The primary reason of non-compliance or mediocre compliance is a high influent of oil and grease (O&G) discharged into STPs serving manufacturing, commercial, and food-related business premises that do not have grease traps or do not maintain grease traps adequately. Excessive soap, detergent, and other cleaning chemical leaks into sewage systems is also an issue. It is inconvenient for operators to collect sewage services, as many Malaysians are unaware of the need of sewage management in terms of a healthy climate. Due to the intricacies of the sewage business, which involves private developers designing infrastructure and then handing it over to a public operator (for operations and maintenance), there is a risk of efficiency being compromised, which would have a negative impact on the environment. (Engku Azman Tuan Mat,2010)

Bamboo is a perennial large woody grass that belongs to the subfamily Bamboo of the family Graminae. It grows in a few months and matures in three to four years (Udeh,2018).

Bamboos are plentiful and widespread in Malaysia. The majority of Malaysian bamboos grow gregariously, albeit in isolated patches along river banks, disturbed lowland forest edges, and on hillsides and ridge tops, as cited in (Appanah,1992). The populations are found in both pure stands and mixed stands with other forest species. Bamboos were historically viewed as weeds in Malaysian Forestry (Watson and Wyatt-Smith 1961; Chin 1977). Nonetheless, it is currently second in economic importance to rattan in Peninsular Malaysia among minor or non-timber forest products (Aminuddin and Abd. Latiff 1991).

Chemical precipitation, chemical on oxidation, air stripping, and adsorption are all common methods for heavy metal removal from wastewater (Renou et al. 2008). This process removes 99 percent of pollutants from raw sewage. However, the whole cost of the therapy, including service, repair, and construction, is astronomical (Mackenzie et al. 2004). However, due to the high cost and the desire to maintain a clean environmental footprint, researchers have investigated the manufacture of activated carbons using inexpensive and renewable precursors. Bamboo appears to be economically attractive because to its abundance, low cost, high carbon content, rapid growth rate, and high rate of multiplication (Udeh,2018)

1.2 Problem Statement

Nowadays, Malaysian rivers are frequently polluted as a result of industrial and agricultural activity. As a result of the pollution created by these activities, various unfavourable impacts have occurred that are detrimental to both the environment and human health. Due to the problem of river pollution, the water treatment facility has used a variety of materials, including activated carbon, to treat or remove pollution from the river.

Additionally, activated carbon is referred to as activated charcoal or activated coal (Shitu, 2016). Activated carbon performs a variety of tasks in the water treatment process, including the ability to absorb a wide variety of components, both organic and inorganic. Additionally, the structure of activated carbon has a huge active surface area, which enables it to absorb a wide variety of chemicals and contaminants from specific surroundings and waste water (Bursic,2016). However, there are a few drawbacks to employing activated carbon, including the procedure required to produce high-efficiency activated carbon and the high cost (George, 2015).

Activated carbon comes in a variety of forms or qualities and can be produced from a variety of plants, one of which is bamboo chips. The need to discover the most effective and suitable properties of activated carbon is critical because they may provide the greatest outcome while also providing the most effective wastewater treatment and a more environmentally friendly environment. And study and identify the effectiveness of burning bamboo chips to produce activated carbon using a temperature between 400 ℃ and 500℃ in order to produce better quality activated carbon and able to reduce pollution in the wastewater industry.

1.3 Objective

There are 3 objectives for this study based on the problem statement. The objectives are as below:

1. To identify the level of pollutant contained in wastewater of Gebeng industrial estate.
2. To determine the ability of activated carbon from bamboo chips in treating wastewater.
3. To compared the performance of physical with 500℃ and 400℃ activations in treating wastewater.

1.4 Scope of Study

The properties of industrial wastewater, as well as the performance of bamboo chip activated carbon in removing heavy metals from it, are the focus of this study. The samples were taken at the Gebeng industrial district's industrial waste water treatment plant (mining activities). The physical and chemical properties of wastewater are utilised to determine the characteristics of the wastewater. An extensive series of experiments is conducted in order to identify the chemical characteristic, which includes the parameters of pH, biological oxygen demand (BOD), chemical oxygen demand (COD), and metal ions. Also required are the measurement of certain physical parameters such as leachate colour, odour and turbidity, as well as the total suspended solids (TSS). In this study, the primary objective is to determine the effectiveness of bamboo chips activated carbon in removing heavy metal ions from industrial wastewater when activated using chemical and physical activation methods. The purpose of these tests is to discover the most effective pH, contact time, agitation level, and dosage for this method by experimenting with various variables. This results in a more cost-effective form of wastewater treatment than other conventional techniques because of the reduced cost of wastewater treatment utilising bamboo chip activated carbon adsorption between temperature 400℃ and 500℃

1.5 Significant of Study

The goal of this study is to compare the effectiveness of physical technique with different temperature when burn the bamboo chips with 400℃ and 500℃ process activation in treating wastewater in the Gebeng industrialisation in order to create activated carbon from inexpensive and renewable precursors. In addition, it will investigate the effectiveness of bamboo chips in reducing pollution in water by the reduction of BOD, TSS, turbidity, and pH levels. A successful demonstration of the use of bamboo chips as activated carbon can result in significant cost savings for water treatment. It is critical to develop an efficient and cost-effective treatment alternative that can be commercialised in order to provide users with clean water to supply for residents.

CHAPTER 2

LITERATURE REVIEW

2.1 River

Rivers are described as a large, natural freshwater stream which flows to the ocean of water or other broad size and usually is fed into it by smaller streams, known as the tributaries. Rivers, water bodies flow dynamically and adjust continuously according to the flow of water. Some of the changes are related to a river or place these are spatial changes. Some of the shift is related to time, in particular the season of the year. Some changes occur abruptly, others occur even more progressively. Any modifications are man-made.

Usually rivers begin at a source, a point that flows downhill to a bigger body of water like an ocean, sea or wide lake. In guiding the streams of rivers, gravity plays an important part. The origin point for rivers is located on the watercourse at the highest point. The region from which runoff drains is also known as the watershed.

Rivers are complex ecosystems which, due to overuse and increased population growth, have been seriously damaged or even destruck. Rivers and human populations are connected closely with socio-economic developments and have contributed to significant depletion and changes in river habitats. However, many specific plants and animals have been affected by human disruption in their provision of vital products and services, such as water purification, power generation, retention of organic matter, nutrient recovery, recreation and habitat (Majib, 2016). The rivers reciprocate the surrounding ecosystem with water, materials, energy and nutrients. The quality of the river, sediment and biological communities all represent upstream and also downstream characteristics. In contrast, thermal, sculptural, watered and nutritionally complemented ecosystems in rivers and rivers are existing. River research has a multidisciplinary nature and is based on several biological, chemical, physical and engineering branches. Given that the overwhelming majority of rivers and streams are regulated in a way by humans, impacts on these systems may be significant and their efficiency can be improved (J. Mccabe ,2010).

2.2 Wastewater

Wastewater is any water that has been affected by anthropogenic influences and includes liquid waste released by domestic households, industrial facilities, manufacturing, or agriculture, and can include a wide variety of possible pollutants and concentrations. Wastewater also is watering whose physical, chemical or biological properties have been changed as a result of the introduction of certain substances which render it unsafe for some purposes such as drinking. The day-to-day activities of man is mainly water dependent and therefore discharge waste into water. Some of the substances include body wastes faeces and urine, hair shampoo, hair, food scraps, fat, laundry powder, fabric conditioners, toilet paper, chemicals, detergent, household cleaners, dirt, micro-organisms (germs) which can make people ill and damage the environment. It is known that much of water supplied ends up as wastewater which makes its treatment very important. Wastewater treatment is the process and technology that is used to remove most of the contaminants that are found in wastewater to ensure a sound environment and good public health.

Wastewater is a liquid that contains nitrogen and phosphorus from human waste, food and certain soaps and detergents. Once the water is cleaned to standards set and monitored by state and federal officials, it is typically released into a local water body, where it can become a source of nitrogen and phosphorus pollution. The composition of wastewater is 99.9% water and the remaining 0.1% is what is removed. This 0.1% contains organic matter, microorganisms and inorganic compounds. Wastewater effluents are released to a variety of environments, such as lakes, ponds, streams, rivers, estuaries and oceans. Wastewater also includes storm runoff, as harmful substances wash off roads, parking lots and rooftops. The organic content of wastewater is made up of human feces, protein, fat, vegetable and sugar material from food preparation, as well as soaps. Some of this organic content is dissolved into the water and some exist as separate particles. The portion of organic material that does not dissolve but remains suspended in the water is known as suspended solids. Wastewater is treated to remove as much organic material as possible.

Wastewater needs to be treated into clean water in order to avoid affecting the health of consumers due to the content contained in the wastewater. Water is an important use for humans, plants, and many more. Water treatment is installations where waste or dirty water is converted into better quality water through various physical and chemical processes.

2.2.1 Types of Waste Water

There are three types of waste water, or sewage: domestic sewage, industrial sewage, and storm sewage. Domestic sewage carries used water from houses and apartments; it is also called sanitary sewage. Industrial sewage is used water from manufacturing or chemical processes.

2.2.1.1 Domestic Wastewater

Domestic wastewater is a community water that includes all the products that have been applied to the water for the use. It is thus composed of waste of the human body, which is faeces and urine and the waste water that is the result of personal washing, washing, preparing food and cleansing cookware. Fresh waste water is an earthy, but harmless, grey, turbid substance. It contains large floating and suspended solids such as fabrics, rags, containers of plastic, cobs of maize, smaller solids, such as partially broken faeces, paper, vegetable peel and very small solids in the colloidal suspension, which is non-stable and contaminants of real solution. In aspect and in content it is dangerous, primarily because of the number of 'pathogenic' species causing a disease. Waste water can soon lose its dissolved oxygen content in warm climates and become 'stale' or 'septic.' Septic wastewater typically has a hydrogen sulphide offensive odour (Mara ,2013).

2.2.1.2 Industrial Effluent

Industrial effluents are a main source of direct and sometimes persistent contaminants into marine environments with lasting consequences for the workings of the environment, such as shifts in the supply of foodstuffs and extreme threats to biosphere self-regulation. Industrial releases or waste include heavy-metals, pesticides, phenolic compounds and microorganisms, polychlorinated biphenyls, dioxins, polyaromatic hydrocarbons (PAHs), petrochemicals. The waste is normally dumped into water sources and has gained much attention because of the cumulative harmful environmental effects. Industrial waste that contains large levels of microbial nutrients will certainly support the development of substantially high types of coliforms and other microbial shapes. Any of the heavy metals found to be carcinogenic in these effluents whereas other substances similarly present are poisonous in accordance with dosage and length of exposure. Undoubtedly, the environmental equilibrium of such a setting could be disturbed if wastes water from factories and residential areas is released into another area without proper treatment. Therefore, during the driy season the industrial discharge contributes to a greater part of the river's flow, resulting in a further deterioration of water quality. Uses for which the river is used in contacts with the body subject people to severe dangers because of bacterial conditions (Achi, 2011).

2.3 Water Pollution

Water pollution may be defined as the contamination of streams, lakes, seas, underground water or oceans by substances, which are harmful for living beings. If the concentration of substances naturally present in water increases then also the water is said to be polluted. Water is considered polluted if some substances or condition is present to such a degree that the water cannot be used for a specific purpose. Water pollution also defined as to be the presence of excessive amounts of a hazard pollutants in water in such a way that it is no long suitable for drinking, bathing, cooking or other uses (Olaniran, 1995). Pollution is the introduction of a contamination into the environment (Webster, 2010). It is created by industrial and commercial waster, agricultural practices, everyday human activities and most notably, models of transportation. No matter where human go and what human do, there are remnants earths environmental and its inhabitants in many ways. The three main types of pollution which is land pollution, air pollution and water pollution.

2.3.1 Sources of Water Pollution

Water pollution can occur from two sources which is firstly from point source and secondly is non-point source. Point source is pollution that be identify directly of source. For example, is includes pipe attached to a factory, oil spill from a tanker, effluents coming out from industries waste. Meanwhile, non-point source is pollution include wastewater effluent both municipal and industrial and storm sewer discharge and affect mostly the area near it (Asha, 2016).

2.3.1.1 Industrial Wastewater

There are several sources of water contamination. The city sewage and industrial waste released into rivers are the most polluting. The wastewater from industries varies so greatly in both flow and pollution strength. Waste in general is produced by human activity, for instance, extraction and processing of raw materials. Industrial waste management is intentionally done to reduce the adverse effects of waste on the environment and human health. Industrial waste management examines the broader context of waste treatment for wastes directly or indirectly originating from industries, and may include corporate sustainability, environmental impact, consideration of government policy and regulations, recycling, containment, handling and transport, centralized compared to on-site treatment, technologies, economics, avoidance and reduction (Awuchi,2020). Industrial waste with a high carbon content that is handled under anaerobic conditions, whether intended or unintended, will produce CH4. The potential for CH4 production from industrial wastewater streams is determined by the quantity of degradable organic matter in the wastewater, the volume of wastewater, and the industrial sector's proclivity to treat their wastewater in anaerobic sludge (Manickam,2017). Industrial wastewater plants, chemical sludge may be generated as a result of neutralization, precipitation of toxic compounds, or coagulation (Wiśniowska,2019).

2.3.1.2 River Dumping

The main form of contamination in these freshwater bodies is nutrient pollution, which involves nitrates and phosphates. Plants and animals need these nutrients to grow, but because of farm waste and fertiliser ruin, they have become a major pollutant.

2.3.2 Types of Water Pollution

There is some of types of water pollution which is firstly surface water. Surface water resources from huge oceans, lakes, and rivers. Contaminants such as chemicals, nutrients, and heavy metals are carried from farms, factories, and cities into streams and rivers and then to seas and oceans. Our seas are also sometimes spoiled by oil spills. And second types of water pollution are ground water. Ground water is Water stored underground in aquifers is known as groundwater. Groundwater gets polluted when contaminants pesticides, fertilizers or waste leached from landfills and septic systems make their way into an aquifer, rendering it unsafe for human use. It is virtually impossible to remove contaminants from groundwater. Groundwater can also spread contamination into streams, lakes, and oceans.

2.3.3 Effect of Water Pollution

Pollution and wellbeing are more closely associated. Pathogens are known as diseases which cause microorganisms, and these pathogens spread disease directly to human beings. Some pathogens are found in a well-defined region around the world (Kamble.L 2014). Many diseases with water spread human beings to human beings. High precipitation and flooding are connected with severe weather and lead to various diseases for developing and developed countries. The food and vegetables grown in polluted water are the basis for 10% of the population. Many infectious diseases transmitted by water are associated with faecal water contamination and result in infection on faecal oral pathways (Markotter W, 2019). Polluted water health risks include various diseases including respiratory conditions, cancer, diarrheal disorders, neurological and cardiovascular diseases. Cancers and blue baby syndrome are responsible for nitrogen chemicals. In rural areas, the rate of mortality from cancer is higher than in urban areas because urban residents drink filtered water while rural residents have no treatment facilities and do not use unprocessed water. The risk of disease in poor people is higher because of insufficient sanitation, hygiene and water supply (Tariq B 2011) In women who are exposed to contaminants during pregnancy, contaminated water has significant negative consequences it results in increased low birth weight as a result of the foetal health.

2.4 Activated Carbon

Activated carbon refers to a wide range of carbonised materials of high degree of porosity and high surface area. Activated carbon has many applications in the environment and industry for the removal, retrieval, separation and modification of various compounds in liquid and gas phases. Selection of the chemical activator agent is a major step controlling the performance and applicability of activated carbon (Deghani, 2020).

The advantages of activated carbon for zeolites or polymer-based adsorbents are high quality in wastewater treatment, simple process design, easy exploitation of the process, resistance to corrosive such as acid and alkali and toxic environments, high adsorption potential in gas and liquid purification and their use as supportive catalysts (Belal et al, 2011).

2.4.1 Function of Activated Carbon

Activated Carbons are the most powerful adsorbents known. It is basically a solid material consisting mainly of pure carbon. A characteristic feature is its porous structure and the resulting immense surface area which may be as large as 1500 m2/gm. Due to its exceptional adsorption qualities, activated carbon is widely used in process destined to purify, discolour, recuperate and remove odours at low cost and superior efficiency. Activated carbons work on the principle of adsorption. Adsorption is an interfacial process involving the collection of gaseous or solute components on the surface of adsorbent solids. This phenomenon is associated with physical attractive forces that bind gaseous and solute molecules commonly known as Van-der Waals forces. Adsorption is thus a physical process, which is the substances adsorbed on the solid do not undergo any chemical reaction with the latter. The adsorbing solid is referred to as adsorbent and the substance to be adsorbed from the liquid or the gas phase as the solute. The adsorption power and rate are determined by the kind of activated carbon, the particle size, the pore size and its distribution (Vairagade,2017).

2.5 Water Quality Parameters

After air, water is the second most critical requirement for life to exist. As a result, the scientific literature on water quality is substantial. Water quality is most commonly defined as the physical, chemical, and biological qualities of water. Water quality is a parameter that indicates how well a body of water meets the requirements of one or more biotic organisms or any human use or purpose. The physical and chemical characteristics of industrial wastewater reported here are representative of the majority of industrial wastewater.

2.5.1 Physical Parameter

Water contains a variety of pollutants, including floating, dissolving, suspended, microbiological, and bacteriological impurities, among other contaminants. In order to test for physical characteristics such as temperature, colour and odours, as well as pH, turbidity, and total dissolved solids (TDS), some physical tests should be performed, whereas chemical tests should be performed to test for BOD and COD levels, as well as alkalinity, hardness and other characteristics. Water should be tested for trace metals, heavy metals, and organic contaminants such as pesticide residues in order to get increasingly high quality and purity (Khan S. , 2018). Evidently, drinking water must pass all of these tests and contain the necessary amount of minerals to be considered safe. Since heavy metal and organic pesticide contaminants are found in very low concentrations in water in developed countries, only highly advanced analytical instruments and highly trained personnel are required to ensure that all of these standards are carefully adhered to.

2.5.1.1 Turbidity

Turbidity is defined as the cloudiness of liquid. It is a measure of the capacity of light to flow through water at a certain wavelength. In water, it is caused by the presence of suspended particulates including clay, silt, organic material, plankton, and other particle elements. Turbidity in drinking water is inappropriate from an aesthetic standpoint, as it makes the water appear unappealing.

When it comes to environmental indicators, turbidity is one of the most beneficial since it may provide valuable information rapidly, at a low cost, and on a continuous basis. A wide range of situations, from low-resource tiny systems all the way up to large and sophisticated water treatment plants, can benefit from the measurement of turbidity. Turbidity, which is generated by suspended chemical and biological particles, can have negative effects on both the water's safety and its appearance in drinking-water supplies, according to the Environmental Protection Agency. Turbidity, in and of itself, does not always pose a direct threat to the public's health. However, it has the potential to detect the presence of pathogenic microbes and to serve as an effective early warning system for hazardous events occurring throughout the water supply system, from the point of collection to the point of use (Organization, 2017).

Turbidity Ratings

Good (<1 NTU) - It is recommended that newborns and people with compromised immune systems drink boiled water or a safe alternative.

Fair (1-5 NTU) - It is recommended that children, the elderly, people with compromised immune systems and anyone seeking additional protection drink boiled water or a safe alternative.

Poor (>5 NTU) - It is recommended that all users drink boiled water or a safe alternative. Tap water intended for drinking should be brought to a rolling boil for at least one minute.

2.5.1.2 Total Suspended Solid (TSS)

Everything floating or drifting in a body of water is referred to as total suspended solids (TSS), and this includes sediment, silt, and sand, as well as plankton and algae (Wetzel, 2001). TSS is a term used to describe any particles suspended in water that cannot be removed by filtering them. TSS refers to particles in water that are larger than 2 microns in size, whereas dissolved solids refer to particles that are less than 2 microns in size, which is the size of a standard filter. TSS concentrations are influenced by both organic and inorganic particles, with organic particles from decomposing materials accounting for a significant proportion of total suspended solids. Because the concentration of solids in water increases as the concentration of solids in water increases, the total suspended solids (TSS) is a crucial factor to consider when analysing water clarity (Omer N. , 2019). As TSS levels grow, the ability of water to maintain a diverse array of aquatic life diminishes. TSS absorbs heat from the sun, raising the temperature of the water and decreasing the oxygen content of the water since warmer water holds less oxygen than cooler water. Water photosynthesis slows down as a result of less light reaching the surface of the water. This leads to a drop in the amount of oxygen produced by aquatic plants, further lowering the dissolved oxygen level.

2.5.2 Chemical Parameter

The chemical parameters of industrial wastewater include the pH, BOD, COD, heavy metals, and ammoniacal nitrogen.

2.5.2.1 pH

pH is one of the most significant characteristics to consider when evaluating water quality. It is defined as the negative logarithm of the concentration of hydrogen ions in the water. It is a dimensionless number that indicates the acidity or basicity of a solution in either acid or base. In reality, the pH of water is a measure of how acidic or basic the water is, depending on the source. Acidic water includes an excess of hydrogen ions (H^+), whereas basic water contains an excess of hydroxyl ions (OH) (Omer, 2019).

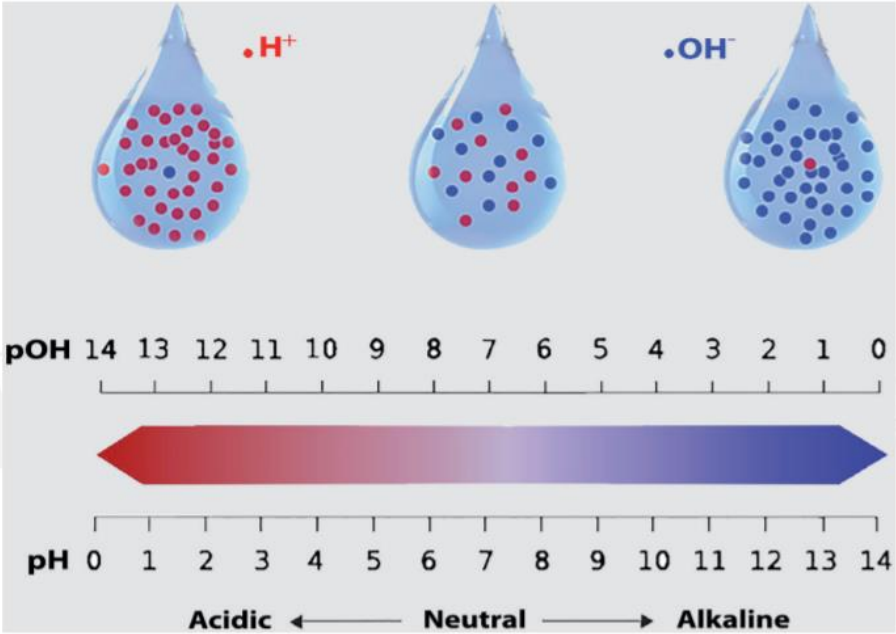


Figure 2.1 pH of water quality

Source: (Omer, 2019)

From the figure 2.1 the pH scale runs from 0 to 14, with 7 representing neutrality. Acidity is indicated by a pH of less than 7, while baseness is indicated by a pH of greater than 7. At 25°C, pure water has a pH close to 7.0, making it a neutral solution. Normal rainfall has a pH of roughly 5.6, making it somewhat acidic due to the presence of carbon dioxide gas in the atmosphere. pH levels from 6.5 to 8.5 are considered safe for drinking water for home use and the needs of living organisms.

2.5.2.2 Biological Oxygen Demand (BOD)

BOD is defined as the amount of molecular oxygen required for the biological oxidation of organic matter in water, as well as the average oxygen demand for aerobically degradable organic waste material. Biological oxygen demand testing is extremely beneficial for managing stream pollution and determining their self-purification potential. BOD is the quantity of oxygen required by aerobic microorganisms to degrade biodegradable organic matter into water and CO2. If the BOD level is low, the water contains little organic matter and has a low microbial population (OmidBozorg-Haddad, 2021).

A laboratory test for determining the relative oxygen requirements of wastewaters, effluents, and polluted waterways is the biochemical oxygen demand (BOD) determination. When it comes to monitoring waste loadings into treatment facilities and evaluating the BOD-removal performance of such treatment systems, the test has the broadest range of applications. Carbonaceous demand is determined by measuring the amount of molecular oxygen consumed during a specified incubation period by biochemical degradation of organic material carbonaceous demand, as well as the amount of oxygen consumed by oxidation of inorganic materials such as sulphides and ferrous iron. It may also be used to determine the quantity of oxygen required to oxidise reduced forms of nitrogen nitrogenous demand, unless the oxidation of these reduced forms of nitrogen is inhibited by a chemical inhibitor. At pH 6.5 to 7.5, the seeding and dilution techniques offer an estimate of the BOD concentration (Constituent, 2019).

2.5.2.3 Chemical Oxygen Demand (COD)

The chemical oxygen demand (COD) of water is the amount of dissolved oxygen required to oxidise chemical organic compounds such as petroleum. COD is used to determine the immediate effect of wastewater effluents on the oxygen levels in receiving waters. COD is a metric that indicates the amount of organic matter in a water sample that is susceptible to oxidation by a powerful chemical oxidant. COD is commonly used to determine the susceptibility of organic and inorganic compounds found in water bodies and municipal and industrial wastes to oxidation (Jain, 2003).

COD is a water quality indicator that is used to evaluate not only the number of biologically active things such as bacteria in water, but also the amount of biologically inactive organic waste (Khan, 2018). The test's shortcoming is its inability to distinguish between physiologically oxidizable and biologically inert material and to determine the aerobic biological stabilisation system rate constant. When a solution of potassium dichromate and sulphuric acid is heated, the majority of organic stuff is destroyed, leaving just carbon dioxide and water. The sample is refluxed with a known concentration of potassium dichromate in sulphuric acid medium, and the excess dichromate is titrated against ferrous ammonium sulphate. Consumption of dichromate is proportional to the amount of oxygen necessary to oxidise the oxidizable organic matter (Delhi, 2012).

2.5.2.4 Heavy Metals

A heavy metal is any metallic chemical element with a relatively high density that is toxic or hazardous at low concentrations. Metals include copper (Cu) and zinc (Zn) (Zn). Heavy metals can enter a water body through industrial and consumer waste, as well as through acid rain, which degrades soils and releases heavy metals into streams, rivers, lakes, and groundwater. Heavy metals are impervious to corrosion and degradation. They enter the human body in trace amounts via food, water, and respiration. While some heavy metals, such as copper and zinc, are required for human metabolism, excessive amounts can induce toxicity. Additionally, heavy metals have a predisposition for bioaccumulation. Bioaccumulation refers to the accumulation of substances or chemicals in an organism, as well as the gradual increase in its chemical concentration over time. Overabsorption occurs when an organism absorbs a potentially dangerous substance at a faster rate than the substance is removed by catabolism and excretion.

Copper (Cu) occurs naturally and is also released into the environment as a result of human activities such as coal-fired power stations, metal manufacture, waste incineration, sewage treatment, and agricultural pesticide use. It is widely used in a variety of applications, including electronic and electrical components, heat exchangers, motors, plumbing fixtures, building construction and roofing, chemical and maritime equipment, culinary utensils, wood preservatives, anti-fouling agents in paints, and as a trace nutrient in livestock feeds. Copper is found in trace amounts in humans' diets and drinking water. This is likely to be beneficial at low quantities because copper is a necessary nutrient for the human body. However, excessive concentrations of Cu have negative health consequences such as chest discomfort, vomiting, and eye and nose irritation.

Zinc (Zn) is used to make paints, plastics, rubber, dyes, preservatives for wood, and cosmetics, as well as corrosion-resistant coatings, dry-cell batteries, and alloys (metal mixtures) such as brass and bronze. Metal manufacturing processes, industrial coal combustion, waste incineration, and worn rubber tyres on automobiles all contributed to pollution discharge into the environment. Natural gas is also emitted from the earth's crust in trace amounts. Zinc contamination has a severe effect on the local aquatic environment by accumulating in aquatic species and poisoning animals that consume it. Consuming contaminated water from Zn water pipes or unintended industrial leaks is the most common method of exposure to potentially harmful levels of Zn. While zinc is an important vitamin for humans, over twice the daily recommended amount can be harmful. It may cause nausea and stomach aches. Prolonged exposure to high levels of metal fumes can cause "metal fume fever," a disorder affecting the lungs and the body's temperature-regulating mechanism.

2.6 Bamboo chips

Bamboo was subfamily Bambusoideae is a large subfamily of the Poaceae family that contains numerous species. Herbaceous bamboos are classified into over 88 genera and 1,642 species worldwide, with 28 genera and over 120 species classified as herbaceous bamboos (Vorontsova et al., 2016). Bamboo species are economically and ecologically significant in a number of countries. Bamboo is used to manufacture a wide array of goods and has a number of uses for humans and other animals, but it also has a large environmental impact (Zhou, 1984).

Bamboos are plentiful and widespread in Malaysia. The majority of Malaysian bamboos grow in patches along river banks, disturbed lowland forests, and on slopes and ridge tops (Ng and Noor 1980; Wong 1989; Azmy 1991). The populations are found in both pure stands and mixed stands with other forest species. Bamboos were historically viewed as weeds in Malaysian Forestry (Watson and Wyatt-Smith 1961; Chin 1977). Nonetheless, it is currently second in economic importance to rattan in Peninsular Malaysia among minor or non-timber forest products (Aminuddin and Abd. Latiff 1991).

Bamboo's potential for use has not been fully explored. Producing value-added goods such as activated carbon would expand its application and assist Malaysia in addressing the emerging wastewater treatment challenge at a very low cost and in an environmentally beneficial manner. It is critical to know the chemical composition of the components that make up bamboo. Carbonization is dependent on the chemical composition of the bamboo. Determining the elemental composition of bamboo by elemental analysis is critical for the comprehensive design of a bamboo carbonization plant's production of activated carbon and helps check the accuracy of the bamboo carbonization process's material and energy balances. Carbon (C), hydrogen (H), oxygen (O), nitrogen (N), sulphur (S), and ash are commonly determined as the last analysis of a bamboo component.

Figure 2.2: Bamboo chips

CHAPTER 3

MTHODOLOGY

3.1 Introduction

The term "methodology" in this research refers to a systematic examination of the processes or procedures used in a particular field of study. The methods section identifies the explanation for the particular techniques or methods of procedures that are used to identify, pick, and analyse data in order to comprehend the detailed research issue. Hence, the reader would be able to assess a study's overall validity and reliability by doing so. Methodology may also be described as the preparation of a thorough research project from start to finish. As a result, the methodology in this study clarified the procedures relating to the chosen agricultural activated carbon, bamboo chips, and the industrial wastewater sample obtained from the Industrial Gebeng Area in Gebeng, Kuantan, Pahang. In this research, the equipment used and the approach to experimentation were discovered.

3.2 Material and Method

3.2.1 Introduction material

The study area and agricultural fruit waste must first be identified before the experiment can begin. The position of the actual sampling, the amounts of sampling, the agricultural fruit waste that will be used, the volume of the activated carbon, and the ability to perform the experiment are all considerations to consider.

3.2.2 Study Area

The research was conducted in the Cargill Palm Products Factory, Industrial Gebeng Area, which is located in Pahang's Gebeng District. The town is close to the port of Kuantan. The East Coast Expressway connects Pahang's main petrochemical cluster, Gebeng Industrial Estate, to Peninsular Malaysia's West Coast. Five kilometres from Kuantan, the Gebeng Industrial Estate offers a large tract of land for investment. By its strategic position, it is home to many multinational companies in the industry. The East West Expressway, which links Kuala Lumpur and Kuantan, is directly connected to the bypass.

Figure 3.1: The view of the Sungai Baluk, Gebeng, Kuantan

Sources: Google Earth 2021

3.2.3 Material

The study's content will consist of three samples of wastewater collected in the Cargill Palm Products Factory at the Industrial Gebeng, each containing two litres. Each storage wastewater will be separated into different groups and treated with different levels of activated carbon made from bamboo chips. The bamboo will be obtained in the agricultural area nearby and the bamboo will be cut into small chips and baked using a furnace and using a temperature of 500℃ and 400℃.

3.2.4 Sample Collection

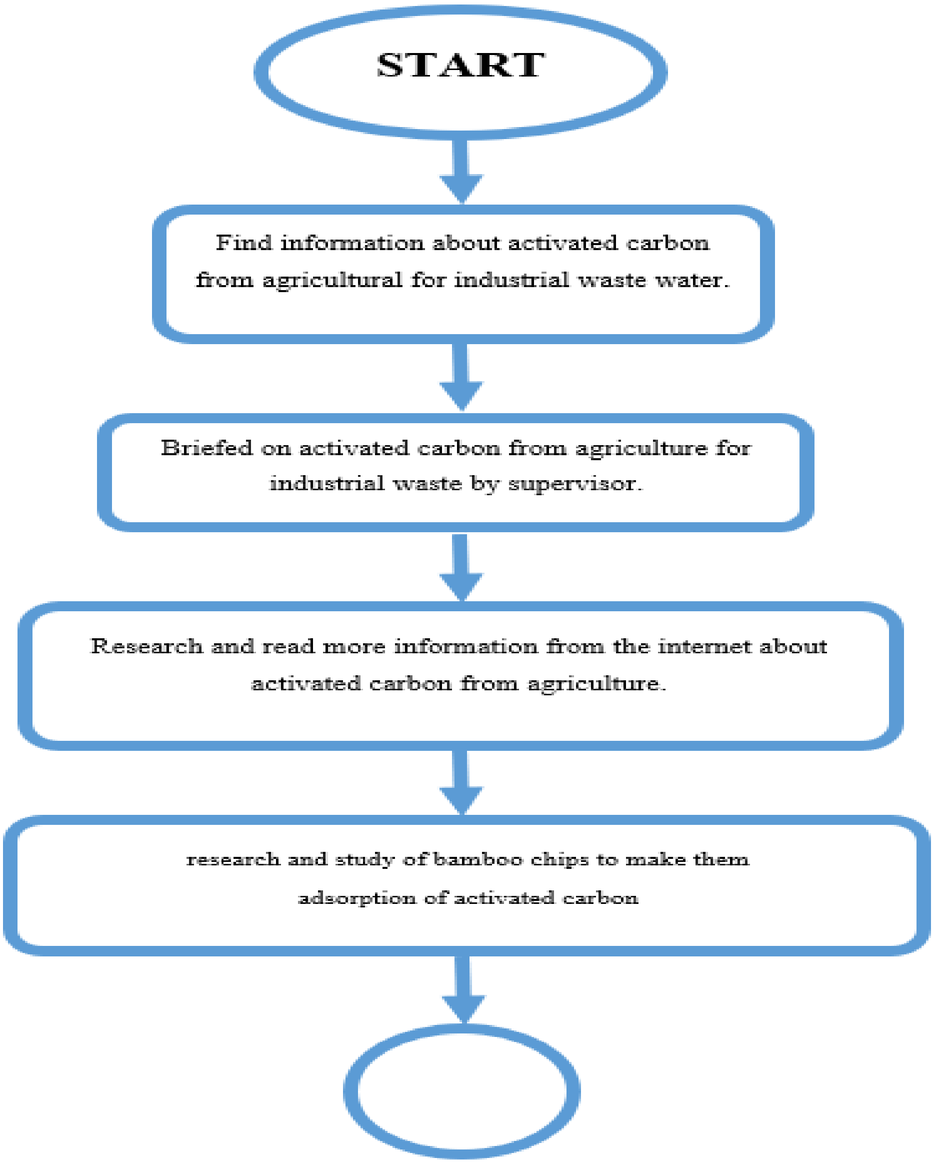
The bamboo chips must be dried and converted into granular activated carbon or powder activated carbon before any experiment can be conducted. The industrial wastewater sample then be collected from the Cargill Palm Products Factory at the Industrial Gebeng area using three containers, each of which must collect two litres of the sample per container. Then, the raw industrial wastewater sample were taken to the laboratory for chemical and physical activation in treating wastewater. For chemical research which is Ph, Biological oxygen demand (BOD), Chemical oxygen demand (COD) and heavy metals. For Physical research method that have been used for this experiment is Colour, Turbidity and Total Suspended Solid (TSS).

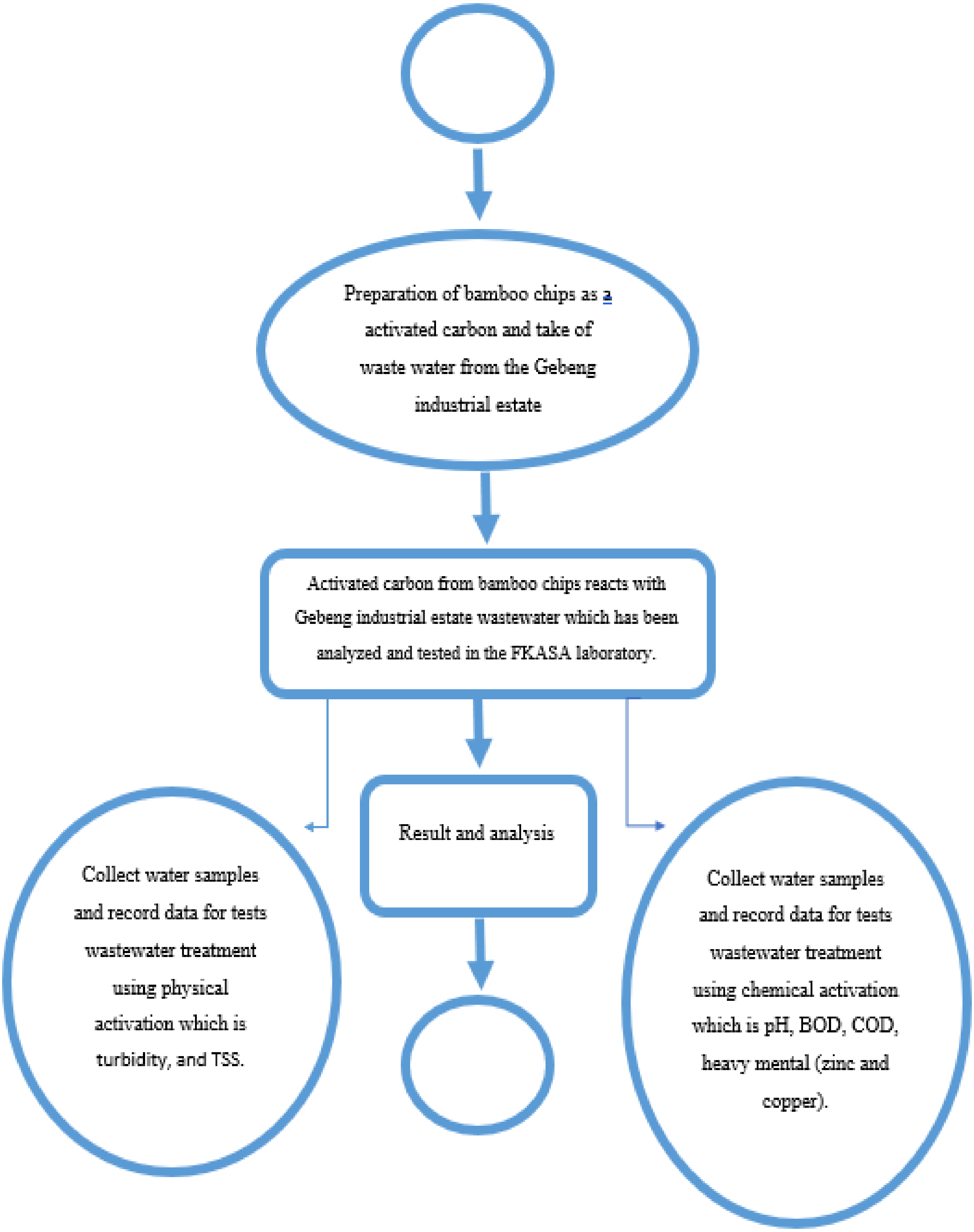
Based on environmental risk and criteria for sediment analysis, cd, ammonia nitrogen and zinc were chosen. This sample was taken before the raw industrial wastewater sample and after the industrial wastewater sample was treated with bamboo chips activated carbon, in other words at the end of the analysis, in order to determine the initial and final heavy metals composition of the industrial wastewater.

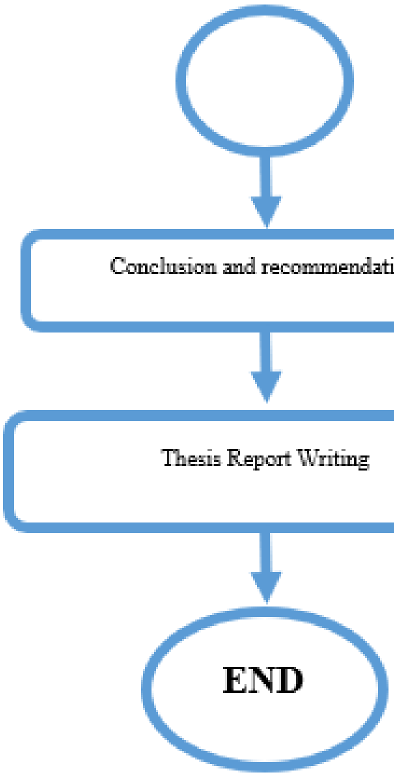
3.2.5 Equipment

The equipment that will be used in this study are the first one is a furnace to burn bamboo chips with 500'c and the next is an oven, blender, hot plate, weighing dishes, glass fiber filter disks, suction flask, membrane filter funnel, crucible, filter paper (45 μm), measuring cylinder (100ml). In addition, the equipment used is a desiccator, beaker (100ml), pH meter (Wagtech N374, M128) which are used for the measurement of the pH. Finally, the equipment used is an incubator that will be used for the BOD analysis at the temperature of 20 ° C.

3.3 Flow Chart of Research Design;




Preparation of bamboo chips as a activated carbon and take of waste water from the Gebeng industrial estate
Activated carbon from bamboo chips reacts with Gebeng industrial estate wastewater which has been analyzed and tested in the FKASA laboratory.
Collect water samples and record data for tests wastewater treatment using physical activation which is turbidity, and TSS.
Result and analysis
Collect water samples and record data for tests wastewater treatment using chemical activation which is pH, BOD, COD, heavy mental (zinc and copper).



3.4 Experiment Set up

Bamboo was collected from the nearest planting area and was cut into small chips. After that, it was dried and 500g of dried Bamboo samples were carbonized in a muffle furnace at two different temperatures which is 400 and 500 °C for 3 hours. The carbonized materials were grinded into smaller sizes to become powder and impregnated with Zinc Chloride (ZnCl) at different weight ratios of 1: 2, 1: 3 and 1: 4 (ZnCl,/bamboo). The resultant mixtures were heated on a hot plate until a paste was formed. The carbon samples were allowed to cool and then washed with distilled water to a pH of 6 and then dried in an oven between temperature ranges of 100 ° C to 110 ° C for 6 hours. After cooling, each activated carbon sample produced from bamboo chips was mixed with wastewater and filtered in one night and using a paper filter to study its effectiveness through testing by physical and chemical characteristic.

3.5 Analysis of Sample

Analysis and testing to study the effectiveness of activated carbon using bamboo chips was performed in a laboratory environment, Faculty of Civil Engineering. There are seven parameters selected analysis of the leachate liquid which are pH, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Dissolved Oxygen (DO), Total Suspended Solid (TSS) and heavy metal (zinc and copper).

3.5.1 pH

The pH value indicates how acidic or basic a solution is. The range is 0 to 14, with 7 representing neutrality. A pH value less than 7 denotes acidity, whereas a value greater than 7 suggests baseness. The pH of water is actually a measure of the relative concentrations of free hydrogen and hydroxyl ions. Through this study, the pH value for the seven samples of activated carbon from bamboo chips that have been produced is a temperature of 400'c with a ratio of 20, 30 and 40 while for a temperature of 500'c with 20, 30, and 40 and wastewater samples can be studied and identified the effectiveness of the sample. Analysing a buffer or other solution with a clear pH value as the standard for pH measurement is a standard procedure. Calibration of the device with a suitable buffer solution is required before carrying out any measurements using a pH meter

3.5.2 Biological Oxygen Demand (BOD)

It is the amount of oxygen that is utilized by bacteria and other microbes while they degrade organic matter under aerobic conditions and at a specific temperature. Biochemical or chemical oxygen demand is a measure of water's decaying organic materials. It takes 5 days to run this experiment and uses equipment such as the biochemical oxygen demand (BOD) test and placed in a incubation. Biochemical oxygen demand (BOD) is usually expressed in mg/L.

$BOD_t = (DO_i - DO_t)/P$

Where:

BOD_t = biochemical oxygen demand, mg/L

DO_i = initial DO of the diluted waste water sample about 15 minutes after preparation, mg/L

DO_t = final DO of the diluted wastewater sample after incubation for t days, mg/L

P = dilution factor

3.5.3 Chemical Oxygen Demand (COD)

Organic matter in water has a "chemical oxygen demand" that determines how much oxygen is required to oxidise it. The amount of oxidation and organic matter in a water sample can be determined via chemical oxygen demand testing. The number of inorganic compounds in a sample can also be determined via chemical oxygen demand testing. COD digestion reactor is used to measure the level of COD value in the sample. 2ml sample was used for the seven samples provided.

3.5.4 Turbidity

Turbidity is generated by particles in water that scatter light, resulting in a cloudy or murky appearance to water. sediment, fine organic and inorganic particles, colourful organic compounds, algae, and other microscopic organisms are all examples of particulate matter. Turbidity can be measured using either an electronic turbidity meter or a turbidity tube. Turbidity is usually measured in nephelometric turbidity units (NTU).

3.5.5 Total Suspended Solid (TSS)

Water -soluble particulate matter is measured as TSS, or Total Suspended Solids. Measuring properties is comparable to turbidity, but gives the exact particle weight per unit volume of the sample usually mg/l. Insert the fiberglass filter with the wrinkled side up in the filtration apparatus and pour the sample water into the fiberglass and dry in an oven at 103 to 105 ° C for 1 hour. The Total Suspended Solids (TSS) in the samples using the following equation:

$$\text{mg TSS/L} = \frac{(A - B) \times 1000}{\text{Sample volume, mL}}$$

where;

A = weight of filter + dried residue, mg

B = weight of filter, mg

3.5.6 Heavy metal

Human and ecological health are at risk when wastewater that has been contaminated with heavy metals makes its way into nature. Arsenic (Ar) and cadmium (Cd) are among the most commonly used heavy metals, followed by lead (Pb), zinc (Zn), mercury (Hg) and nickel (Ni).

3.5.6.1 Zinc

Zinc levels in the atmosphere, soil, and water have risen dramatically in recent decades as a result of increased consumption, incorrect wastewater discharge, landfill and dumpsite leaks, and the combustion of fossil fuels. An equilibrium between the amount of zinc absorbed from food and the amount lost through perspiration defines zinc's physiological homeostasis. A wide variety of industrial activities release zinc into the surrounding environment as one of the most regularly used metals.

3.5.6.2 Copper

When it comes to tap water, copper is the most frequent heavy metal. This is because corroded pipes, faucets, and other plumbing fixtures can introduce copper into the drinking water supply. If the groundwater isn't properly treated, it can get into drinking water.

3.6 Data Analysis

Data analysis is the process of analysing, cleaning, manipulating, and modelling data in order to identify usable information, inform conclusions, and help decision-making. when all the parameter analysis has been performed and the data has been obtained and in chapter 4 the result and discussion is a detailed and clear analysis obtained. Objective can be achieved by analysing the data that has been obtained by producing results with graphs and data tables.

3.7 Research Outcomes

The research outcomes from this study is to ensure the effectiveness of activated carbon made from bamboo chips using different temperatures of 400℃ and 500℃. Activated carbon from bamboo chips has also been proven through data obtained with parameters that have been tested. Besides, the effectiveness temperature bamboo chips activated carbon will be proposed as the new solution for treatment of the industrial wastewater.

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

This chapter will cover out about the result and discussion of Activated Carbon's effectiveness made from Bamboo Chips using different combustion temperature of 400℃ and 500℃. This result uses Waste Water industries mixed with 6 ratio samples at 400℃ temperature having three ratio Which is 20, 30, 40 grams and 500℃ have three ratios as well as 20,30,40 gram and each sample is mixed with 10grams Zinc Chloride. In addition to sample, unmixed waste water is also tested. Parameters used are pH, turbidity, total suspended solid, Chemical Oxygen Demand, Biochemical Oxygen Demand, mental heavy zinc and Copper.

4.2 Characteristic of Industrial Wastewater

Waste Water Sample has been collected in the industry close to Gebeng. The Waste Water is Waste that has been contaminated due to waste disposal from the ongoing industry. Before treating the water. The characteristic of the wastewater has been analysed to achieve the first objective and to know if the water meets the standard in Environmental Quality (Sewage and Industrial Effluents Regulations 1979, Environment Quality ACT 1974). (Sewage and Industrial Effluents Regulations 1979, Environment Quality ACT 1974). Department of Environmental been tough with this to avoid the river pollution and water contamination. The Environment Quality is a guideline where a company of industries should adopt to avoid the water pollution and river pollution. Therefore, the methods that have been used to treat water are by activated carbon using the adsorption process to achieve the objective of the study which is a more effective combustion temperature between 400 and 500℃ to produce activated carbon from bamboo chips.

4.3 Performance of Bamboo Chips between 400℃ and 500℃

4.3.1 pH

The pH parameters were selected to study the level of effectiveness of activated carbon from bamboo chips. Temperatures of 400℃ and 500℃ burning bamboo chips were compared to study between those temperatures which is more effective in measuring the pH value. pH value is showing the degree of hydrogen ion concentration in a substance or solution and is presented as the log of the hydrogen ion concentration in an aqueous solution. And according to standard A and standard B the value of pH which 5.5-9.0

Table 4.1: The value data of pH for activated carbon from bamboo chips.

Ratio (G)	**20**	**30**	**40**
400℃	5.15	5.04	4.83
500℃	5.2	5.22	4.87
Sample	5.73	5.73	5.73

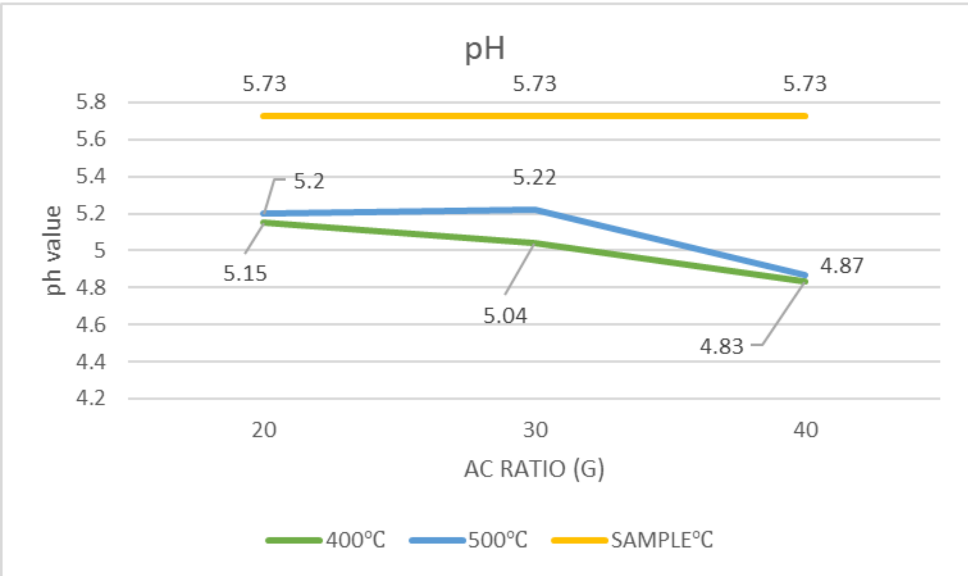


Figure 4.1 The graph value of pH for activated carbon from bamboo chips.

Table 4.1 shows the value of data obtained through the results of the study using pH for each temperature of the sample. While figure 4.1 shows the flow graph where the sample value for wastewater previously mixed with activated carbon from bamboo chips has a value of 5.73 and while the graph shows that the value of each ratio for a temperature of 400℃ is 20g which is 5.15, and at 30g a decrease occurs which is the value pH was 5.04 and for 40g also decreased was 4.83. And for the temperature of 500℃ shows a downward and upward flow that is at a ratio of 20g the pH value shows a value of 5.20 and at a ratio of 30 g the value is slightly upward which is 5.22 and at a ratio of 40g it decreases with a value of 4.87. This indicates that instability occurs in each ratio. However, both of temperature through the water quality standard, each data obtained has not reached that standard.

4.3.2 Biological Oxygen Demand (BOD)

At a given temperature and time, the amount of dissolved oxygen required by aerobic organisms to break down organic material in a water sample is known as Biological Oxygen Demand (BOD) and has been analysed to study the level of effectiveness between 400℃ and 500℃ temperatures.

Table 4.2: The value data of Biochemical oxygen demand for activated carbon from bamboo chips.

Ratio (G)	**20**	**30**	**40**
400℃	19.6	3.95	1.35
500℃	30.3	17.4	5.55
SAMPLE	34.3	34.3	34.3

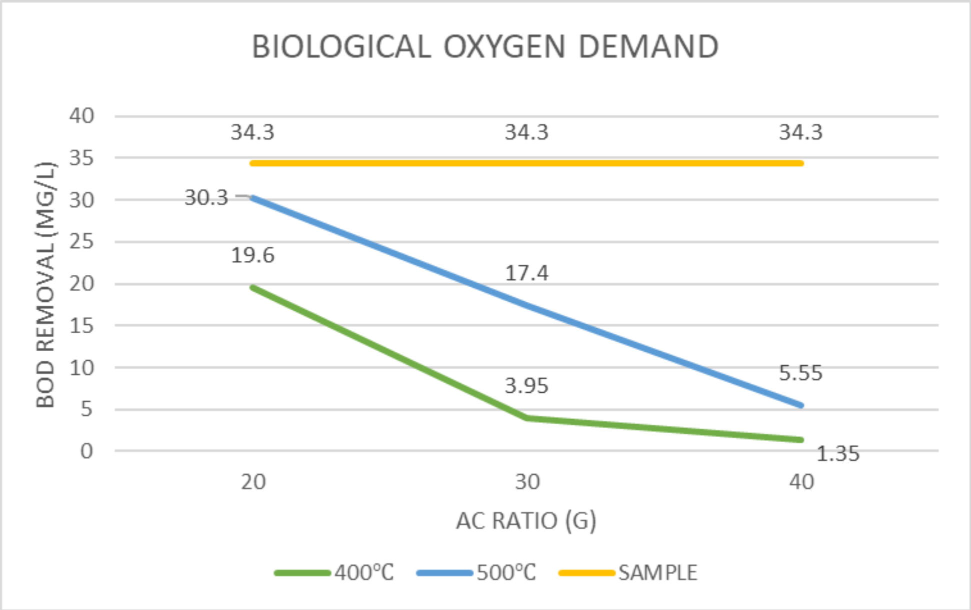


Table 4.2: The graph value of Biochemical oxygen demand for activated carbon from bamboo chips.

Table 4.2 shows the data taken when performing the BOD experiment and in figure 4.2 shows the BOD flow graft that has been recorded. These data show that for the wastewater sample before being mixed with any of the activated carbon is 34.3 and after mixing for both the activated carbon temperature a decrease occurs. The lower the BOD value, the less amount of dissolved oxygen needed by aerobic biological organisms in a waste water. At a temperature of 400℃ has shown effectiveness where at a ratio of 20 g is 19.6 mg/l and decreased at 30g which is 3.95 mg/l and finally at a ratio of 40g decreased to 1.35 mg/l. While for the temperature of 500℃ has a difference in effectiveness on activated carbon because each ratio has a larger than the temperature of 400℃ that is at a ratio of 20g is 30.3 mg/l and decreased ratio 30 is 17.4 mg/l and at a ratio of 40g decreased to 5.55 mg /l. But if compared, it can be seen through the graph that a temperature of 400 ℃ is more effective than a temperature of 500℃.

4.3.3 Chemical Oxygen Demand (COD)

Oxygen consumption in a solution can be approximated using the COD indicator. The SI unit for this measurement is milligrams per litre (mg/L), which is equal to the mass of oxygen consumed per litre of solution. Oxygen is needed more when COD levels are higher. This suggests that water with high COD levels contains more oxidizable organic material. Dissolved Oxygen (DO) concentrations are also lowered in wastewater with high COD level.

Table 4.3: The value data of Chemical oxygen demand for activated from carbon bamboo chips.

Ratio (G)	**20**	**30**	**40**
400℃	216.3	194.7	121.7
500℃	273.3	273.7	194
Sample	428.7	428.7	428.7

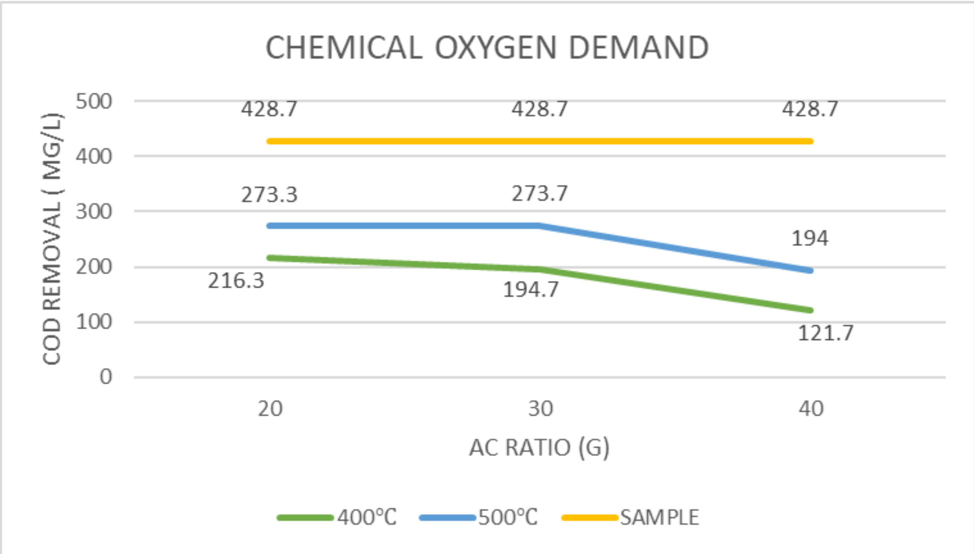


Figure 4.3: The graph value of Chemical oxygen demand for activated carbon from bamboo chips.

Table 4.3 and figure 4.4 show the results for the COD parameter analysis. These data show that there is a decrease for both temperatures, but the temperature that shows the most effective decrease is 400℃. Decreases occurred starting at ratios of 20, 30 and 40 which is 216.3, 194.7 and 121.7 mg/l. This proves to be a ratio of 40 has shown the level of effectiveness of activated carbon from bamboo chips. In addition, for a temperature of 500℃ also shows a decrease but the amount of decrease there is a difference that is a slightly higher amount with a temperature of 400℃. At a ratio of 20, 30.40 the total COD obtained was 273.3, 273.7 and 194 mg/l. However, if we compare the value of the second temperature with the sample of waste water that has not been mixed with activated carbon from bamboo, which is 428.7 mg/l, it proves that for COD analysis it is effective.

4.3.4 Turbidity

Turbidity is a critical indicator of suspended material in water, which can have a variety of deleterious consequences on aquatic life. Turbidity is caused by suspended sediments that can shade aquatic plants, suffocate aquatic species, and transport toxins and pathogens such as lead, mercury, and germs.

Table 4.4: The value data of Turbidity for activated carbon from bamboo chips.

Ratio (G)	**20**	**30**	**40**
400℃	148.7	98.8	27.4
500℃	399.3	311.7	36.5
Sample	900	900	900

Table 4.4 shows the data obtained for both the temperature sample and the sample before being mixed with activated carbon produced from bamboo chips which is 900 ntu. Through the data and figure 4.4 which is a graph that has been shown at a temperature of 400℃ for the three ratios of 20g, 30, and 40g there is a decrease of 148.7,98.8 and 27.4 while at a temperature of 500℃ also for the three ratios there is a continuous decrease

which is 399.3, 311.7 and 36.5. The decrease in turbidity value between these two temperatures proves that bamboo chips are able to reduce the turbidity in the wastewater and at a temperature of 400℃, the sample that has been mixed with a ratio of 40g bamboo chips and zinc shows the highest effectiveness.

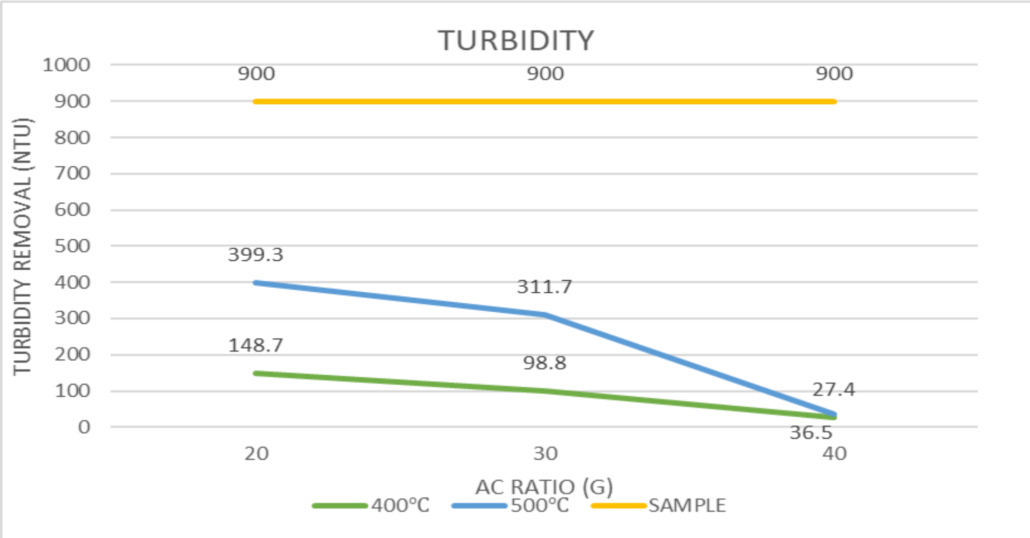


Figure 4.4: The graph value of Turbidity for activated carbon from bamboo chips.

4.3.5 Total Suspended Solid

Total Suspended Solids (TSS) refers to the amount of fine particle matter suspended in water. It is related to turbidity in that it determines the actual weight of particulate matter in a given amount of sample commonly in mg/L.

Table 4.5: The value data of Total suspended solid for activated carbon from bamboo chips.

Ratio (G)	**20**	**30**	**40**
400℃	122	199	168
500℃	316	300	122
Sample	1539	1539	1539

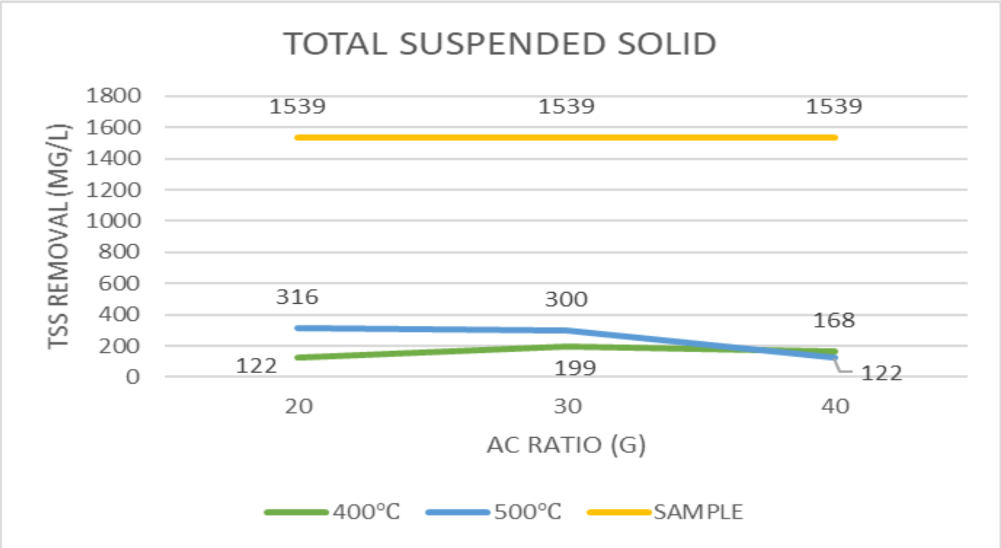


Figure 4.5: The graph value of Total Suspended Solid for activated carbon from bamboo chips.

Table 4.5 and figure 4.5 show the data and graphs for the total suspended solid that has been analysed and recorded for both temperatures of 400℃ and 500℃ and the sample wastewater that was previously mixed with activated carbon bamboo chips that is 1539mg/l. This data shows the effectiveness of the activated carbon where between the temperature of 400'c and 500'c, both temperatures show a decrease and increase as well.

At 400'c it has been shown that the ratio of 20g has a decrease of 122 mg/l but there is instability of increase and decrease in the ratio of 30 and 40 which is 199 and 168 mg/l. While at a temperature of 500'c there is no instability but there is a continuous decrease from the ratio of 20, 30 and 40 g at values of 316, 300 and 122 mg/l.

4.3.6 heavy metal

Heavy metal cations, hydrocarbons, pesticides, nitrogenous chemicals, pharmaceutical residues, detergents, and phosphorus are the most common chemical contaminants found in wastewater. Microbiological contamination may occur as a result of animal or human faeces harbouring a variety of protozoa, viruses, and bacteria that are capable of causing disease in people (Agoro, 2020). Lead (Pb), chromium (Cr), arsenic (As), zinc (Zn), cadmium (Cd), copper (Cu), mercury (Hg), and nickel are the most often discovered heavy metals at contaminated sites (Ni)

4.3.6.1 Zinc

Zinc concentration in industrial waste is widely regulated across a large portion of the world because to the implications to the environment and human health. Additionally, zinc, like other heavy metals, has the potential to impair the performance of biological wastewater treatment systems. As a result, establishments that use or handle zinc or zinc compounds are often required to implement strategies for monitoring and treating wastewater, both to comply with regulatory requirements and to maintain the optimal operation of any onsite wastewater treatment systems.

Table 4.6: The value data of zinc for activated from carbon bamboo chips.

RATIO (G)	20	30	40
400℃	456	444	296
500℃	482	466	444
SAMPLE	502	502	502

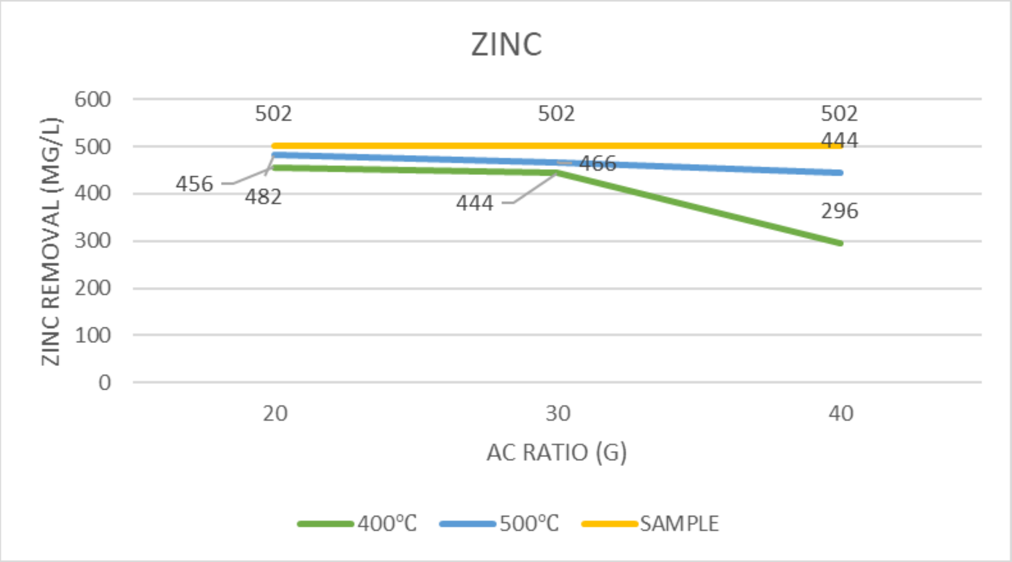


Figure 4.6: The graph value of Zinc for activated carbon from bamboo chips.

For the data that has been recorded for zinc can be seen in table 4.6, this data shows a relatively high value for both temperatures, although it has been added with activated carbon, but there will still be a relatively small decrease from the value of wastewater samples that have not been mixed with activated carbon. which is 502 mg/l. At 400℃ there is a decrease in each ratio which is 456, 444 and 296 mg/l this shows that for 400℃ at 40g ratio is more effective while for 500'c for the three ratios which is 482, 466 and 444 less effective because the percentage decrease is only a small value.

4.3.6.2 Copper

Copper is the most common heavy metal. The phrase heavy metal refers to any metallic chemical element that has a relatively high density and is hazardous or poisonous at low concentrations. A deficiency of these essential metals may increase susceptibility to heavy metal poisoning. Copper is the most often detected heavy metal in tap water. This is because copper can leak into tap water as a result of corroding pipes, faucets, and other plumbing fixtures. It can potentially contaminate drinking water if the groundwater is not appropriately treated

Table 4.7: The value data of copper for activated from carbon bamboo chips

RATIO (G)	**20**	**30**	**40**
400°C	1.39	1.01	0.53
500°C	1.05	0.93	0.7
SAMPLE	3.68	3.68	3.68

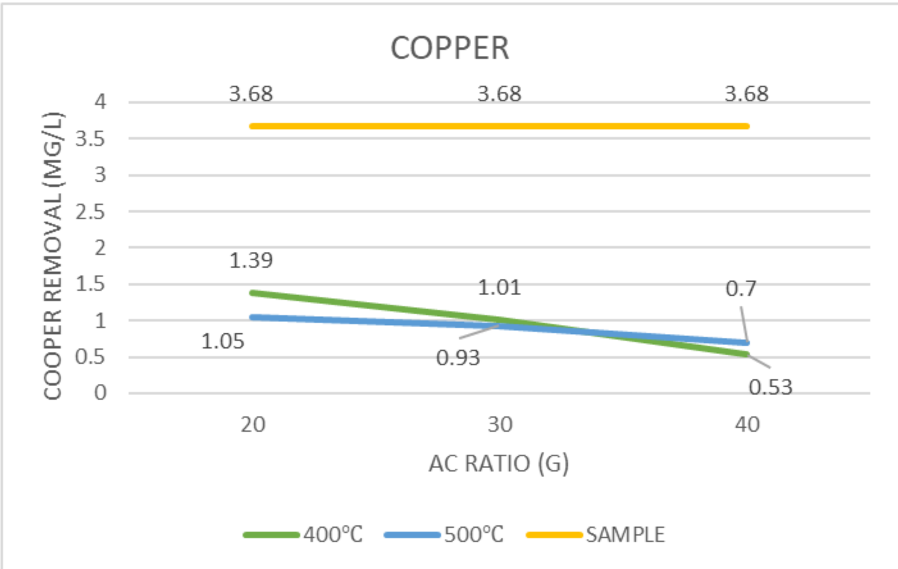


Figure 4.7: The graph value of copper for activated carbon from bamboo chips

Table 4.7 and figure 4.7 show the data and graphs that have been recorded and, on these data, have shown the efficacy between the temperature of 400℃ and 500℃. This data has proven that activated carbon from bamboo chips can reduce pollution that occurs in water. Data of 400'c at the ratio of 20, 30 and 40 g were recorded data which is 1.39, 1.01 and 0.53 and at the ratio of 20, 30 and 40g for the temperature of 500℃ are 1.05, 0.93 and 0.7. This has been proven for both temperatures of 400℃ and 500℃ at a ratio of 40g is very effective in producing activated carbon from bamboo chips.

CHAPTER 5

CONCLUSION

5.1 Conclusion

The conclusion that can be made for the two temperatures that have been studied is the level of effectiveness of activated carbon from bamboo chips has achieved the objective that is firstly to identify the level of pollutant contained in wastewater of Gebeng industrial estate. Second objective is to determine the ability of activated carbon from bamboo chips in treating wastewater and last objective is to compare the performance of physical with 500℃ and 400℃ activations in treating wastewater. can see that the effective and best to use is at a temperature of 400℃ and a ratio of 40g because it has the lowest value of 4.83. This indicates that it is safe to use for water treatment because there is a difference that occurs at the pH value.

For the next analysis, the biochemical oxygen demand has also proved that the temperature of 400'c and at a ratio of 40g with a value of 1.35 mg/l has proved the effectiveness of the activated carbon with a value that has affected the waste water is 34.3. Furthermore, for the analysis of chemical oxygen demand has also shown that the temperature of 400℃ and 40g is also effective as much as 121.7 compared to the temperature of 500 ℃ and other ratios.

For turbidity has also been shown that at a temperature of 400℃ and a ratio of 40g a good value to produce activated carbon because the results of the study found that the turbidity is 27.4 ntu. That proves that the turbidity in that ratio has a different amount from the turbidity of wastewater before being treated with activated carbon from these bamboo chips. Furthermore, the temperature of 400℃ also showed more effective results when the ratio of 40g has obtained a low value for heavy mental that is zinc and copper, but for the parameters analysed that is total suspended solid has shown that the temperature of 500℃ has a more effective ratio of 40g that is 122 mg/l compared to a temperature of 400'c and a ratio of 40 g which is 168mg/l.

The conclusion that can be analysed is that the temperature of 400℃ is better than 500℃ in preparing Activated Carbon from bamboo chips and has been proven.

5.2 Recommendation

For recommendation is the first the reagent of Activated carbon could be change such as potassium hydroxide or sulfuric acid for future recommendation in treating waste water. Because it is possible that by substituting different reagents will get more effective efficacy. In addition, the scales of each ratio also need more precise and detailed and in addition research equipment on different treatment methods for heavy metal removal. In addition, it can be proven by adding more treatment methods such as colour and lastly studying in more depth how to filter activated carbon that has been produced with wastewater.

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APPENDIX A

ACCEPTABLE LIMITS FOR DISCHARGE OF INDUSTRIAL EFFLUENTS OR MIXED EFFLUENTS OR MIXED EFFLUENT OF STANDARDS A & B PARAMETER UNIT STAND.

Parameter	Unit	Standard A	Standard B
(1)	(2)	(3)	(4)
(i) Temperature	°C	40	40
(ii) pH Value		6.0 - 9.0	5.5 - 9.5
(iii) BOD5 at 20°C	mg/l	20	50
(iv) COD	mg/l	50	100
(v) Suspended Solids	mg/l	50	100
(vi) Mercury	mg/l	0.005	0.05
(vii) Cadmium	mg/l	0.01	0.02
(viii) Chromium, Hexavalent	mg/l	0.05	0.05
(ix) Arsenic	mg/l	0.05	0.10
(x) Cyanide	mg/l	0.05	0.10
(xi) Lead	mg/l	0.10	0.5
(xii) Chormium, Trivalent	mg/l	0.20	1.0
(xiii) Copper	mg/l	0.20	1.0
(xiv) Manganese	mg/l	0.20	1.0
(xv) Nickel	mg/l	0.20	1.0
(xvi) Tin	mg/l	0.20	1.0
(xvii) Zinc	mg/l	1.0	1.0
(xviii) Boron	mg/l	1.0	4.0
(xix) Iron (Fe)	mg/l	1.0	5.0
(xx) Phenol	mg/l	0.001	1.0
(xxi) Free Chlorine	mg/l	1.0	2.0
(xxii) Sulphide	mg/l	0.50	0.50
(xxiii) Oil and Grease	mg/l	Not detectable	10

Source : (The Malaysian Reserve, 2021

APPENDIX B

STUDY AREA AND TEST (PHOTO)

Figure B1: Raw material

Figure B2: Cutting of raw material

Figure B3: Burning bamboo chips using a furnace

Figure B4: Cooled at room temperature

Figure B5: Grinded into powder

Figure B6: Powder of bamboo chips

Figure B7: Divided to each ratio of bamboo chips and mix with zinc chloride.

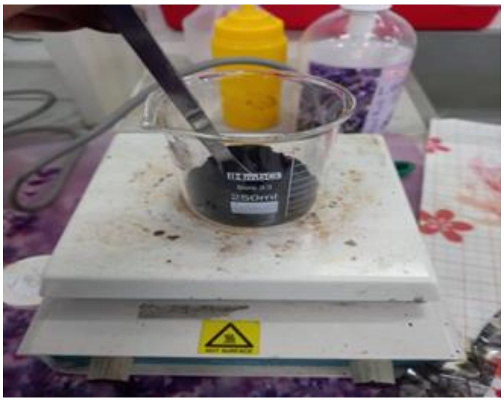

Figure B8: Heat on a hot plate.

Figure B9: Dried in oven after washed with distilled water

Figure B10: Isolated by temperature and ratio

Figure 11: Mixed with wastewater

Figure 12: Filtered

Figure 13: Chemical oxygen demand

Figure14: Total suspended solid

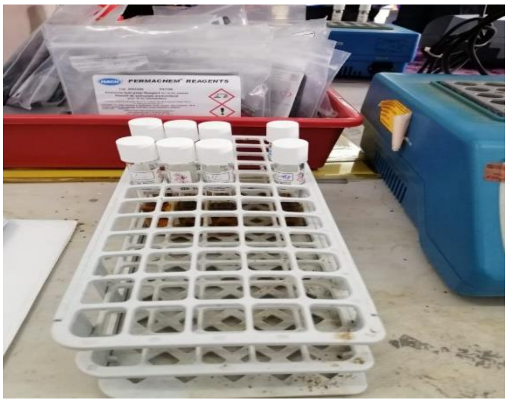

Figure 14: Biochemical oxygen demand

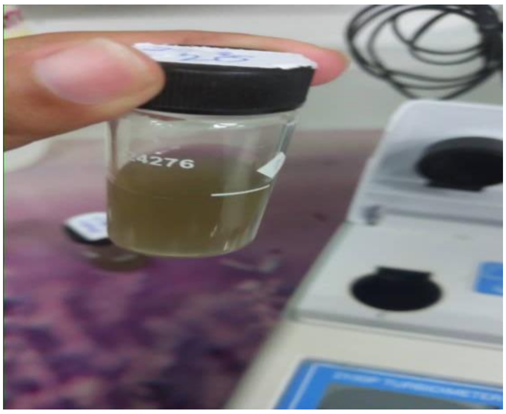

Figure 15: Turbidity