

## **ISLAM AND ENVIRONMENT (A Study of Durian Skin Waste as an Adsorbent to Overcome Water Pollution)**

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### **Abstract**

Nowadays environmental pollution has become a serious problem. Textile dye waste is one of the biggest contributors to environmental pollution. Durian (*Durio zibethinus*) has been known as a popular fruit in Indonesia. However, only several part of the durian fruit is used, namely its flesh. Durian skin is generally only thrown away and becomes waste pollutes the environment. Durian skin waste can be used as activated carbon in overcoming textile dye waste pollution. This study aims to determine the potential of durian skin from Luwu Regency, South Sulawesi as an adsorbent for textile dye waste. The process of making activated carbon is carried out through two stages that is physically by heating at 600 °C and chemically with hydrochloric acid 1M as activator and stirring for 24 hours. The quality test of activated carbon includes tests for water content, ash content, volatile matter content and fixed carbon content. The results showed that the activated carbon of the durian skin had met the standards of SNI 06-3730-1995, namely water content 12.1%, ash content 0.2%, volatile matter content 27.3% and bound carbon content 72.5%.

**Keywords:** Activated Carbon, Durian Skin, Waste Water.

### **Abstrak**

Pencemaran lingkungan telah menjadi masalah yang semakin bertambah. Limbah zat warna tekstil merupakan salah satu penyumbang terbesar bagi

pencemaran lingkungan khususnya perairan. Durian (*Durio zibethinus*) telah dikenal sebagai buah yang digemari di Indonesia. Namun hanya sebagian dari bagian buah durian yang dimanfaatkan yaitu isinya. Kulit buah durian umumnya hanya dibuang dan menjadi sampah yang mencemari lingkungan. Kulit buah durian dapat dimanfaatkan menjadi karbon aktif dalam mengatasi pencemaran limbah zat warna tekstil. Penelitian ini bertujuan untuk mengetahui potensi kulit buah durian dari daerah Kabupaten Luwu Sulawesi Selatan sebagai adsorben limbah zat warna tekstil. Proses pembuatan karbon aktif melalui dua tahap yaitu secara fisika dengan pemanasan pada suhu 600 °C dan secara kimia dengan aktivator asam klorida (HCl) 1 M dengan pengadukan selama 24 jam. Pengujian kualitas karbon hasil aktivasi meliputi uji kadar air, kadar abu, kadar zat menguap serta kadar karbon terikat. Hasil penelitian menunjukkan bahwa karbon aktif kulit buah durian telah memenuhi standar SNI 06-3730-1995, yaitu kadar air 12,1%, kadar abu 0,2%, kadar zat menguap 27,3% serta kadar karbon terikat 72,5%.

**Kata Kunci:** Karbon Aktif, Kulit Durian, Limbah.

## **INTRODUCTION**

The potential of natural resources in Indonesia is quite large. Indonesia is an agricultural country with vast agricultural land and plantations. This encourages a lot of research that utilizes natural resources for a product or item that is more efficient. The development of science and technology has an impact on the utilization of all parts of the plant for more diverse benefits. Plants are not only used for fruit parts, but parts such as fruit peels, stems, bark, leaves, roots and tubers can be processed into products that are more valuable for sale. In the health sector, many herbal products come from leaves and plant roots.<sup>1</sup> industrial sector, especially the use of alternative energy.<sup>2</sup>

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<sup>1</sup> Sulutaniyah, S., & Darmawan, E. 2022. *Jurnal Surya Medika*, 8(1), 1-10.

<sup>2</sup> Parinduri, L., & Parinduri, T. 2020. *Journal of Electrical Technology*, 5(2), 88-92.

Allah swt also has grown a variety of plants that can be used by humans as understood in His words in surah As-Syu'ara; 7 as follows:

أَو لَمْ يَرَوْا إِلَى الْأَرْضِ كَمْ أَنْبَتْنَا فِيهَا مِنْ كُلِّ زَوْجٍ كَرِيمٍ

It means

"And do they not pay attention to the earth, how much We grow in the earth various kinds of good plants?"<sup>3</sup>

This verse implies that humans sometimes do not think about the earth. Earth with various kinds of plants that have been bestowed by Allah SWT. to humans, all of which bring benefits to mankind.<sup>4</sup> The use of plants for various purposes has been ordered in the Qur'an, namely surah An-Nahl; 11, namely

يُنْبِتُ لَكُمْ بِهِ الزَّرْعَ وَالزَّيْتُونَ وَالنَّخِيلَ وَالْأَعْنَبَ وَمِنْ كُلِّ النَّمْرُوتِ إِنَّ فِي ذَلِكَ لَآيَةً لِقَوْمٍ يَتَفَكَّرُونَ

It means;

With the rain, He grows for you plants, olives, dates, grapes and all kinds of fruits. Truly in that there is truly a sign (greatness) of Allah for those who think.<sup>5</sup>

The surah contains the content of plants that can provide more benefits in human life. All plants are created for the benefit of humans. Rainwater which is a gift from Allah swt sent down and grow all plants that were previously withered so that they can grow long and provide benefits for human life.<sup>6</sup>

The current era of development has had the impact of pressing every country, especially developing countries like Indonesia to be able to advance development in order to catch up with the development of developing countries in order to support national stability. Development that penetrates all sectors of life will eventually have an impact on one another. The impact in the form of environmental damage is something that has been occurring for a long time, so every country needs special attention and handling. Technological advances that cause multidimensional crises contribute to these problems. For example, the

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<sup>3</sup> Departemen Agama RI., *Al-Qur'an dan Terjemahnya*. 1989. Semarang: CV. Toha Putera.

<sup>4</sup> Al-Mahalli, Jalaluddin dan Jalaluddin As-Suyuti, *Tafsir Al-Jalalain*, diterjemahkan Bahrin Abubakar. 2008. Bandung : Penerbit Sinar Baru Algensindo.

<sup>5</sup> Departemen Agama RI., *Al-Qur'an dan Terjemahnya*. 1989. Semarang: CV. Toha Putera.

<sup>6</sup> Shihab, M. Quraish. 2012. *Tafsir al-Misbah*, Jakarta : Lentera Hati.

increasing use and disposal of emission gases from the industrial sector as well as the use of household appliances which release carbon dioxide which accumulates more and more. In addition, illegal logging contributes significantly to the destruction of nature.

In the industrial sector, such as the textile industry, it is one of the biggest contributors to water pollution, with many industries having no handling of residual production waste. Residual waste in the form of textile dyes is often disposed of and pollutes the waters. Not only for humans who use these waters as a source of water for their daily needs, but also for aquatic organisms that live in them and the plants that grow around these waters.

The development of the agricultural and plantation sectors also has an impact on the amount of waste and waste such as wood, leaves, fruit peels and other rotting and damaged remains. Even though plants are classified as biodegradable, the increasing piles of waste can also find sources of pollution for the environment. The existence of waste in Indonesia is one of the problems that often occurs in the era of globalization due to the increasing population growth which then has an impact on the amount of waste produced so that the environment becomes unhealthy due to waste pollution. Utilization of plant residues into more useful materials can be a solution to overcome this problem.

Durian (*Durio zibethinus*) as a natural product that can be found in Southeast Asia, including Indonesia. In South Sulawesi, many durian fruit plants are found in the Luwu area with various durian varieties, both existing ones and new varieties being developed. The Otong durian is one of the varieties currently being developed in Luwu.<sup>7</sup>

Durian has been known as the favorite fruit. However, only part of the whole durian fruit is edible and most of the other parts, namely the skin and seeds are discarded. Durian skin and seeds usually only become trash or are burned which can cause problems for the environment. Durian skin contains cellulose, hemicellulose, lignin and absorbed water. This makes durian rind potentially to be developed as activated charcoal for the adsorption of residual dye waste from textiles. Based on this, this study aims to utilize plant residues that have been wasted into activated carbon for use in absorbing textile dyes.

## **METHOD**

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<sup>7</sup> Islamiah, Nurul Adha. 2018. "Unanda Produksi Durian Bibit Unggul Palopo". <https://makassar.tribunnews.com/2018/09/03/unanda-produksi-bibit-durian-unggul-palopo>

This research is an experimental study using local durian peels from Luwu Regency, South Sulawesi. The tools used include glassware, analytical balance, furnace, sieve shaker, waterbath shaker, pH meter, UV-Vis spectrophotometer. The materials used were durian rind, distilled water (H<sub>2</sub>O), aluminum foil, 1M hydrochloric acid (HCl), calico cloth, filter paper, sodium hydroxide (NaOH), yellow methanol. The data were obtained from the results of tests on the ability of durian shell activated carbon to absorb yellow methanol textile dyes

## **RESEARCH PROCEDURES**

### 1. Activated Carbon Manufacturing process

The durian used is durian taken from the Senga Selatan District, Luwu Regency, South Sulawesi. The durian skin is cleaned and dried and then fired using a drum kiln (carbonization) technique. The resulting carbonization is then activated physically and chemically. Physical activation was carried out by heating for 2 hours at 600 °C. Chemical activation was carried out by adding 1 M HCl solution and soaking for 24 hours. The carbon is filtered and neutralized with distilled water and then dried in an oven at 105°C. Furthermore, testing the quality of activated carbon was carried out. Testing the quality of activated carbon is carried out by several test steps, namely testing for moisture content, ash content, volatile matter content and bound carbon content.<sup>8</sup>

### 2. Adsorption Process

The adsorption process was carried out by first preparing a standard solution of methanol yellow from 0.1 gram of methanol yellow with a concentration of 1000 ppm. The adsorption process was carried out with two variations of the solution, namely concentration variations and mass variations. Variations in concentration were made from activated carbon from durian skin as much as 0.5 grams and standard standard solutions of 2 ppm, 4 ppm, 6 ppm, 8 ppm and 10 ppm respectively. The container is closed with a cotton cover that has been wrapped in gauze and aluminum foil. Mass variations were made with activated carbon from durian peels of 0.25 gram, 0.5 gram, 0.75 gram, 1.0 gram and 1.25 gram respectively and then added standard standard solution of 6 ppm each. Each sample was stirred using a water bath shaker for 2 hours at 150 rpm. Then it was filtered and the filtrate was

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<sup>8</sup> Sianipar, L.D. dkk. 2016. *Jurnal Kimia Khatulistiwa*, 5(2), 50–59.

transferred to a test tube for further testing with a UV-Vis spectrophotometer with a wavelength of 430 nm.

## **DISCUSSION**

### **1. Good Environment; Islamic View**

The environment is part of the integrity of humanity, as a result of which the biological environment needs to be viewed as a component of an ecosystem that must be respected, valued and preserved. Good behavior will help efforts to preserve the environment permanently, while bad behavior will result in environmental damage. So humans must have a responsibility in behaving well towards the creatures around them.

The current era of development has had the impact of pressing every country, especially developing countries like Indonesia, to be able to advance development in order to catch up with the development of developed countries in order to support national stability. Development that penetrates all sectors of life will eventually have an impact on one another. The impact in the form of environmental damage is something that has been happening for a long time, so every country needs special attention and handling. Technological advances that cause multidimensional crises contribute to these problems. For example, the increasing use and disposal of emission gases from the industrial sector as well as the use of household appliances which release carbon dioxide which accumulates more and more. In addition, illegal logging contributes significantly to the destruction of nature.<sup>9,10</sup>

In the industrial sector, such as the textile industry, it is one of the biggest contributors to water pollution, with many industries having no handling of residual production waste. Residual waste in the form of textile dyes is often disposed of and pollutes the waters. Not only for humans who use these waters as a source of water for their daily needs, but also for aquatic organisms that live in them and the plants that grow around these waters.<sup>11</sup>

Advances in science and technology do not always have a positive impact on human life and the environment. Human activities are primarily responsible for the occurrence of a number of environmental cases at local, national and world levels. The latest global

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<sup>9</sup> M. Arief Soleh, dkk. *Journal of Islamic Law Studies* 2, No. (2021).

<sup>10</sup> Hartini. 2013. *Jurnal Al-Daulah* 1, No. 1 (2013), p. 38.

<sup>11</sup> Munib, dkk. 2022. Samarah: *Jurnal Hukum Keluarga dan Hukum Islam*, 6(2), 43-59

phenomenon that is supported by high-tech sophistication in its use has ignored ethics, aesthetics and natural balance. This has caused damage to the world's ecosystems and the evolution of life, which can threaten the ecological balance and human life.<sup>12</sup> Pollution and environmental destruction that occurs in the sea, forests, atmosphere, water, soil and other environments is the result of reckless selfish human activities. Allah SWT issues a stern warning to mankind for the damage their actions have caused to this earth, as explained in surah Ar-Rum; 41 that the various damages that occur on land and in the seas are the result of human activities.

ظَهَرَ الْفَسَادُ فِي الْبَرِّ وَالْبَحْرِ بِمَا كَسَبَتْ أَيْدِي النَّاسِ لِيُذِيقَهُمْ بَعْضَ الَّذِي عَمِلُوا لَعَلَّهُمْ يَرْجِعُونَ

It means;

It has been clear that damage on land and at sea is caused by the actions of human hands, Allah wants them to feel some of the (results of) their actions, so that they return (to the right path).<sup>13</sup>

According to Sayyid Qutb, the verse explains that the damage to nature that occurs is not without cause or occurs suddenly, but all by the will of Allah and His laws. In addition, the consequences that occur as a result of human actions will damage it, humans feel pain and experience suffering as a result of these actions. All of this happens by Allah's will so that humans are aware and determined to fight evil, and return to Allah, and do good deeds and follow the straight path.

The verse explains that Allah swt has emphasized that all the damage that occurs on land and in the sea is caused by human activity itself. Therefore, humans should be aware of the consequences of their behavior and of course must immediately stop negative behaviors that will cause damage on land and in the sea by taking good actions and having benefits for the preservation of nature. The good deed that can be done is by utilizing existing natural resources to be processed into a useful material for a wider purpose.

## **2. Utilization of Natural Resources in Handling Environmental Problems**

The growing agricultural and plantation sectors also have an impact on the amount of waste and waste such as wood, leaves, fruit

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<sup>12</sup> Abdul Kalim. 2017. *Genetika: Jurnal Tadris Biologi* 1, No 1 (2017), p. 189-90.

<sup>13</sup> Departemen Agama RI., *Al-Qur'an dan Terjemahnya*. 1989. Semarang: CV. Toha Putera.

peels and rotting and damaged remains. Even though plants are classified as biodegradable, the increasing piles of waste can also find sources of pollution for the environment. The existence of waste in Indonesia is one of the problems that often occurs in the era of globalization due to the increasing population growth which then has an impact on the amount of waste produced so that the environment becomes unhealthy due to waste pollution. Utilization of plant residues into more useful materials can be a solution to overcome this problem.

In surah Al-Qashash; 77 Allah SWT. said:

وَأَبْتَعْ فِي مَاءِ آتَانِكَ اللَّهُ الدَّارَ الْآخِرَةَ وَلَا تَنْسَ نَصِيبَكَ مِنَ الدُّنْيَا وَأَحْسِنَ كَمَا أَحْسَنَ اللَّهُ إِلَيْكَ وَلَا تَبْغِ الْفُسَادَ فِي الْأَرْضِ إِنَّ اللَّهَ لَا يُحِبُّ الْمُفْسِدِينَ

According to Tafsir Ibn Katsir, Allah swt recommends using what is bestowed upon His servants which can be an addition to the scales of human charity, both in this world and in the hereafter. Everything that Allah allows in any form, everything has a right. As well as do good to His creatures and not the spirit that has only become a destroyer on earth.<sup>14</sup> From these verses and interpretations we can know that everything in our lives has benefits even if it is just waste. Waste can be useful for human life in the world of agriculture which can be used as fertilizer for plants. So Allah strongly recommends using anything according to his rights and not doing damage to him.

Indonesia as a country with a tropical climate is blessed with the gift of the greatest diversity of biological natural resources with the most diverse varieties. Utilization of natural resources can be maximized for the welfare of the entire population. However, it is quite unfortunate that this country has not succeeded in utilizing this enormous natural wealth to improve the welfare of its people. For example, rice, during the last 15 years, there have been thousands of local rice varieties that have disappeared.

Apart from this potential, Indonesia as a developing country is faced with various real problems. The population is increasing, the lack of public awareness of the importance of protecting the environment is supported by law enforcement against environmental damage that is not strict, limited infrastructure and inadequate development of science and technology. Besides that, forest fires are also the main enemy that often hit the country. Indonesia pays great attention to efforts to preserve biodiversity and guarantee the protection of every citizen's

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<sup>14</sup> An-Nabi, Syaikh Ahmad Abdul Rabbi, dkk. 2015. *Tafsir Ibnu Katsir*. Surakarta: Insan Kamil.



right to science. However, the problem of biodiversity is not only a matter of conservation, but also the right of the nation. Another disappointing fact is that efforts to conserve biodiversity and to rehabilitate degradation are progressing at a slower pace while the process of environmental destruction due to events such as depletion and erosion of biotic/genetic resources is accelerating. Often attention to environmental sustainability becomes the last concern so that unknowingly it is getting damaged.<sup>15</sup>

Natural resources (SDA) include resources that are produced naturally and sustainably. Natural resources include raw materials, area, function and quality of environmental components such as soil, air and water or genetic diversity. Utilization of renewable natural resources for something that is more efficient is a promising breakthrough. Besides easily decomposed, the impact on the environment is also very small. The rest of the combustion of natural materials is safer than non-renewable natural resources such as natural gas, gasoline, diesel and so on.

Although plants are classified as biodegradable, natural materials can also become piles of waste if they are not handled properly. Agricultural products that rot or fail, residual consumption products such as fruit peels, seeds and leaves can become waste which in turn can become a source of environmental pollution. The existence of waste in Indonesia is one of the problems that often occurs in the era of globalization due to the increasing population growth which then has an impact on the amount of waste produced so that the environment becomes unhealthy due to waste pollution. Utilization of plant residues into more useful materials can be a solution to overcome this problem.

### **3. Manufacture and Quality Test of Durian Fruit Skin Activated Carbon**

The process of making activated carbon goes through several stages. The technique was chosen with the aim of burning with limited use of oxygen. The carbon formed is pulverized with the aim of increasing the surface area of activated carbon and sieved to obtain carbon with a homogeneous surface area. Carbon is activated physically by heating and chemically by activating hydrochloric acid (HCl) solution. The activated carbon was then tested for its quality with several tests, namely tests for moisture content, ash content, volatile matter content and bound carbon content.

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<sup>15</sup> Hani Mumtazah. 2021. <https://islamonline.net/en/indonesias-natural-wealth-nation-and-people/>

Table 1. Quality Test Results of Durian Skin Activated Carbon

Pengujian	Hasil (%)	SNI (%) <sup>16</sup>
Kadar Air	12,1	≤15
Kadar Abu	0,2	≤10
Kadar Zat Menguap	27,3	≤15
Kadar Karbon Terikat	72,5	≥65

Determination of water content aims to determine the water content of activated carbon. The smaller particle size of activated carbon makes it more difficult for water to enter the carbon pores and less carbon is trapped. The water content in activated carbon will affect the absorption of gases or liquids.

The water content of activated carbon according to SNI 06-3730-1995 is a maximum of 15%, while the moisture content of durian skin activated carbon produced in this study is 12.1%. This shows that the carbon activation process of the durian skin has met the standards that have been set. The moisture content of activated carbon is related to hygroscopic properties, the amount of moisture in the air, the length of the cooling, grinding and sifting processes. Determination of ash content aims to determine the amount of mineral content in activated carbon. Mineral content can be in the form of metal oxides that do not evaporate during the ashing process. These metals can reduce the absorption of activated carbon, so the lower the ash content, the better the absorption capacity of activated carbon.<sup>17</sup>

The ash content of activated carbon according to SNI 06-3730-1995 is a maximum of 10%, while the water content of the activated carbon of durian shells produced in this study is 0.2%. This shows that the carbon activation process of durian skin has met the standards that have been set. Ash content can affect the ability of activated carbon to absorb adsorbate. This can be caused because the minerals that are still present in the ash will be scattered in the carbon lattice which can clog the pores so that the carbon surface area is reduced.

Determination of volatile matter content aims to determine the content of volatile compounds. Gases such as nitrogen and sulfur which are referred to as volatile matter must be removed because they can fill the pores of the activated carbon so that it covers the active side. The results of the study showed that the volatile matter content was 27.3%.

<sup>16</sup> Badan Standarisasi Nasional. 1995. Arang Aktif Teknis. SNI 06-3730-1995.

<sup>17</sup> Kristianto, H. 2017. *AIP Conference Proceedings*, 2049.

This result is quite high from the maximum value limit of 15% based on SNI 06-3730-1995. This can be affected by the activation temperature which is not high enough so that some of the gas has not completely disappeared.<sup>18</sup> On the other hand, temperatures that are too high can damage the activated carbon and reduce the resulting yield.<sup>19</sup> This is due to the large amount of activated carbon that evaporates with only a small amount of residual carbon left behind. At higher temperatures, more volatile matter will be released, causing less carbon to form.

The bonded carbon content is the amount of carbon present in the sample. Determination of carbon content aims to determine the value of pure carbon contained in activated carbon. The greater the bonded carbon value, the more pure carbon is obtained. This means that there are fewer other ingredients that can affect the effectiveness of activated carbon. The bonded carbon content based on SNI 06-3730-1995 is a minimum of 65% while the value obtained in this study was 72.5%. This indicates that the pure carbon contained in the activated carbon sample obtained from durian shells is more.

#### **4. Activated Carbon Adsorption Process**

Durian peel activated carbon can be used as an absorbent for dyes in textile waste. This is because activated carbon is an amorphous which in the activation process the carbon atoms produced will form a hexagonal structure in which there are carbon atoms at each corner. Imperfect arrangement between layers and hexagonal rings will result in spaces in the activated carbon structure. These spaces or pores can absorb adsorbate such as yellow methanol dye and enter into the porous activated carbon structure. The process of adsorption of yellow methanyl dye by activated carbon in durian peel occurs because of the van der Waals forces, namely the weak attractive force between the adsorbate and the adsorbent surface.

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<sup>18</sup> Maulina, S., dan Iriansyah, M. 2018. *IOP Conference Series: Materials Science and Engineering*, 309(1).

<sup>19</sup> Yakout, S. M., dan Sharaf El-Deen, G. 2016. *Arabian Journal of Chemistry*, 9, S1155-S1162.

Table 2. Table of results for measuring the absorbance of various concentrations yellow methanol standard solution.

Konsentrasi Metanil Kuning (ppm)	Absorbansi	Konsentrasi Metanil Kuning sisa (ppm)	Kapasitas Adsorpsi	Efektifitas Adsorpsi
2	0,1340	2,2913	$-0,2900 \times 10^{-4}$	-14,5650%
4	0,2041	3,5521	$0,4479 \times 10^{-4}$	11,1975%
6	0,3167	5,5773	$0,4427 \times 10^{-4}$	7,3780%
8	0,4069	7,1996	$0,8000 \times 10^{-4}$	10,0050%
10	0,4562	8,0863	$0,9137 \times 10^{-4}$	19,1370%

Table 3. Table of results of absorbance measurements of mass variations of durian skin activated carbon.

Massa Karbon Aktif (gram)	Absorbansi	Absorbansi	Konsentrasi Metanil Kuning sisa (ppm)	Kapasitas Adsorpsi	Efektifitas Adsorpsi
25	0,	0,3319	5,8507	0,29	2,4883
5	0,	0,2838	4,9856	$86 \times 10^{-4}$	%
75	0,	0,2647	4,6421	44 $10^{-4}$	%
0	1,	0,2207	3,8507	50 $10^{-4}$	%
25	1,	0,2266	3,9568	46 $10^{-4}$	%
				0,81	34,0530
				72 $10^{-4}$	%

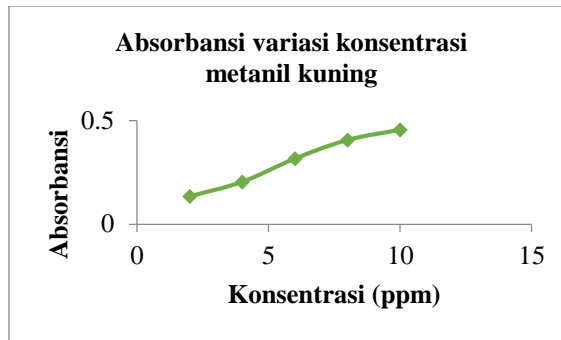


Figure 1. Graph of the relationship between concentration and adsorption capacity of durian peel activated carbon (*Durio zibethinus*)

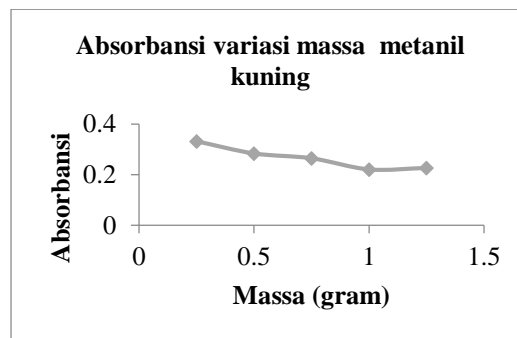


Figure 2. Graph of the relationship between mass and adsorption capacity of durian (*Durio zibethinus*) shell activated carbon

The greatest adsorption capacity was at a concentration variation of 10 ppm with 0.5 gram activated carbon, which was  $1.9137 \times 10^{-4}$  with an adsorption effectiveness of 19.137% and for a mass variation of 1 gram with a sample solution concentration of 6 ppm, which was  $1.07465 \times 10^{-4}$  and adsorption effectiveness is 35.8216%.

### CONCLUSION

Based on the research results obtained, durian rind waste can be used as an adsorbent for textile dye waste. The results of the proximate test of activated carbon from durian skin met the criteria of SNI 06-3730-1995 with a moisture content of 12.1%, ash content of 0.2%, volatile matter content of 27.3% and bound carbon content of 72.5%. The use of natural resources can be maximized by utilizing materials that have been wasted or unused into a product that has wider benefits.

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