ANALYSIS OF CHEMICALS ELEMENTS ON TREATED WASTE COOKING OIL FOR THE ORGANIC CRAYONS

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in fulfillment of the requirements for the degree of
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DECLARATION

I declare that this thesis entitled " Analysis of chemicals elements on treated waste cooking oil for the organic crayons " is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :

Name : MUHAMMAD IQMAL BIN MOHD ADNIN

Date : 19/1/2023

APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Mechanical Engineering Technology (BMMV) with Honours.

Signature : ....

Supervisor Name : PUAN NOR FAIZAH BINTI HAMINUDIN

Date : 20 Jan 2023

DEDICATION

In this thesis, I dedicate to both of my parents, who always stayed by my side and gave me moral support throughout the implementation of this study. Not forget the supervisor who always guided me during this thesis and my fellow friends who supported me.

ABSTRACT

Crayons are one of the items reserved for use by children, and they are so widely used because crayons are one of the necessities of children nowadays. Today's crayons are different from what they used to be because crayons have also evolved. In the past, crayons were only made of paraffin wax and contained substances that were harmful to the human body. Now, the manufacture of crayons uses waxes that are more natural, and they are called organic crayons. However, the cost required to make crayons from these natural waxes is still considered high. As such, crayon makers began to develop their technology. This is where the idea of mixing treated cooking oil waste as an additive to reduce the cost of making crayons came from. The waste cooking oil undergo transesterification process by mixing the filtered waste cooking oil with ethanol and heating it between 60°C and 70°C for two hours. After the transesterification process is completed, a titration process was conducted to determine the oil's fatty acid value before it can be tested for chemical elements using rotating disc electrode spectrometer. There are four ratios mixture of waste cooking oil and ethanol such as 9:1, 12:1, 15:1,and 18:1. The best ratio for treated waste cooking oil was determine by calculating acid value. From the result, ratio 15:1 was selected as this ratio has the lowest the acid number of 2.08 . All ratios undergo the chemical elements testing to identify any potential harmful chemical. This is crucial because, the treated waste cooking oil will be added to waxes mixture to produce the organic crayons. Overall, it was proven that the treated waste cooking oil is safe to make crayons for children.

ABSTRAK

Krayon merupakan salah satu barangan yang dikhaskan untuk kegunaan kanak-kanak, dan ia begitu meluas digunakan kerana krayon merupakan salah satu keperluan kanak-kanak pada masa kini. Krayon hari ini berbeza daripada yang dahulu kerana krayon juga telah berkembang. Dahulu, krayon hanya diperbuat daripada lilin parafin dan mengandungi bahan yang berbahaya kepada tubuh manusia. Kini, pembuatan krayon menggunakan lilin yang lebih semula jadi, dan ia dipanggil krayon organik. Walau bagaimanapun, kos yang diperlukan untuk membuat krayon daripada lilin semulajadi ini masih dianggap tinggi. Oleh itu, pembuat krayon mula mengembangkan teknologi mereka. Di sinilah tercetusnya idea mencampurkan sisa minyak masak yang telah dirawat sebagai bahan tambahan untuk mengurangkan kos membuat krayon. Minyak masak terpakai menjalani proses transesterifikasi dengan mencampurkan sisa minyak masak yang ditapis dengan etanol dan memanaskannya antara 60°C dan 70°C selama dua jam. Selepas proses transesterifikasi selesai, proses pentitratan dijalankan untuk menentukan nilai asid lemak minyak sebelum ia boleh diuji untuk unsur kimia menggunakan spektrometer elektrod cakera berputar. Terdapat empat nisbah campuran minyak masak terpakai dan etanol seperti 9:1, 12:1, 15:1, dan 18:1. Nisbah terbaik untuk minyak masak terpakai ditentukan dengan mengira nilai asid. Daripada keputusan tersebut, nisbah 15:1 telah dipilih kerana nisbah ini mempunyai bilangan asid terendah iaitu nilai 2.08 . Semua nisbah menjalani ujian unsur kimia untuk mengenal pasti sebarang bahan kimia berbahaya. Ini penting kerana, sisa minyak masak yang telah dirawat akan ditambah ke dalam campuran lilin untuk menghasilkan krayon organik. Secara keseluruhannya, terbukti bahawa sisa minyak masak yang telah dirawat adalah selamat untuk dibuat krayon untuk kanak-kanak.

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LIST OF SYMBOLS AND ABBREVIATIONS

WCO	-	Waste cooking oil
ppm	-	Part per million
Pb	-	Lead
Cd	-	Cadmium
As	-	Arsenic
Cr	-	Chromium
Se	-	Selenium
Hg	-	Mercury
Ba	-	Barium
Zn	-	Zink
Ni	-	Nickel
Sb	-	Antimony
mg/kg	-	Milligram per kilogram
g	-	Gram
℃	-	Degree celsius
NaOH	-	Sodium hydroxide
KOH	-	Potassium hydroxide

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CHAPTER 1

INTRODUCTION

1.1 Background study

Waste cooking oil (WCO) is obtained from domestic or industrial food waste. Cooking oil can be reused several times; however, it will degrade each time used. For example, if frying chicken more than twice, it increases the chance of becoming toxic. This toxic element was called aldehydes, created from the degradation of fatty acids in cooking oil. Figure 1.1 shows the aldehydes structure. They can interfere with the proper functioning of the organism by reacting with proteins, hormones, and enzymes (Guillén & Uriarte, 2012). This waste cooking oil will usually be thrown away in the kitchen sink. This process may cause the oil to convert into solid or sticky messes of fats that will adhere to the edges of the pipes, eventually clogging the drainpipe and necessitating the services of a plumber. To prevent this, our government has already performed various incentives to ensure all waste cooking oil is thrown properly. Waste cooking oil can now be sold in Alam Flora Buy Back Center for RM 1.10 per kg. Due to the low price of waste cooking oil, every company used this opportunity to cut the production value and increase their profit, including cosmetic andcandle manufacturing companies. Waste cooking oil was used as an additive ingredient for making various products such as cosmetics, soaps and organic candles, and the newest development is the organic crayons.

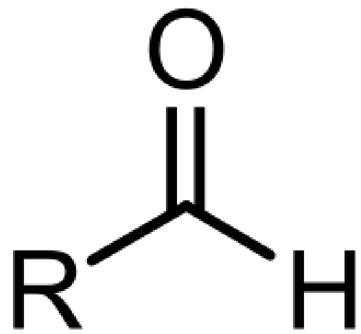

Figure 1.1 Aldehydes structure

Crayon is the wax pastel used among children to write or draw. At the beginning of crayon making, paraffin wax was used on a large scale because it was readily available. Paraffin wax, also known as petroleum wax, is a colourless, soft material formed from petroleum, coal, or oil shale of hydrocarbon molecules (Hassanpour, 2021). This wax was mainly used because approximately 90% of all waxes utilised in the business today are made principally from petroleum lubricating oil fractions (Duru, 2013). As time changed, crayon manufacturers began to turn to natural wax instead of paraffin wax to produce crayons such as beeswax, soy wax, vegetable wax, and many more. Beeswax is one of these natural waxes employed in cosmetic and pharmaceutical formulations as a support element. Despite its well-known healing powers, it is still regarded as a secondary and undervalued commodity, notably in the United States (Eduardo Lema et al., 2019).

Because crayons have become one of the products designed for kids, every company that produces crayons must be honest with every statement they release. For example, if one company states that all of its products are safe for every kid,they must ‘walk the talk’. But in reality, often the crayon companies in the market claimed their product is made from non-toxic substances such as beeswax, soy wax, and vegetable wax, however, after conducting chemical test on that crayon, it was found an existance of toxic chemical substance in it (Gowda & Cook-Schultz, 2018). Some harmful chemical elements already found in children's crayons are asbestos, lead, arsenic, cadmium, chromium, and nickel (Svetlana Dogo et al., 2022). Even though the crayon is organic and labelled as non-toxic, it still has toxic chemicals, but it is below the designated limit (Guney et al., 2020). Prolong exposure to these toxic chemicals effecting a person are impaired kidney function, gastrointestinal complications, neurological disorders, bone defects, and cancer (Igweze et al., 2020). Many articles or journals discussing these chemical substances, yet most parents are still unaware of this toxic chemical and its effects on their children if they still let their kids use that toxic crayon.

Thus, all the toxic chemical substances found in this study will be listed. After that, the treated WCO that will be used in the organic crayon production must undergo a chemical test to determine its chemical substance to ensure the crayon base on treated WCO are safe for children to use. The method used in this study is by using a rotating disc electrode spectrometer to identify the chemical substance in the treated WCO.

1.2 Problem Statement

A large amount of waste cooking oil is dumped in collecting centres making many people try to use this waste cooking oil to make a new products such as candles and soap. Because of that, one study was carried out to make organic crayons using this waste cooking oil as an additive ingredient. However, the WCO needs to be treated before it can be used as an additive.

In addition, most crayon manufacturers claim that their organic crayons are safe/non-toxic. But, when the chemical test was run on that crayon, some of the crayons contained harmful chemicals that exceeded the toy standard ASTM F963. Because this project uses treated waste cooking oil to make organic crayon, a chemical test on the oil is needed to ensure this mixture of waste cooking oil and natural wax contain no harmful chemical. The testing on the treated waste cooking oil was conducted using the rotating disc electrode spectrometer, and the result will be compared with the toy standard ASTM F963.

1.3 Research Objective

The objectives of this research are:

I. To determine the suitable ratio for treated WCO by measuring the acid value.

II. To identify the chemical elements on treated WCO by using rotaring disc electrode spectrometer

1.4 Scope of Research

The scope of this research is as follows:

- Identify the potential chemical substances that existed in the crayon as reported by previous researchers, such as asbestos, lead, arsenic, cadmium, chromium, and antimony.
- Studying the method for WCO treatment to be use as an additive in product such as candle and soap.
- The choosen method of WCO treatment is the transesterification process using food grade ethanol. The mixture ratio for ethanol to WCO are 9:1, 12:1, 15:1, and 18:1.
- Find the acid value for each ratio of treated WCO to observe the trend.
- For each ratio, chemical test are conducted using rotating disc electrode spectometer and this test is run for untreated WCO too

- Result from the chemical test are analyse and compare to the toy safety standard ASTM F963.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Cooking oil is extracted from palm, nuts, olives, and more, and it is usually used for cooking or as food dressing. However, cooking oil can't be used repeatedly because it can become harmful to the human body due to the degradation of the oil quality, which leads to changes in smell and taste (Idun-Acquah et al., 2016). According to America's Test Kitchen (ATK), it can be reused three or four times if the oil is used for cooking breaded and battered foods. In contrast, if the oil is used for cooking cleaner frying items like potato chips, it could be reused up to eight times (Aaron Hutcherson, 2022). According to the U.S. Environmental Protection Agency, around two hundred million gallons of WCO are improperly disposed of yearly.

Most people throw away their WCO, which can cause many problems. Most of the problems are pollution, such as smell and water pollution. Despite that, in this modern society, used cooking oil can be sold for recycling (Adrian Yap CK, 2021). Figure 2.1 shows one of the places where waste cooking oil can be sold. The used oil, commonly called waste cooking oil (WCO), is mainly used for biodiesel production (De Feo et al., 2020). Besides biodiesel, WCO is also used to make soap (Estatal De Bolívar et al., 2018) and candles (Norouzian Baghani et al., 2022).

If the WCO can produce soap and candles, it also can be used in crayons as an additive component.

Figure 2.1 Alam Flora Buy Back Centre

2.2 Waste cooking oil (WCO) treatment

As mentioned previously, many products have been used treated WCO to help reduce the amount of dumping used cooking oils such as soap, candle and biodiesel production. In this project, treated WCO will be used as an additive to produce organic crayons, hence, the used cooking oil needed to be treated beforehand. There are various method to treat the WCO from natural method up to chemical usage just to get the desired treated WCO. For this project, the WCO treatment used is transesterification.

In the process of transesterification, alcohol and esters of long-chain carboxylic acids combine to create an biodiesel and glycerol. Waste cooking oil is frequently utilised to make biodiesel (Shatesh Kumar et al., 2020). The collected waste cooking oil is filtered to remove any food particles or contaminants before beginning the process. Next, heat the used cooking oil to a temperature of around 60℃ to 70℃. Add alcohol, such as methanol or ethanol, at a molar ratio to the warmed oil next. The next step is to add some sulfuric or hydrochloric acid as a catalyst to speed up the reaction. After thoroughly combining the reactants, the mixture is heated to a temperature of roughly 70°C to 80°C. Next, give the combination a few hours to react, so the transesterification is finished. The amount of glycerol created during the reaction can be measured. For the final step, Distillation or other separation techniques should be used to separate the biodiesel product from the glycerol and any unreacted reactants.

The acid value of a substance is a measure of the amount of free carboxylic acid present in the substance. It is determined by the number of milligrams of potassium hydroxide (KOH) required to neutralize the acidity of one gram of the substance. The acid value is an important parameter to measure in the transesterification reaction between ethanol and waste cooking oil because it can affect the quality and performance of the biodiesel produced. A high acid value can indicate the presence of free fatty acids, which can cause the biodiesel to be more prone to oxidation and to have a lower flash point. This can lead to problems such as decreased storage stability, increased emissions, and reduced engine performance. In addition, the acid value can also be used to determine the efficiency of the transesterification reaction. By measuring the acid value of the starting materials (waste cooking oil) and the products (biodiesel), it is possible to calculate the conversion rate and to optimize the reaction conditions for the production of high-quality biodiesel. Therefore, measuring the acid value after the transesterification reaction between ethanol and waste cooking oil is an important step in the production of biodiesel in order to ensure that the desired product characteristics are achieved and to optimize the reaction for maximum efficiency.