



**REPAIR POTHOLE USING THE MIX OF
AGGREGATE WITH THERMOPLASTIC**

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INTELLECTUAL AND PROPRIETARY RIGHTS

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APPRECIATE

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ABSTRACT

Abstract

The increase of plastics waste leads to serious problems such as it will dispose to landfill, urban and commercial areas. When the unsafe plastic waste secretes the toxic chemicals that leach out into the soil and underground water pollutes the water bodies. Plastic disposal is one of the major problems developing in Malaysia, at the same time our country needs a proper network of roads for smooth economic and social development. The limited sources of bitumen need a deep thinking to ensure fast road construction. Therefore, the use of plastic waste in road construction industry is possible. The aim of this project is to repair pothole using thermoplastic. Plastic roads mainly use thermoplastic such as Polyethylene Terephthalate (PET or PETE) and High Density Polyethylene (HDPE) that are collected from garbage dumps. By using plastic waste as modifier, we can reduce the quantity of bitumen, hence decreasing the overall cost of construction. Use of plastic waste will reduce the need of bitumen in repairing pothole. The usage helps to improve the performance of road pavement which also reduce the rutting effects.

ABSTRAK

Peningkatan sisa bahan plastik membawa kepada masalah serius seperti yang ada di kawasan pelupusan sampah, kawasan pendalaman serta kawasan komersial. Sebagai contoh, apabila bahan kimia yang terdapat di dalam plastik, dirembeskan ke dalam saluran air, atau udara, ia akan menyebabkan pencemaran toksik yang teruk. Bukan shaja kepada manusia tetapi flora dan fauna juga akan terjejas.

Pelupusan plastik merupakan salah satu masalah utama yang berkembang di Malaysia, pada masa yang sama negara kita memerlukan jaringan jalan yang betul untuk pembangunan ekonomi dan sosial yang lancar. Penggunaan Bitumen yang banyak menyebabkan bahan itu semakin berkurangan, Jadi tujuan projek kami ialah, menggantikan Bitumen dengan Thermoplastik. Termoplastik yang digunakan ialah Polyethylene Terephthalate (PET atau PETE) dan High Density Polyethylene (HDPE). Dua plastik ini sering dijumpai dimana mana kawasan seperti tempat pembuangan sampah. Dengan menggunakan Plastik sebagai ganti kepada Bitumen, Ia dapat mengurangkan penggunaan Bitumen serta mengurangkan kos pembinaan plastik. Penggunaan plastik ini juga dapat meningkatkan lagi prestasi penurapan jalan raya serta mengurangkan kesan rutting.

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INTRODUCTION

1.1 Background study

Nowadays, the use of plastic bottles with different sizes has been growing day by day. This development led to an increase in the amount of waste. This hazardous waste is

disposed by land filling or incineration. Waste plastic does not undergo biodecomposition. Therefore, whether it is land filled or incinerated, it still pollutes the land and the atmosphere. However, the discovery of the binding property of plastics in this molten state which can be used in road laying has help to manage this waste plastic. Repairing pothole is a way to use plastics waste in road pavement as one of a material.

This recycled product is more environmentally harmful than the first-time manufactured because every time plastic is subjected to high intensity heat during the recycling process. This can make it to deteriorate and lead to environmental pollution. That is why, it is necessary to find the effective way to deal with this non-biodegradable waste.

The use of plastics waste in road construction can be one of the solutions. This type of construction gives benefits to environment because it uses plastics to repair pothole that would otherwise be disposed which is harmful to the environment. Other type of methods that has been used to deal with plastic waste is by incineration. However, often incinerators used are not recommended by standards and guidelines.

The various experiments have been carried out whether the waste thermoplastic can be reused productively. The various literature indicated that the waste plastic when added aggregates will form a fine coat of plastic over the aggregate and it's found to have higher strength, higher resistance and better performance over a period of time. Many reasons of using plastic in road construction is that easy to find, long-lasting, water resistant and economical. Pothole happens because of crack underlying pavement layer. By repairing pothole can reduce the amount of accidents happen in our country

1.2 Problem Statement

Nowadays usage of heavy vehicles on federal roads leads to form potholes. So, road users had to take a toll roadway. Some of the potholes are getting worse by everyday which leads to traffic jam. As the potholes become larger it also damages the vehicle which becomes a safety risk and this can leads to accident for motorbike riders.

Some of the common damage is a flat tire or damage to your tires, bent or damaged rims, suspension damage, steering damage and even damage to the body of the car. Potholes can even knock the car out of alignment so it will affect the way the tires wear and can lead to replacing tires before earlier than expected.

1.3 Objectives of the Study

The main objective of doing this project is to have a better repairing system in repairing pothole as it increases the durability and strength of the repaired pothole.

- 1) Replace bitumen with thermoplastic in the mixture.
- 2) Compare bitumen and thermoplastic in terms of;
 - i. Durability
 - ii. strength
- 3) Minimize the work to be done to repair a pothole.

1.4 Study Questions

A research question is a responsible investigation on a particular concern or issue. This is the first step in a research project. 'Early steps' means that once you have an idea of what you want to learn, research questions are the first active step in a research project. Reuse of waste is one of the additional benefits of saving measures. The use of natural materials from the environment where they are readily available, cheaper and comfortable and safe to use.

Table 1.4 shows question that is common ask when needed

NUMBER	QUESTION
1	What is friction between road and the surface of the repaired pothole using thermoplastic?
2	What is the durability of the thermoplastic?
3	How to melt the thermoplastic into the pothole?
4	What is the melting point of the thermoplastic?

1.5 Scope of the Study

The project was conducted at the GATE B Politeknik SHAH ALAM. The scope of the study will involve the process of collecting data and information relating to the repaired pothole. Information such as students who passing by the repaired pothole is taken into count in order to ensure the effectiveness. In addition, to determine the skid resistant and strength of the thermoplastic, Skid resistant test and penetration was carried out at highway laboratory, PSA.



Figure 1.5: Pothole at gate B entrance

1.6 Importance of Research

The importance of this project as follows:

i. Safety

Safety is one of the most important criteria that need to be considered in repairing pothole. The product design should not be dangerous, and the material used should be non-hazardous. This is because the exposure of human bodies to hazardous materials or product can lead into serious fatality. The addition of thermoplastics is environment friendly thus not give any negative impact to the surrounding living organisms.

ii. Easy to handle

The product made must be easy for the user to repair or replace if damage occurs. Plastics are placed in the pothole on the road. Thus, it can lead to cracks or sharply exposed surface. This type of conditions requires immediate replacement of the bitumen. thermoplastics are easy to repair pothole compare to bitumen.

iii. Short time period

This project takes really a short time period to repair a pothole using thermoplastics. It takes around 20 minutes to repair a pothole compare with using bitumen. Furthermore, it takes only a short period of time to cool down after the project is done at the site.

iv. Reduce the number of accidents

Hitting a pothole can not only cause damage to a vehicle's shocks and suspension, it can also cause the driver to lose control of his or her car. Potholes can cause truck accidents and motorcycle accidents in addition to poor road

conditions that often result in serious car accident injuries. So, this project can reduce the number of accidents happen in our country.

1.7 Definition of Terms

Terms is usually an annex to a work (book, research paper, pamphlet, etc.) either at the beginning or more likely near the end with a list of acronyms, jargon, credits, etc. This is an important part of Research paper or report is that in which the key or important terms in the study are clearly defined.

1.8 Summary

As a conclusion, the major threat to the environment is the disposal of waste thermoplastic. In a highway, the potholes and corrugation is the major problem. thermoplastic pavement will be a better solution to the above stated problems. thermoplastic is a non-degradable waste, causes green-house effect and global warming. The various literature indicated that the waste thermoplastic when added aggregates will form a fine coat of thermoplastic over the aggregate and it's found to have higher strength, higher resistance and better performance over a period of time. Compare with bitumen, use waste thermoplastic increases its life and smoothness. It is economical and eco-friendly. So, by that thermoplastic can use for repair pothole.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Literary studies are basically the unification of an informational body obtained from secondary sources as books, newspapers, magazines and other appropriate resources. This information is specific content and usually spins around specific themes or issues. It represents the selection of thoughtful ideas derived from the findings of others on this topic. The selected resources should be authoritative and well-written in good grammar and should provide an explanation of the research to be carried out.

Polyethylene Terephthalate (PETE) plastic is the common thermoplastic polymer resin of the polyester family and is used in fibers for clothing, containers for liquids and foods, thermoforming for manufacturing and in combination with glass fiber for engineering resins. It has the number "1" as its resin identification code.

High density polyethylene (HDPE) plastic is a thermoplastic polymer produced from the monomer ethylene. It is sometimes called "alkathene" or "polythene" when used for HDPE pipes. With a high strength-to-density ratio, HDPE is used in the production of plastic bottles, corrosion-resistant piping, geo membranes and plastic lumber. HDPE is commonly recycled, and has the number "2" as its resin identification code.

2.1.1. Plastic

DIFFERENT TYPES OF PLASTICS AND THEIR CLASSIFICATION

The Society of the Plastics Industry (SPI) established a classification system in 1988 to allow consumers and recyclers to identify different types of plastic. Manufacturers place an SPI code, or number, on each plastic product, usually molded into the bottom. This guide provides a basic outline of the different plastic types associated with each code number



Polyethylene Terephthalate sometimes absorbs odors and flavors from foods and drinks that are stored in them. Items made from this plastic are **commonly recycled**. PET(E) plastic is used to make many common household items like beverage bottles, medicine jars, rope, clothing and carpet fiber.



High-Density Polyethylene products are very safe and are not known to transmit any chemicals into foods or drinks. HDPE products are **commonly recycled**. Items made from this plastic include containers for milk, motor oil, shampoos and conditioners, soap bottles, detergents, and bleaches. It is **NEVER** safe to reuse an HDPE bottle as a food or drink container if it didn't originally contain food or drink.



Polyvinyl Chloride is **sometimes recycled**. PVC is used for all kinds of pipes and tiles, but is most commonly found in plumbing pipes. This kind of plastic should not come in contact with food items as it can be harmful if ingested.



Low-Density Polyethylene is sometimes recycled. It is a very healthy plastic that tends to be both durable and flexible. Items such as cling-film, sandwich bags, squeezable bottles, and plastic grocery bags are made from LDPE.



Polypropylene is occasionally recycled. PP is strong and can usually withstand higher temperatures. It is used to make lunch boxes, margarine containers, yogurt pots, syrup bottles, prescription bottles. Plastic bottle caps are often made from PP.





Polystyrene is commonly recycled, but is difficult to do. Items such as disposable coffee cups, plastic food boxes, plastic cutlery and packing foam are made from PS.



Code 7 is used to designate miscellaneous types of plastic not defined by the other six codes. **Polycarbonate** and **Poly lactide** are included in this category. These types of plastics are **difficult to recycle**. Polycarbonate (PC) is used in baby bottles, compact discs, and medical storage containers.

By the comparison, the plastics that suitable for repair pothole is PET AND HDPE

Table 2.1.1: Comparison of PET AND HDPE plastic.

<p>Polyethylene terephthalate (PETE or PET).</p>  <p style="text-align: center;">PET</p>	<ul style="list-style-type: none"> ● Introduced by J. Rex Whinfield and James T. Dickson in 1940. ● Most commonly used. ● Stiffer and more durable. ● Strong and impact-resistant. ● PETE is hygroscopic > absorbs water from surrounding. <p>Example: water bottle</p>
<p>High density polyethylene (HDPE)</p>  <p style="text-align: center;">HDPE</p>	<ul style="list-style-type: none"> ● commonly recycled. ● Never breaks under exposure to extreme heat or cold. ● Harder. ● Higher chemical resistance. ● withstand higher temperatures. ● Stronger intermolecular forces and tensile strength. <p>Example: detergent</p>

2.1.2. Compare between bitumen and plastic

Table 2.1.2: Comparison between bitumen and thermoplastic

Bitumen	Thermoplastic
Water proof: bitumen is insoluble in water and can serve as an effective sealant.	Water proof: plastic is insoluble in water
Economical: it is available in cheaper almost all over world.	Economical: easy to get and cheaper than bitumen
Adhesive: binds together all the component without bringing about any positive or negative changes in their properties.	Adhesive: binds together all the component without bringing about any positive or negative changes in their properties.

2.1.3. Pothole

A pothole is defined as a bowl-shaped depression in the pavement surface. With the climate change such as heavy rains can damaged pavements like potholes are increasing, and thus complaints and lawsuits of accidents related to potholes are growing. There are internal causes to potholes such as the degradation and responsiveness or durability of the pavement material itself to climate change, such as heavy rainfall and external causes such as the lack of quality management and construction management. They are produced when traffic beaches small pieces of the pavement surface allowing the entry of water. These spots disintegrate because of the weakening of the base Course or poor-quality surfacing. Free water collecting in the hole and the underlying base accelerates its development.

SEVERITY LEVELS

MEASUREMENTS TO BE TAKEN

- a) Depth of Pothole.
- B) Area of Pothole.
- C) Number of Potholes In Each Severity Level

Table 2.1.3: Depth of pothole

DEPTH (mm)	AREA (square metre)		
	< 0.1	0.1 -0.3	> 0.3
< 25	Low	Low	Moderate
25-50	Moderate	Moderate	High
> 50	Moderate	High	High

NO.	POSSIBLE CAUSES	PROBABLE TREATMENTS
1.	Loss of surface course	Patching
2.	Moisture entry to base course through a cracked pavement surface	Cut and patch
3.	Load associated disintegration of base	Base reconstruction

(sources: IBU PEJBAT JABATAN JKR, KL)

POTHOLE

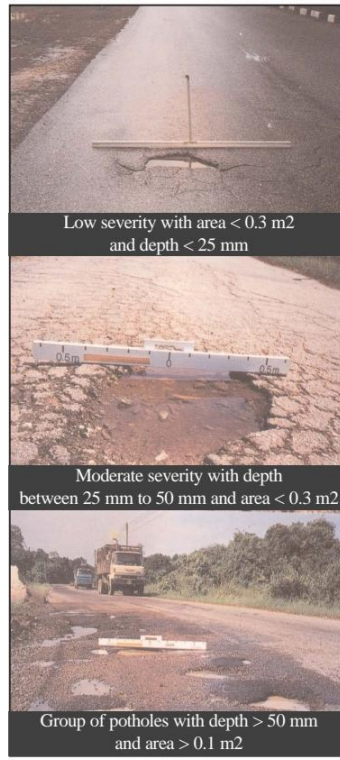


Figure 2.1.3: Pothole

Normally holes in the road surface are sized $200\text{mm} < \text{width} < 1000\text{mm}$ and $\text{depth} > 25\text{mm}$.

2.1.4. Burner

- Butane fuel burner is the burner which going to be use to melt the thermoplastics. Melting point of HDPE and PETE is 170°c and 185° respectively. Butane fuel Burner's temperature is up to 1430°c .



Figure 2.1.4: butane fuel

2.1.5. Aggregates

Aggregates is used to make road surface rough and strength to the structure, reduction cracking, improve structure, help water drainage. Size is in between 6mm to 10mm.



Figure 2.1.5: Aggregates

2.2 Concept and theories

These roads are made from recycled plastics, and the first step in constructing them is to collect and manage the thermoplastic material. The thermoplastics involved in building these roads consists mainly of common post-consumer products such as product packaging. Some of the most common thermoplastics used in packaging are polyethylene terephthalate (PET or PETE) and High-Density Polyethylene (HDPE) these materials are first sorted from plastic waste. After sorting, the material is cleaned, dried, and shredded. The shredded thermoplastic is mixed and melted at around 170°C to 185°C.

2.3 Previous studies

So far, no large scale, systematic approach has been employed to build roads entirely of plastics. On September 13, 2018, the Dutch company Volkerwessels built a bicycle path made of recycled plastic in Zwolle, in the North-east part of the Netherlands. According to the Guardian, "A second path is to be installed in Giethoorn in Overijssel, and Rotterdam is the city most likely to take up the technology."

Minimization of waste materials is important aspect of the modern growth and development initiated. Plastic is used in various domestic and industrial application. Use of plastic bags and bottles is very common. The disposal of plastic waste is major problem due to non-biodegradable nature of plastic. The thermoplastic can be used as feedstock for ethanol like products. It can be used for road construction and other construction related activity. The current review summarizes the research on use of waste plastic.

(Sunil J. Kulkarni - 2015)

In the highway infrastructure, a large number of originate materials and technologies have been invented to determine their suitability for the design, construction and maintenance of these pavement. Plastic and rubber are one of them. Also considering the environmental approach, due to excessive use of polythene in day to business, the pollution to the environmental is enormous. The use of plastic materials such as carry bags, cups etc. Is constantly increasing day by day 10. since the polythene in some beneficial purposes. The use of these materials as a road construction prove eco-friendly, economical and use of plastic gives strength in the sub-base course of the pavement.

(Rishi Singh chhabra - 2014)

2.4 Summary

As a conclusion, this chapter reviews the materials which will be use for the repairing damaged potholes. HDPE (2) and PETE (1) are the type of plastics that we are using instead of bitumen. PETE use because its stiffer and more durable and it is strong and impact-resistant and PET is hygroscopic, meaning that it absorbs water from its surroundings. HDPE uses because of commonly recycled plastic because it will not break under exposure to extreme heat or cold. Harder, has a higher chemical resistance and can withstand higher temperatures and also giving stronger intermolecular forces and tensile strength. A Burner will be used to melt the thermoplastics into a liquid form in order to cover the potholes on the roads. Aggregates will mix with the plastics before burn it and also spread on top of the melted thermoplastics as it will increase the friction.

CHAPTER 3

METHODOLOGY

3.1 Introduction

Research methodology is a set of rules, activities, and procedures used by the perpetrators of a discipline. Methodology is also a theoretical analysis of a method or method. Research is a systematic investigation to improve some of the knowledge, also

a systematic and organized effort to research specific problems requiring supervision. The fact of research can be understood by studying the various aspects that encourage research to conduct research. Everyone has different motivations, among which are influenced by their respective goals and professions. Motivation and research purposes in general are essentially the same, that research is a reflection of human desires who are always trying to find out something. The desire to acquire and develop knowledge is a basic human need which is generally the motivation to conduct research. The purpose of the research is discovery, proof and development of science.

1. Discovery. Data obtained from the research is new data that has never been known.
2. Providing. Data obtained from this research is used to prove the existence of doubt about certain information or knowledge.
3. Development. The data obtained from the study are used to deepen and expand existing knowledge.

3.2 Research design

The research design is an action plan that shows in detail how a study was conducted (Sabitha,2006). It also serves as a guide to assisting researchers in the process of collecting, analyzing and making interpretations of the results of research conducted. The research design is also a model for researchers to make inferences of the variables studied, below demonstrating research methods in education.

Our study of research will be carried out using experimental design in triplicate.

We will be doing research on site and take data to conclude our result. Research design can be divided into two groups:

Exploratory and conclusive. Exploratory research, according to its name merely aims to explore specific aspects of the research area. Exploratory research does not aim to provide final and conclusive answers to research questions. The researcher may even change the direction of the study to a certain extent, however not fundamentally, according to new evidences gained during the research process.

3.3 Research design method

3.3.1. SURVEY

Conducting survey is an unbiased approach to decision making and collect unbiased survey data and developed sensible decision based on analyzed result. No other than that, a survey may focus on factual information about individuals, or might aim to obtain the opinions of the survey take. We take survey on site and get much complain from people that use road that have pothole in their area.



Figure 3.3.1.1: Pothole at Sentosa Klang



Figure 3.3.1.2 Sentosa Klang

3.3.2 INTERVIEW

Throughout the interview with the JKR officer we get to know how to do in proper way to repair pothole using plastic. With interview with other engineer that have been done the same project, we could get their tips and how to done it properly.

- JKR officer: Jurianshah Manta
- Position: Jurutera Awam Bahagian Pengurusan Projek (zon tengah) Cawangan Jalan.
- Street branch: Ibu Pejabat Jabatan Kerja Raya (JKR) Kuala Lumpur, Malaysia.

Figure 3.3.2.1: JKR KUALA LUMPUR



Figure 3.3.2.2: JKR KUALA LUMPUR



Figure 3.3.2.4: Picture with MR. JURIANSHAH MANTA

3.3.3 SITE VISIT

We will do site visit at POLITEKNIK SHAH ALAM that has pothole that need to repair, look at their condition and do testing with proper safety.





Figure 3.3.3.3: Pothole at near to gate B at POLITEKNIK SHAH ALAM

3.4 - Research instrument

3.4.1 Method and material

we choose to do this project to solve problem pothole in highway Malaysia and to use plastic in eco-friendly. The material is thermoplastic HDPE plastic and PET plastic as main part to solve cover pothole. Using mix thermoplastic that already shredded in pieces in size 10 mm to 6mm. The pothole that need to cover is in size 200mm<width<1000mm and depth>25mm. The mix plastic is both HDPE (2) and PETE (1) plastic to cover up pothole without using any mix. Apparatus that are use to make this project is butene fuel burner as to melt the thermoplastics into liquid form.

Table 3.4.1.1: Material Ratio

Materials	Ratio
PETE	1
HDPE	1
Aggregates	4

3.4.2 Process

Step 1: Swipe the pothole to remove dust or particles that remain inside the pothole.

Figure 3.4.2.1: Swipe the pothole

Step 2: Measure the length and depth of pothole.



Figure 3.4.2.2: Measure the depth of pothole using ruler

Step 3: Make sure the pothole is in dry condition.



Figure 3.4.2.3: Make sure the pothole is dry

Step 4: Spread the small pieces of thermoplastics Polyethylene terephthalate (PETE) AND High density polyethylene (HDPE) into the pothole.



Figure 3.4.2.4: Spread the small pieces of thermoplastics into the pothole

Step 5: Melt the thermoplastics using the burner with the temperature from 170°C to 185°C.



Figure 3.4.2.5: Melt the thermoplastics

Step 6: Spread aggregates as the second layer.



Figure 3.4.2.6: spread the aggregates on top of thermoplastic layers

Step 7: Melt it again the thermoplastics with mix of aggregates so that to stick strongly with shredded plastics.

Figure 3.4.2.7: Melt with mix of aggregates with thermoplastics

Step 8: Repeat 2, 3,4,5, layer by layer until the pothole is covered.



Figure 3.4.2.8: Repeat 2-5 steps until complete the pothole.

Step 9: Let it to dry for 20 minutes.



Figure 3.4.2.9: After complete repair the pothole.



Figure 3.4.2.9: Pothole after 20 minutes

3.4.3. Experimental test

Test that use to make sure that the project is can be done, is using penetration test to test that test melting thermoplastic can properly cover pothole and can handle a heavy load. Next test is using skid resistant test to make sure that vehicle will not slide when passing through the repaired pothole due to less friction.

3.4.3.1. Penetration test - to make sure melting thermoplastic could handle a load like lorry, car, and motorcycle. Moreover, to compare between mixture of bitumen and mixture of thermoplastic.

Procedure

1. The oven is heated for 15 minutes.
2. Pieces of thermoplastic were put into metal container.
3. The metal container with thermoplastics is put inside the oven for 15 minutes with the temperature of $< 150^{\circ}\text{c}$.
4. The thermoplastics were let to cool for 10 minutes in water with the temperature of 25°c .
5. Once it is cooled, penetration test is been done. The test is repeated thrice to get a average value.
6. The data is been recorded.



Figure 3.4.3.1: Penetration test

Table 3.4.3.1: Penetration test result

Penetration test	Test 1	Test 2	Test 3	Average
Result thermoplastic	0.1 mm	0.16 mm	0.18 mm	0.15
Result bitumen	0.19 mm	0.55 mm	0.62 mm	0.45

3.4.3.2. Skid resistant - to make sure melting thermoplastic could handle load of transport without sliding.

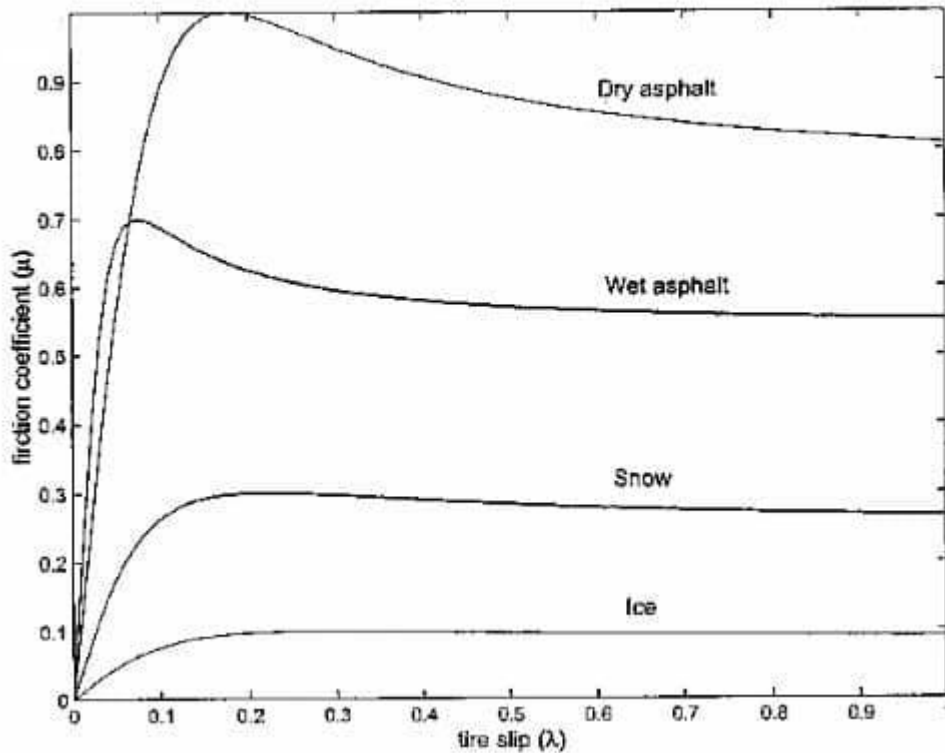


Figure 3.4.3.2: Graph of skid resistance

(sources: Data from JKR)

Procedure

1. Select the spot which the texture depth has been measured.
2. Set the apparatus on the plastic sample so that the slider will swing in the direction of traffic flow and level the base screws.
3. Raise the swinging arm clear of the sample and clamp in the horizontal position. Release the arm and check that the pointer reads zero.
4. With the pendulum arm free and hanging vertically, place the spacer, attached to a chain on the base of the column, under the lifting handle setting screw to raise the slider. Lower the head of the tester so that the slider just touches the plastic surface and clamp in position. Remove the spacer.

5. Check the sliding length of the rubber slider over the plastic surface by gently lowering the pendulum arm until the slider just touches the surface first on one side of the vertical and then on the other. When passing the arm through the vertical, use the lifting handle so that the slider does not touch the surface. The sliding length should be between 125 and 127 mm. If not, adjust by raising or lowering the head.
6. Place the pendulum arm in the horizontal and clamp in position.
7. Wet the plastic surface and slider with water.
8. Bring the pointer to its stop then release the pendulum by pressing the button. Take care to catch the arm on its return swing before it hits the ground.
9. Return the arm and pointer to the release position keeping the slider off the Plastic surface by means of the lifting handle. Repeat the test, wetting the surface between swings. Record the mean of five successive readings, provided they do not differ by more than three units. If the range is greater than this, repeat swings until three successive readings are constant; record this value.



Figure 3.4.3.2: Skid resistance test

Table 3.4.3.2: Skid resistance result for bitumen and thermoplastics

TEST CONDITION	BITUMEN		THERMOPLASTIC	
	WET	DRY	WET	DRY
TEST 1	50	86	46	78
TEST 2	49	88	48	85
TEST 3	45	92	49	89

3.4.3.3. Sieve test - to know which size of aggregate that need to use to make road pavement more roughly so there's no sliding for car. Aggregate that need to use is 10mm to 6mm size of sieve.



Figure 3.4.3.3: sieve test

3.5 Sampling techniques

3.6 Analysis Data

The data analysis method describes in brief the methods that will be used to compile, process and analyse collected data to achieve specified objectives. Besides this data analysis can also provide other information that can give enlightenment to the contents of the study. By using the data analysis method then all the readings and the accuracy for the purpose of improving a project. Through the study, the data analysed can give a result of the study studied. Therefore, this method can also achieve the objectives studied.

3.7 Summary

Conclusively, the experiments had been done to prove that the objective is valid. Thermoplastics such as HDPE (2) and PETE (1) have a better strength compare to bitumen. The consistency test has been proven that the thermoplastics that mentioned above have lesser penetration compare to bitumen. This clearly concludes that the thermoplastics are way stronger than the bitumen. Other tests also give a better view on the characteristics of the materials that can be use during related situation.

CHAPTER 4

RESULTS AND ANALYSIS

4.1 INTRODUCTION

The data analysis method briefly describes the method to be used for compiling, processing and analysing data collected in response objectives of the study. In addition, data analysis can also provide information objectives of the study. Others can shed light on the issues being studied.

4.2 PROJECT ANALYSIS

To find out the product efficiency, we have conducted some test which are

- Penetration test
- Skid resistant test

4.2.1 Penetration Test



Figure 4.2.1: Analysis data for penetration test

Penetration values for thermoplastic and bitumen in table 4.2.1.

Table 4.2.1: Penetration Result

TEST	BITUMEN	THERMOPLASTIC<
TEST 1	0.19	0.1
TEST 2	0.55	0.16
TEST 3	0.62	0.18
AVERAGE	0.45	0.15

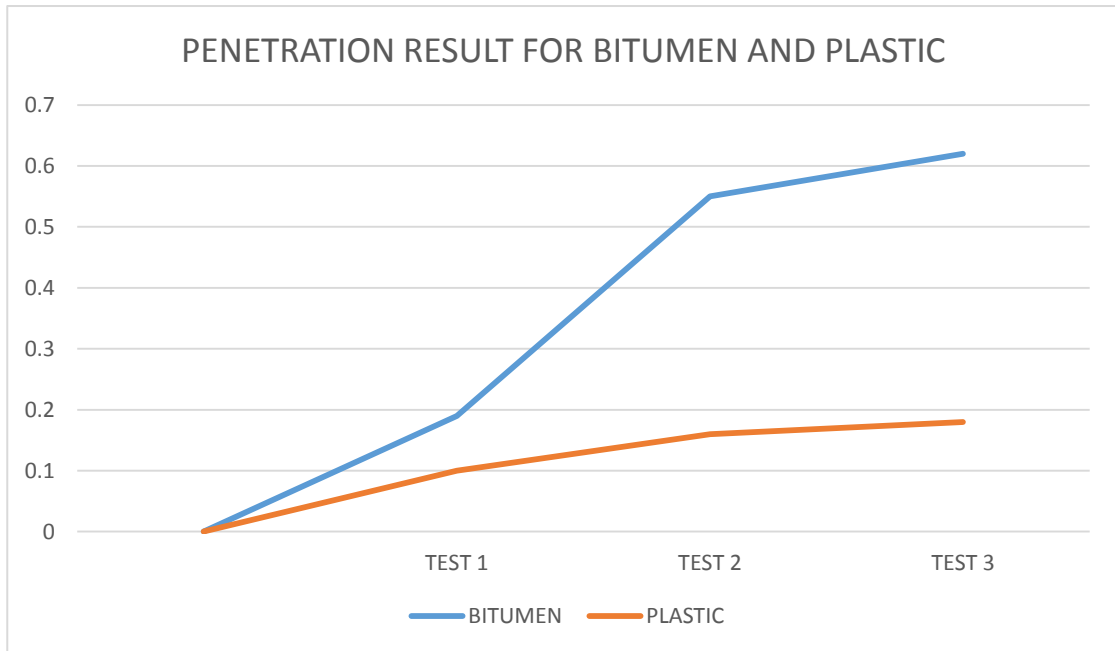


FIGURE 4.2.1.1: Penetration result for bitumen and plastic

FIGURE 4.2.1 illustrates the effects of plastics in concentration on penetration. Penetration test is commonly adopted on bitumen to grade the material in terms in hardness. But the result for penetration test with plastic is harder than bitumen. So, it shows plastics is suitable to replace bitumen to repair pothole.

4.2.1 Skid Resistance Test



Figure 4.2.2 Analysis data for skid resistance test

Skid resistance values for thermoplastic and bitumen in table 4.2.2.

Table 4.2.2 Skid resistance result

TEST CONDITION	BITUMEN		THERMOPLASTIC	
	WET	DRY	WET	DRY
TEST 1	50	86	46	78
TEST 2	49	88	48	85
TEST 3	45	92	49	89

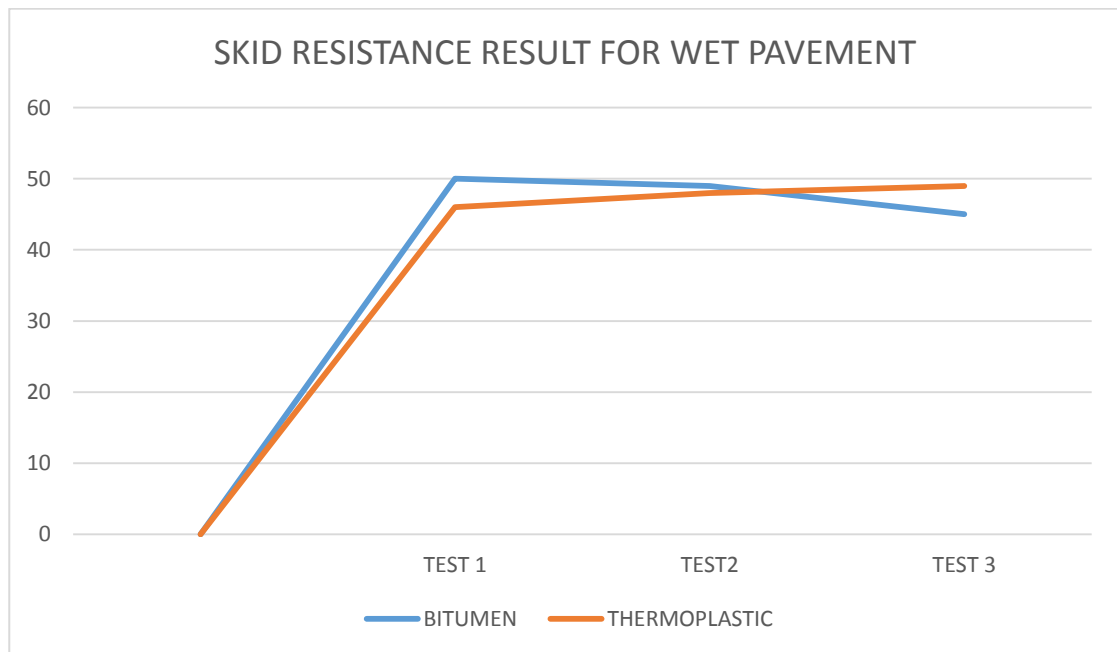


FIGURE 4.2.2.1: Skid resistance result wet pavement.

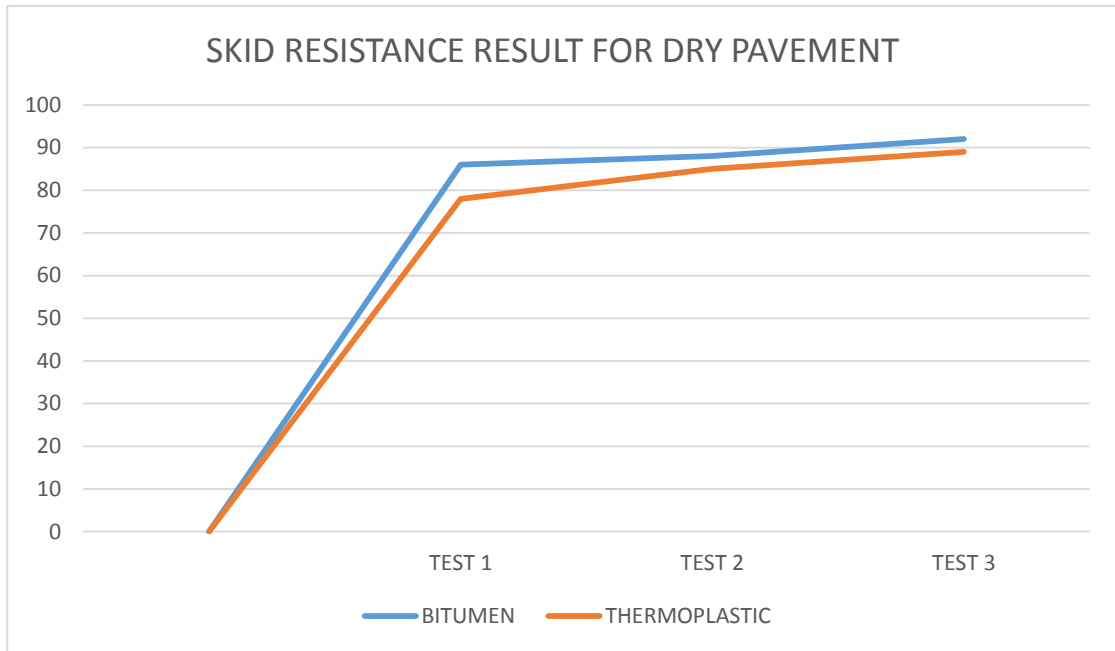


FIGURE 4.2.2.2: Skid resistance result for dry pavement.

FIGURE 4.2.2.1 and FIGURE 4.2.2.2 illustrates the Skid resistance is the force developed when a tire that is prevented from rotating slides along the pavement surface. Skid resistance is an important pavement evaluation parameter because: Inadequate skid resistance will lead to higher incidences of skid related accidents. So, thermoplastics can also replace bitumen to repair pothole.

CHAPTER 5

DISCUSSION AND CONCLUSION

5.1 Introduction

In implementing this final project, it is not impossible for every individual to have problems. To achieve a sound and unanimous decision, it may be necessary to do some discussion. The findings are obtained as well as some of the problems that arise, and the discussions are gathered to make a solid discussion of the solution in relation to all the problems that occur. Through the discussion, a new alternative or approach can be established to provide a clue to ensure that all problems arise can be resolved with cautiousness and intelligence. The results of the discussions between members of the group will be referred to the supervisor for advice and addition if necessary.

Among the issues that has been discussed are:

- Choosing of concept
- Characteristics of design
- Function and objectives of the projects
- Materials
- Testing methods

5.2 Product Commentary and Review

5.2.1 Discussion

Discussions are conducted from time to time and the latest developments in the implementation are discussed. All issues need to be addressed as soon as possible and hold discussions among group members and refer to project supervisor.

Our project was to repair pothole using thermoplastics. It can be executed because Malaysia seriously has a huge problem with plastic so that it can be used to repair pothole.

After group discussion, we generate ideas and found the solution by repairing pothole using thermoplastics. It also saves time, cost of the repairing pothole using bitumen.

5.2.2 Concept and Design

In this process, we designed and created the project repairing pothole using thermoplastics based on the objectives set in the beginning of the project. We have made comparison between plastics and bitumen

After choosing the concept, design and suitable materials, we have proceeded with the execution of the project.

5.2.3 Problem solving

Each project that is to be developed should not be missed from encountering problems during the implementation of processes. Our group encountered problems when the material, initially planned is not suitable for the repairing pothole. We overcome the problem by choosing an alternate material which is plastics.

5.2.4 Testing and Results

The testing of the project is conducted to determine the efficiency of the project. The testing is done by comparing bitumen and thermoplastics.

The project is completed with penetration test and skid resistance test is to analysis the strength and skid resistance of plastics. The data are presented in suitable form for the viewing of panels, supervisors and other individuals.

5.3 Ideas of Improvement

As a result of our project to replace bitumen with plastic has passed but need major improvement. Even though the plastic stick to the paved tar road, the plastic around the pavement cracked due to incorrect procedure, in which we poured water during the drying process of the pothole, resulting in the plastic mixture and the aggregates not having the correct ratio. so the advice to future students who want to improve our idea is, by giving them more time for the pothole to dry and no other mixture besides aggregates and plastic

5.4 Conclusion

The observable conclusions from this project we have found is that the method or steps to complete a project should be done with caution in order to get a perfect and precise result. In the event of any negligence or carelessness being found, the project to be produced as expected will not last long and the use of the components must also be correct with its use.

In collaboration with members of the group, this project will be successful and well-crafted according to the desired concept and set. This will be proven after the final project can be implemented perfectly and works well. Through the final project REPAIRING POTHOLE USING MIXTURE OF AGGREGATE AND THERMOPLASTICS, it is stated that in the light of our planning we should carefully select the appropriate materials and equipment before making a connection, test the components before it is used to ensure the product safe to use as well as make a thorough study of the project to be developed.

This project is realized to reduce use of bitumen to repair pothole. It is found out that the strength of plastics is stronger than bitumen. In addition, the skid resistance test of plastics is almost same with bitumen.

EXPENSES

ITEM	QUANTITY	PRICE (RM)
Burner	1	40
Butane Gas	1	5
Aggregate	6Kg	12
PETE	1.5Kg	15
HDPE	1.5Kg	15
Broom	1	10
Trowel	1	5
Safety west	1	10
Glove	1pair	3
Total		115

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