# Utilizing High Density Polyethylene (HDPE) Synthetic Aggregate as a Chip Sealing Material in Improving Skid Resistance

(Pemanfaatan Agregat Sintetik High Density Polyethylene (HDPE) Sebagai Material *Chip Sealing* Untuk Meningkatkan *Skid Resistance*)

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## ABSTRACT

There are four main factors causing traffic accident : human factor, vehicle factor, road factor and environment factor. Accident data from Poltabes Yogyakarata in 2007 showed that road factor causes accident is 2.45%. In effort to achieve traffic safety, the infrastructure must be considered in the first list. This research is dealing with "Utilizing High Density Polyethylene (HDPE) Synthetic Aggregate as a Chip Sealing Material in Improving Skid Resistance". The purpose of this research is to understand the effect of chip sealing using HDPE synthetic aggregate on the skid resistance, so that the surface pavement can provide good service for traffic and road users and the quantity of accident can be reduced. In this research the skid resistance was measured using British Pendulum Tester such that the its skid resistance is also called British Pendulum Number (BPN). BPN is a measured based on 3 variations of aggregate weight being spreaded, that are 240 grams, 271 grams and 304 grams. The result of BPN will be correlated with the wet accident ratio, friction coefficient and stopping distance. The BPN values being obtained are 55.96, 55.6 and 53.4, respectively. The BPN was found to increase with the increase of aggregate weight in chip seal mixture. It was revealed that BPN with chip sealing using HDPE could be increased by approximately 10 % in comparison with that without chip sealing. In addition, chip sealing using HDPE can reduce the accident ratio by 47.32 %, improve the traffic safety by 47.32 %, and shorten the stopping distance. The greater friction coefficient the lower stopping distance, and the lower stopping distance the better traffic safety.

**Keywords**: traffic safety, skid resistance, chip sealing, HDPE

## INTRODUCTION

Historically, highway safety countermeasures are developed in response to accidents. These countermeasures are based on the identification of contributing factors in the operating environment that can be eliminated such that the accidents are no longer occur. There are four main factors cause traffic accidents: human factor, vehicle factor, road factor, environment factor. The composition of such factors obtained from Poltabes Yogyakarata in 2007 is shown in Table 1.

Based on Table 1, the human factors are the dominant factor causing the traffic accident. However, it is not a wise suggestion if we ignore the other accident factors, especially the road factors. In effort to achieve the traffic safety, the infrastructure must be considered in the first list.

TABLE 1. Accident causes

| Accident Causes | The Number of Traffic Accident | % |
|---|---|---|
| Human Factors | 1667 | 90,65 |
| Vehicle Factors | 92 | 5,00 |
| Road Factors | 45 | 2,45 |
| Environment Factors | 35 | 1,90 |

*Source : Poltabes Yogyakarta, 2007*

In this research, we conduct a study about *Utilizing High Density Polyethylene (HDPE) Synthetic Aggregate As A Chip Sealing*

*Material In Improving Skid Resistance*. The reason is because there are many advantages of chip sealing method, such as:

1. Improving skid resistance: chip seals provide good skid resistance.
2. Cost effective treatments: chip seals are typically cost effective when properly placed on the right type of pavement.
3. Good durability: chip seals wear well and can have long service lifes.
4. Easiness of construction: chip seals are typically constructed rapidly and cause less disruption to the traveling public than do other treatments that take longer (California Departement of Transportation, 2003).

High Density Polyethylene (HDPE) recycle plastic is used as a material in this research. It is because fifty-nine percents of today's plastic packaging consist of high density polyethylene (HDPE). HDPE serves as an excellent protective barrier and has a very good chemicals resistance properties which are desirable for containing household chemical and detergents. In 1994 HDPE made approximately one-fifth of the 17 million metric tons of plastics discarded in landfills. Most HDPE has the specific gravity between 0,94 and 0,97, and melts at 126 – 135$^{o}$C (Holmstorm and Swan, 1999).

The main objectives of this research are:

1. To investigate the performance of recycle/waste plastic HDPE as the aggregate on chip sealing,
2. To compare the performance of pavement (skid resistance value) using chip sealing with recycle waste plastic HDPE and the performance of pavement without chip sealing
3. To make a correlation between the skid resistance value with the wet accident ratio, friction coefficient and stopping distance.

Skid resistance is the coefficient of friction between wetted road surface and vehicle tire. The major requirement for wearing coarse surfacing is good skid resistance. Skid resistance is controlled by several factors including: other materials on the road surface, tyre performance, ambient temperatures causing the physical hardening of the binder, water on the road surface, microtexture and macrotexture of the roas surface (Tosswell et al., 1997).

The skid resistance or friction, which develops between a vehicle's tires and the surface of the road, is a function of two components: macrotexture and microtexture. Basically, the microtexture is determined by the frictional properties of the aggregate, whereas the macrotexture is determined by the size, shape, and spacing of the aggregate particles (Abdul-Malak *et. al*, 1993 in Transport Research Board, 2005).

Microtexture refers to irregularities in the surfaces of the stone particles (fine-scale texture) that affect adhesion. These irregularities causing the stone particles feel smooth or harsh to the touch. The magnitude of microtexture depends on initial roughness on the aggregate surface and the ability of the aggregate to retain this roughness against the polishing action of traffic. Accordingly, microtexture is an aggregate-related property that can be controlled through the selection of aggregates with desirable polish-resistant characteristics. The evaluation of the aggregates with respect to their polishing behavior can be accomplished by using a laboratory test procedure that has been developed for this purpose. Microtexture and adhesion contributes to skid resistance at all speeds and are the prevailing influence at speeds less than 30 mph (Noyce, et al., 2005).

Macrotexture refers to the larger irregularities in the road surface (coarse-scale texture) that affects hysteresis. These larger irregularities are associated with voids between stone particles. The magnitude of this component will depend on several factors. The initial macrotexture on a pavement surface will be determined by the size, shape, and gradation of coarse aggregates used in pavement construction, as well as the particular construction techniques used in the placement of the pavement surface layer. Macrotexture is also essential in providing escape channels to water in the tire-surface interaction, thus reducing hydroplaning. Macrotexture and hysteresis are less important at low speeds but a coarse macrotexture is very desirable for safe, wet-weather travel as the speed increases (Noyce, et al., 2005). The difference between macrotexture and microtexture is shown in Figure 1.

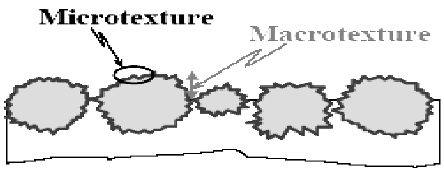


FIGURE 1. Difference between Macrotexture and Microtexture (*Kuttesch, 2004)*

Skid resistance is the force developed when a tire that is prevented from rotating slides along the pavement surface (Highway Research Board, 1972).

Referring to Asi (2005), skid resistance is an important pavement evaluation parameter. It is because, inadequate skid resistance will lead to higher incidences of skid related accidents, most agencies have an obligation to provide users with a roadway that is "reasonably" safe, skid resistance measurements can be used to evaluate various types of materials and construction practices.

Skid resistance is generally quantified using several forms of friction measurement such as a friction factor or skid number. The friction factor (like a coefficient of friction) can be calculated using:

$$f = \frac{F}{L} \quad \text{.............................................(1)}$$

$$SN = 100\,(f) \quad \text{....................................(2)}$$

where:

SN : Skid Number;
F : frictional resistance to motion in plane of interface;
L : load perpendicular to interface.

In general, the friction resistance of most dry pavements is relatively high; wet pavements are the problem. The numbers of accidents on wet pavements are twice as high as dry pavements (but other factors such as visibility are involved in addition to skid resistance).

Another equipment that can be used to measure the friction coefficient is Sideway-force Coefficient Routine Investigation Machine (SCRIM). SCRIM is a machine, which measures the skid resistance of road under wet conditions, and is capable for testing on both wheel paths of long road at a speed approximately 50 km/h that SCRIM will measure the friction coefficient and need to be converted to have the sideway-force coefficient. The result of the SCRIM is ESC (Equilibrium SCRIM Coefficient) that similar with friction coefficient. The Relationship for converting output from these testers to the equivalent SCRIM ESC values can be obtained by using (Transit, 2002):

$$ESC = 0.0071\,BPN + 0.033 \quad \text{............. (3)}$$

where:

ESC : Equilibrium SCRIM Coefficient
BPN : The British Pendulum Number

In general, the highway surface should have some sort of roughness to facilitate friction between the car wheel and pavement surface. Skid resistance is the force developed when a tire that is prevented from rotating slides along the pavement surface. Skid resistance is a measure of the resistance of the pavement surface to sliding or skidding of the vehicle. It is a relationship between the vertical force and the horizontal force developed as a tire slides along the pavement surface. Therefore, the texture of the pavement surface and its ability to resist the polishing effect of traffic is of prime importance in providing skidding resistance. Skid-resistance is the term usually employed to point out the maximum friction-coefficient between a tire and a road. This parameter, which is essential for the safety of road users, may decrease when the road surface is worn due to traffic and climatic conditions.

Kuttesch (2004) had investigated a relationship between pavement skid resistance and accident frequency. This report analyzes the relationships between skid resistance, accident, and traffic data for the state of Virginia. Crash data, based on police reports, from across the state and skid number was collected from Virginia Department of Transportation (VDOT) over two years (2000-2002), the most accident occurred. The wet accident data was aggregated in 1.6 km (1 mile) sections and divided by the annual traffic to obtain wet accident rates. The correlation between wet skid resistances measured with a locked wheel trailer using a smooth tire (ASTM E 274). The relationship between pavement skid resistance and accident frequency can be formulated as follow:

$$y = -0.0078\,x + 0.4813 \quad \text{...............(4)}$$

where:

y : wet accident ratio;

x : average skid resistance value (BPN)

Stopping sight distance, the distance required for a vehicle traveling at the design speed to stop before reaching a stationary object in its path, is the minimum sight distance that should be provided at any point on any highway. The available stopping sight distance on any roadway should be long enough to enable a vehicle traveling at the design speed to stop before reaching a stationary object in its path. Stopping sight distance represents a near worst-case situation. Greater distances should be provided wherever practical (Minnesota Department of Transportation, 2004).

The stopping distance is calculated according to the equation (Varhelyi, 2002):

$$s = (v \times tr) + \frac{v^2}{(2 x g x (f+G)} \quad (5)$$

where:

s : the car's stopping distance (m);
v : the car speed (m/s);
tr : the driver's reaction time (2 sec);
g : acceleration due to gravity (m/s2);
f : coefficient of braking friction (dry road: 0.5-0.8; wet road: 0.3-0.4; slippery road: 0.1-0.2);
G : gradient (slope of the road) tan α (+ uphill; - downhill)

Chip sealing is the application of a bituminous binder immediately followed by the application of an aggregate. The aggregate is then rolled to embed it into the binder. Multiple layers may be placed and various binder and aggregate types can be used to address specific distress modes or traffic situations. In TRB, 2005, the types of chip seal treatments include: single chip seal, multiple chip seal, racked in seal, cape seal, inverted seal, sandwich seal and Geotextile - Reinforced Seal.

Chip seal design involves determining the asphalt material spray rate, the cover aggregate spread rate, and the top size or gradation of the cover aggregate. The influencing variables are the traffic level and the existing condition. The spray rate includes the total asphalt material including asphalt, the asphalt binder, and water in an asphalt emulsion. The most common design concept is based on work done by Norman Mcleod. The concept is based on the principle that the asphalt binder or the residue of the asphalt binder should generally fill 60-70 percent of the aggregate void space after the particles has been fully oriented. The greater the amount of aggregate or spread rate is, the greater the amount of asphalt binder that will be required. The application of a given cover aggregate should be only one stone thick when possible. The amount of aggregate should remain constant regardless of the asphalt material type or pavement condition (Alaska DOT, 2001, in Lavin, 2003). Traffic and pavement type or use determines the maximum top size of the aggregate.

The flakiness index (FI), is a measure of the percent by weight of flat particles. It is determined by testing a small sample of aggregate particles for their ability to fit through a slotted plate. If the particle can fit through the slotted plate, they are considered to be flat. If they cannot fit, they are considered to be cubical. The lower FI, the more cubical the aggregate is (Alaska DOT, 2001, in Lavin, 2003).

The ALD can actually be measured by measuring the dimension of each aggregate particle based on 200 pieces of sample size. Alternatively, the ALD can also be calculated using the median particle size and the FI of the aggregate. ALD is the measurement of the ability of the aggregate in the chip seal to be able to pack together. A higher ALD value means greater packing together of the aggregate, higher asphalt binder, demand and a greater macro texture or texture depth. The space between the aggregates provides room for the asphalt binder volume and the design texture depth after the aggregate is rolled or embedded into the pavement. The space that is available is 15-40 percent of ALD volume with 30 percent being typical (Whiteoak, 1991). The loose weight or unit weight of the aggregate also needs to be known.

The aggregate spread rate can be calculated using equation below.

$$S = 0.001\ (ALD)\ x\ (W) x\ (1 + E) \quad (6)$$

where:

S : aggregate spread rate (kg/m$^2$);
ALD : average Least Dimension (mm);
W : the aggregate unit weight (kg/m$^3$);
E : the waste factor (%), for loose aggregate usually 5-10 %

## RESEARCH METHOD

The sequence of research is illustrated in Figure 2.

### *Implementation of Research*

*1. Design of chip sealing*

Chip seal design involves determining the asphalt material spray rate, the cover aggregate spread rate, and the top size or gradation of the cover aggregate.

To calculate the weight of synthetic aggregate that will spread using this step.

a. Calculated the loose unit weight of aggregate.

b. The value of Average Least Dimension (ALD) can be measured by measuring the dimension of each aggregate particle based on 200 pieces of sample size. Because the aggregate that will be used in this research is fabricated aggregate, so the aggregate have the same size (single size). The value of ALD of HDPE is 2.3 mm.

c. The weight of recycle HDPE that will be spread in mould with size 0,4 x 0,4 (m) can be calculated using Equation (6). There are 3 variations weight of HDPE aggregate : 240 gr, 271 gr, 304 gr.

d. Calculated the weight of resin spray. Thick of spray (2/3 ALD) = 0.153 cm, weight of resin spray is 285 gr.

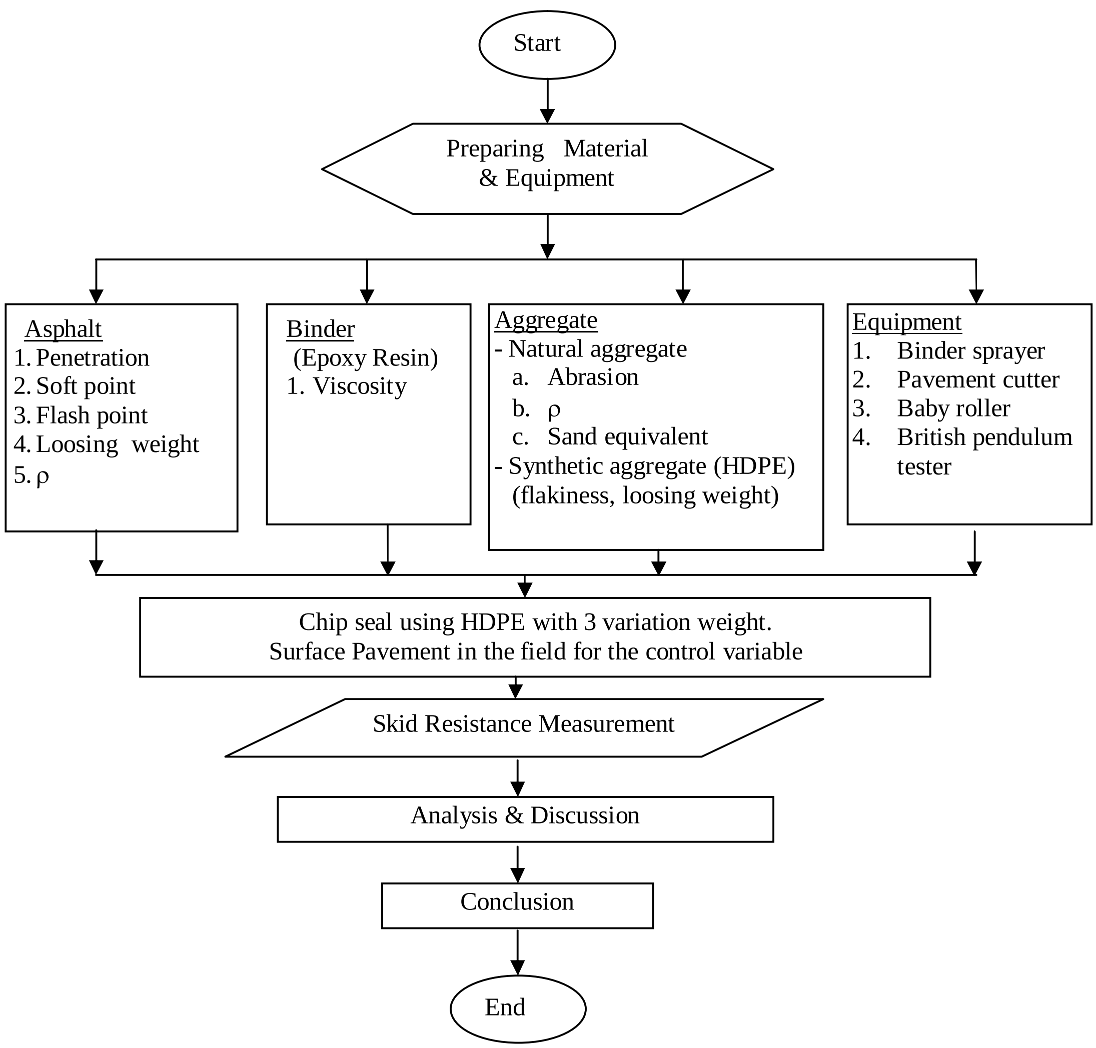


FIGURE 2. Research sequence

*2. Manufacturing sample design with size 40 cm x 40cm x 3 cm*

The steps of creating sample design are:

a. separating the aggregate that will use appropriately with the specification of gradation already determined.
b. heating the aggregate until reaching the temperature of $165^0$C.
c. mixing asphalt with temperature of $155^0$C and aggregate until the mixture is homogeneous.
d. the mixture of material put in the mould with size 40 cm x 40cm x 3 cm.
e. compacting the mixture of material in the mould using baby roller (Figure 3).

FIGURE 3. The mixture material is compacted using baby roller

f. spraying resin in the top of HRS (Figure 4).

FIGURE 4. The resin is sprayed on the top of HRS with thickness 2/3 ALD

g. spraying the HDPE aggregate (Figure 5).

FIGURE 5. The HDPE aggregate is sprayed

*2. Testing phase*

The measurement of the skid resistance using British Pendulum Tester can be done after making the sample design. In each sample design, the skid resistance measurement will be conducted at 5 locations or points.

FIGURE 6. Skid resistance measurement on chip sealing

## RESULT AND DISCUSSION

### *Result*

The test result of material components (coarse aggregate, fine aggregate and filler) on HRS-WC can be seen in Table 2, 3 and 4.

The test result of Asphalt AC 60/70 ex Pertamina can be seen in Table 5.

The test result of epoxy resin can be seen in Table 6.

The test result of synthetic aggregate HDPE can be seen in Table 7.

TABLE 2. Coarse aggregate test result

| No | Aggregate Characteristic | Unit | Requirement | Result |
|---|---|---|---|---|
| 1 | Los Angeles Abrasion Test | % | <40 | 23.5 |
| 2 | Adhesion with asphalt | % | >95 | 98 |
| 3 | Water absorption | % | <3 | 1.836 |
| 4 | Bulk specific gravity | $gr/cm^3$ | >2.5 | 2.562 |
| 5 | Apparent specific gravity | $gr/cm^3$ | >2.5 | 2,688 |
| 6 | Soundness Test | % | <7 | 1.30 |

TABLE 3. Fine aggregate test result

| No | Aggregate Characteristic | Unit | Requirement | Result |
|---|---|---|---|---|
| 1 | Water absorption | % | <3 | 2.564 |
| 2 | Bulk specific gravity | $gr/cm^3$ | >2.5 | 2,671 |
| 3 | Apparent specific gravity | $gr/cm^3$ | >2.5 | 2.868 |
| 4 | Sand equivalent | % | >50 | 84.62 |

TABLE 4. Filler test result

| No | Aggregate Characteristic | Unit | Requirement | Result |
|---|---|---|---|---|
| 1 | Apparent specific gravity | $gr/cm^3$ | >2,5 | 2.722 |

TABLE 5. Test result of asphalt AC 60/70 ex Pertamina

| No | Type of Test | Unit | Requirement | Result |
|---|---|---|---|---|
| 1 | Penetration Test (25 $^0$C, 5 sec) | 0.1mm | 60 – 70 | 62.2 |
| 2 | Softening Point | $^0$C | 48 – 58 | 48 |
| 3 | Flash Point | $^0$C | Min 200 | 347 |
| 4 | Ductility (25$^0$C, 5 cm/mnt) | Cm | Min 100 | >100 |
| 5 | Loss on Heating (163$^0$C, 5 hours) | % | Max 0,4 | 0.0408 |
| 6 | Solubility in CCL4 | % | Min 99 | 99.317 |
| 7 | Penetration after loss on heating | % | Min 75 | 81.83 |
| 8 | Specific Gravity | $gr/cm^3$ | Min 1 | 1.030 |

TABLE 6. Test result of Epoxy Resin

| No | Chemical Composition | Diglycidyl ether of Bisphenol-A |
|---|---|---|
| 1 | Physical matter | Liquid |
| 2 | Flash Point ($^o$C) | >150 |
| 3 | Viscosity (cps, 25$^o$C) | 12000 – 15000 |
| 4 | Censity (g/cm$^3$, 25$^o$C) | 1,16 |

TABLE 7. HDPE test result

| No | HDPE test | Result |
|---|---|---|
| 1 | Specific Gravity | 0.903 gr/ml |
| 2 | Melting Point | 155 $^0$C |

*Discussion*

*1. The relation between the weight of spread aggregate and BPN*

The average of British Pendulum Number (BPN) on chip sealing method with 3 variation of weight can be seen in Table 8 and Figure 7.

TABLE 8. The average of BPN on chip sealing

| Weight of HDPE aggregate | BPN |
|---|---|
| 304 | 55.96 |
| 271 | 55.6 |
| 240 | 53.4 |

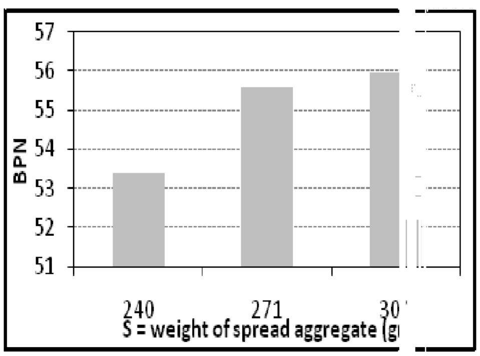


FIGURE 7. The relation between the weight of spread aggregate and BPN

As shown in Table 8 and Figure 7, the average of British Pendulum Number (BPN) on chip sealing method with 3 variations of weight have tendency to increase with the increasing of weight aggregate in chip sealing mixture. The increase of BPN can occur because of with increasing the weight of aggregate in chip sealing make the space inter aggregate become much smaller. This condition makes the surface rougher so the BPN will be higher.

*2. The comparison BPN between chip sealing and without chip sealing*

The highest average of BPN using chip sealing and the average BPN without chip sealing can be seen in Table 9.

TABLE 9. The comparison BPN between chip sealing and without chip seal

| | without chip sealing | with chip sealing |
|---|---|---|
| BPN | 50.8 | 55.96 |

In Table 9 can be seen the result of British Pendulum Number (BPN) between chip seal and without chip sealing. Chip seal method can increase the British Pendulum Number around 10,157 % than without chip sealing.

*3. Correlation between British Pendulum Number (BPN) and wet accident ratio*

As discussed earlier, that chip sealing method can improve the BPN around 10 % than without chip seal. The improvement of BPN means that the skid resistance of the surface is improving too. By measuring the BPN, the relationship between BPN and the accident data could be observed. As stated by Kuttesch (2004), skid resistance becomes a factor which contributes to the accident. Correlation between BPN and wet accident ratio in chip sealing using High Density Polyethylene (HDPE) as a synthetic aggregate and without chip sealing can be calculated using Equation (3). The result can be seen in Table 10.

TABLE 10. Correlation between BPN and wet accident ratio

| | without chip sealing | with chip sealing |
|---|---|---|
| BPN | 50.8 | 55.96 |
| Wet accident ratio | 0.085060 | 0.044812 |

As shown in Table 10, the wet accident ratio with chip sealing is lower than wet accident ratio without chip sealing. Wet accident ratio without chip sealing is 0.085060 and the wet accident ratio with chip sealing is 0.044812. The decreasing BPN can increase the wet accident ratio. Chip sealing method using HDPE can lowering the wet accident ratio 47.32 %. It also can be said that chip sealing using HDPE can improve the traffic safety around 47%.

*4. Correlation between British Pendulum Number (BPN) and friction coefficient*

There is a relationship between British Pendulum Number and friction coefficient. The relationship between BPN and friction coefficient can be calculated using Equation (2). The result can be seen in Table 11.

TABLE 11. Correlation between BPN and friction coefficient

| | without chip sealing | with chip sealing |
|---|---|---|
| BPN | 50.8 | 55.96 |
| Friction Coefficient | 0.39 | 0.43 |

*5. Correlation between British Pendulum Number (BPN) and stopping distance*

The friction coefficient got from the BPN can be used to determine the stopping distance with various speeds. The relationship between friction coefficient without chip sealing and with chip sealing can be calculated using Equation (5). The result can be seen in Table 12.

From Table 12 can be seen that by using HDPE for chip sealing, the stopping distance will decrease. The decreasing of the stopping distance is getting higher as follows by the increasing of vehicle speed. For example by implementing HDPE for chip sealing, if the vehicle speed are 40 km/h then the stopping distance will decrease 1.5 meters. 40 km/h is the vehicle speed allowed in the urban area, and decreasing stopping distance 1.5 meters will be very important in the mixed traffic area (car, motorcycle, cyclist, pedestrian). If the vehicle speed is 90 km/h (high speed) then the stopping distance will decrease 7.6 meters. It is also important for high speed traffic, because reducing stopping distance 7.6 meters is more than the length of two times standard car although 7.6 meters can be passed not more than half second in the 90 km/h speed.

TABLE 12. Stopping Distance with and without chip sealing with various speeds.

| Speed (km/h) | Stopping distance (m) | | Improvement stopping distance | |
|---|---|---|---|---|
| | Without chip sealing | With chip sealing | (m) | (%) |
| 10 | 6.56 | 6.47 | 0.09 | 1.43 |
| 20 | 15.14 | 14.77 | 0.38 | 2.48 |
| 30 | 25.74 | 24.90 | 0.84 | 3.28 |
| 40 | 38.36 | 36.86 | 1.50 | 3.91 |
| 50 | 52.99 | 50.64 | 2.35 | 4.43 |
| 60 | 69.64 | 66.26 | 3.38 | 4.85 |
| 70 | 88.30 | 83.70 | 4.60 | 5.21 |
| 80 | 108.98 | 102.98 | 6.00 | 5.51 |
| 90 | 131.68 | 124.08 | 7.60 | 5.77 |
| 100 | 156.40 | 147.01 | 9.38 | 6.00 |
| 110 | 183.13 | 171.78 | 11.35 | 6.20 |
| 120 | 211.88 | 198.37 | 13.51 | 6.38 |

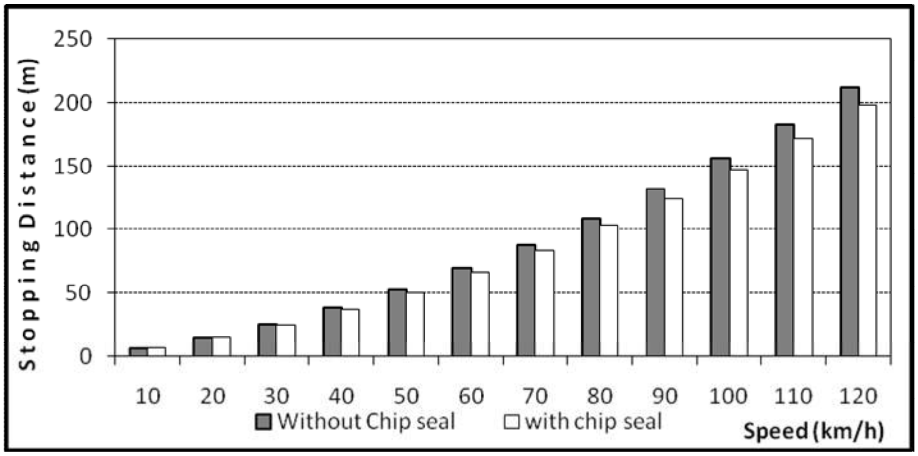


FIGURE 8. Stopping distance results with variation of speeds.

Stopping distance formula considered friction coefficient to determine stopping distance. The greater friction coefficient is the lower stopping distance. The lower stopping distance is the better for traffic safety. From Figure 8 can be seen that chip sealing method can lowering the stopping distance than without chip sealing. If vehicle passes with 40 km/h speed then the stopping distance without chip seal will be 38.36 m; it is the same stopping distance 41.09 km/h with chip sealing. Also if a vehicle passes with 60 km/h speed then the stopping distance without chip sealing will be 69.64 m; it is the same stopping distance 61.94 km/h with chip sealing

The reduction of stopping distance reflects the improvement of safety factor in traffic. By increasing the friction coefficient it will reduce the stopping distance, and the reduction of stopping distance will be higher in the high speed compare to the existing condition whether it is in its length or in percentage.

## CONCLUSION

1. The chip sealing method using High Density Polyethylene (HDPE) as aggregate with 3 variations weight of aggregate spread (304 gr, 271 gr, 240 gr), the result British Pendulum Number were 55.96, 55.6 and 53.4.
2. The chip sealing method using High Density Polyethylene (HDPE) as aggregate can increase the British Pendulum Number around 10 % than without chip sealing.
3. The wet accident ratio of pavement without chip sealing is 0.085060 and the wet accident ratio of pavement with chip sealing using HDPE are 0.044812. It means that chip sealing using HDPE can lower the accident ratio 47.32 %. It also can be said that chip sealing using HDPE can improve the traffic safety 47.32 %.
4. Chip sealing method using HDPE can lowering the stopping distance from the existing condition. The greater friction coefficient the lower stopping distance, the lower stopping distance is the better for traffic safety.
5. British Pendulum Number referred to the skid resistance is one parameter that important in a road surface design. British Pendulum Number can be used as the determination for designing pavement surface in improving the traffic safety in road environment. The British Pendulum Number has a correlation with the friction coefficient. The greater British Pendulum Number, the shorter braking distance will get and the accident can be avoided

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