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Effect of the use of rubber material as partial pieces damages bitumen in flexible pave

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ABSTRACT
The study was conducted to study the effects of the use of pieces of rubber as a partial substitute in bitumen flexible pave ACW 14. Bitumen is one of the binder materials used in construction of roads and pave has increased prices and costs to achieve it. As a result of increasing economic and traffic load, road bitumen structure designed should have the durability and capability services play a key role in the communication network, the most important. Objective of this study is to reduce the quantity of bitumen used and replaced with pieces of rubber. Therefore, many efforts have been undertaken to improve the quality of the existing bitumen. In this study, modified bitumen grade 80/100 pricking is done with the addition of various pieces of rubber per cent content. Percentage of rubber used is 0%, 3%, 6%, 9%, 12% and 15% of the total amount of bitumen used. ACW 14 mixes compacted with mechanical junkie and tested values Marshall Stability. Potential ACW 14 modified with a mixture of rubber elasticity modulus obtained by studying, scorching and Maximum Load and then compared with the control capabilities through a mixture of ACW 14 Indirect Tensile Test. Once the three parameters were studied, the percentage of rubber content can be determined that the optimal content of 12% rubber. Based on studies conducted, it found pieces of rubber bitumen ability to increase capacity by an increasing in the occurrence of Blowing Point Temperature Index and pricking of altered samples. It also can decrease the value of pricking. In addition the ability of a mixture of slip resistance also showed good results through the slip resistance test. Overall analysis carried out shows, the addition of pieces of rubber in the mixture can enhance the capability of the mixture 14 as ACW pave flexible.

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Introduction

Pave existing roads should be capable of distributing the burden transferred from vehicle to the layer below that is not experiencing excessive emphasis and control the occurrence of any failure which can result in sluggish any form of physical changes to the road surface plaster. Vehicles can also move quickly without any Disruption as hole which can cause accidents.

Lack of resources and continuous bitumen production costs increasing demand has caused problems to road construction projects are increasing. Until now, many scholars in this field are still continuing and various studies and experiments to further develop these alternative methods, especially in the use of tire wasted rubber as source material in a mixture of modified bitumen.

Problem Statement

Price increase bitumen resource is an increasingly acute problem especially in developed countries and increasingly in developing countries such as Malaysia. Bitumen production is from petroleum distillation stages of the production cost is high. As a result, construction costs are also rising over the burden to the government and consumers indirectly (Intan Salwani, 2006). According to sources WTI, Bloomberg, international oil prices until the year 2008 has increased to U.S. $ 92.98 per barrel, and is the highest value of global oil prices

Find a suitable alternate materials and semi-equivalent to the original material used with the existing goals and targets is key. Use of alternative materials will also indirectly be changed to mixture bitumen of new network and it is a method that can be considered to enhance the capabilities and characteristics of bitumen layer to produce pave which can provide better service (Oliver et al, 1999).

Use pieces of rubber as a partial replacement in this study refers to the nature of the elasticity of rubber with bitumen elasticity equations with nature and where bitumen has a nature which controlled the flexibility and elastic (Ahmad Kamal, 2004). Overlap with the properties of rubber that has prolonged flexibility (Oliver et al, 1999). But the nature of similarities between the rubber and bitumen is used as the basis for studies to reduce the use of bitumen in the mixture pave and made of rubber as a semi-lieu thereof.

This study focuses on aspects of capacity flexibility, strength to bear the burden, scorching slip and impact resistance of a mixture of pieces of rubber as a partial substitute in bitumen material. Specimens were prepared according to the ratio of mixture of different sizes and will be tested in the laboratory based on specifications that have been set.

Effect slip resistance will be compared with a mixture of control specimens to be prepared in accordance with Standard Public Works Department (JKR/SPJ/1988). This study is the use of pieces of rubber determination suitability as a partial substitute to reduce the quantity of bitumen for bitumen resources used.

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Objective

i. Test the elasticity of rubber in the mixture of bitumen altered flexible pave ACW 14.

ii. Test scorching rubber modified bitumen in the mixture pave flexible ACW 14.

iii. Test the maximum load that can be incurred in a mixture of rubber modified bitumen flexible pave ACW 14.

iv. Obtain the percentage of rubber in optimum mixture pave flexible bitumen as a partial substitute.

Ability to assess the level of surface resistance of rubber modified bitumen slip

Cope

The study was carried out against pave flexible bitumen to thirst ACW14 layer. Selection of studies thirst ACW14 layer as the scope of the study is based on the ability levels of this factor to the burden and the actions that can lead to damage construction pave. Therefore, the selection of studies thirst ACW layer 4 will take into account the level of elasticity, and ability to bear the burden scorching maximum pave rubber modified samples compared to controls. Besides the determination of an optimum rubber content will be offered and the level of slip resistance was also studied.

Restriction Of Study

The study was conducted to test and evaluate the ability to mix pave bitumen layer ACW14: 5.0% -7.0% bitumen content (Road Work Specification, Public Works Department, 1988). Pave compacted specimens that have been prepared based on the quantity and apply tire pieces in a mixture of different levels of resistance pave tested using equipment slip Skid Resistance. While the sample mixture provided by modifying the quantity of different pieces of tire apply the mixture tested flexible pave level, scorching and dependents with a maximum load of equipment using Universal Testing Machine. Behaviour modification research mixed samples will be compared with the control specimens. Determination of optimum rubber content will be offered and the level of slip resistance was also studied.

Literature Review

Since several decades, many studies have been done to re-use waste materials in road construction industry. Study the uses of piece of tires as a partial replacement applicable in pave bitumen have been conducted with so widely around the world since three decades ago. Results from studies carried out by Imtiaz Ahmed, (1995) use a number of advantages of rubber material has been identified. Among them include:

i. Reduction in the reflections and fractures pave.

ii. Increased resistance of vehicle thirst tires.

iii. Increased slip resistance surface roads.

iv. Reduce effects of noise by friction between tire and road surface.

v. Reuse of waste tires that are still applicable disposal is a major problem.

Use applicable as a source of rubber tires in road construction is still at an early stage because the effectiveness of its use in terms of quality pave still can not decided. Use of environmental impact is yet to be determined as this method is still a new technology and research and many studies have been done and are still at the trial by some developed countries. Therefore, some consideration of its use should be taken into account.

Characteristics of durability and ability pave altered only offered in a relatively long period of time. Important data such as data dough design, methods of plastering on the site, dough characteristics, effects slick (skid resistant) to the surface pave, durability of rutting, aging and others still can not fully concluded to the situation in Malaysia. Widespread use of natural rubber latex materials in highway construction in Malaysia and elastic properties of natural rubber in the material used in the production of tires felt could help achieve a good result and reasonable in its use as a partial replacement.

Operating costs, while cost dough, research costs and other costs related to production of altered pave this should be taken into account. These circumstances will result in higher costs dough altered from dough pave normal cost. Study conducted by the Federal Highway Administration (FHWA), United States (1990) has found that the additional cost of 40% to 100% needed to modify dough. Additional costs involving a profitable return in terms of age cycle road costs (life cycle cost) of course obtained if dough modify this reduces cracking problems early, the effects of vehicle wheels and road service age (Plus Ride, 1990).

Materials can be added to increase capacity in the structure either hot or cold conditions. When under the blazing sun or a high traffic load, which has been modified bitumen which has been hard this will give elastic and higher resistance to the structure, compared with the usual mixture of bitumen (Yamada, 1999).

Aiza Syuhaniz, (2006) report in writing about industry training materials used in manufacturing added tires. Manufacture of tires typically use several substances such as added bulk agent, assistant agent process and antioxidant agent filler. In the tire manufacturing industry, the addition of agents such as resins and sulphur bulk is to improve the natural rubber. Bulk agents commonly used sulphur because sulphur is much cheaper compared with other agents' bulk.

Addition of sulphur will increase the melting point bulk rubber, rubber bulk cause more resistant to heat than rubber bulk not. Bulk rubber also not easily damaged by oxygen in the air, ultraviolet rays (UV), ozone and other chemicals. Assistant agents used as lubricants in the tire manufacturing process. It will reduce the force and provide intermolecular increase of changes the molecular structure of polymers.

Oxygen in the air, when catalyzed by light can cause the formation of bonds between the hydrocarbon chain. Ties will make the rubber hard and less elastic. To prevent this process from occurring, anti-oxidation material and ozone used. The material is used to prevent rubber from cubic to form bonds with oxygen and other unwanted and prevent the rubber from becoming hard. The main purpose filler used in tire manufacturing industry is to improve the capability and process synonymous rubber, bulk rubber improve physical capacity and reduce manufacturing costs.

Structural problems in the context pave are due to structural changes due to fatigue and the sustained temperature, pressure and fatigue due to aging. This problem can be solved with the use of rubber modified bitumen (Caltran, 2004). Structure paves more durable due to the addition of rubber in the mixture of materials that will enhance the ability to sweep away (Elongation). Road structure is more flexible when exposed to lower temperatures and a high burden. Structural changes will occur but does not involve cracking. Strength is also influenced by the agents in the rubber tire manufacturing process such as sulphur and zinc. The presence of this agency's ability to increase coherence between aggregate and bitumen modified (Roberts et al, 1989). Among the advantages of rubber modified bitumen mixture pave outlined in the report that California Department of Transportation (2004) are as follows:

i. Travel more comfortable, flat and smooth.
ii. Not easy for vehicle skid.
iii. Structures pave durable.
iv. Resistance to impact cracks.
v. Potentially reduce the sound tires.
vi. Reduce life cycle costs.
vii. Improve environment quality.

Methodology

Method to determine implementation study to achieve the stated objectives are based on research results methodology. Methodology involve aspects including study design, sample survey, the study instrument, validity and reliability, methods of data collection, data analysis, assumptions and research studies flow chart.

Design of Study

Design this study using experimental methods for obtaining data and research results as interpretation. In this method, the collection of raw data through tests on samples carried out according to objective studies can be obtained in quantitative studies.

Sample of Study

Samples compacted in the mold diameter 60mm and 50mm height. Method of mixing rubber dough done in a mixture of wet method, the rubber is mixed with bitumen at a controlled temperature. These materials then slang brim with stones. Testing laboratories involved in production of 15 samples to find the optimum bitumen content and 21 samples containing rubber modified bitumen.

Experimental Material

Materials used in producing rubbers modified bitumen mix is as follows:

i. Bitumen
ii. Brim stone
iii. Filler
iv. Rubber

Bitumen

Pricking of 80/100 grade bitumen. Percentage of bitumen content that will be used is based on the optimum bitumen content that may be obtained from the Marshall test. Next for the production of rubber modified bitumen, part of the percentage of bitumen will be taken over by rubber

Brim Stone

Brim stone consists of coarse and fine stone brim which features both standards ensured the Public Works Department (JKR/SPS/1998) while grading for the stone brim standard refers to standard layer decreasing ACW 14 (Asphaltic Concrete Wearing 14)

Filler

Filler material used was ordinary Portland cement (Ordinary Portland Cement). It must be assured of clean impurities and at least 30% of the weight must be retained in 75µm BS sieve (JKR/SPJ/1988).

Rubber

Rubber to be used is synthetic rubber from tires destroyed applicable size 150µm. After determination of optimum bitumen content, the percentage of rubber which will be used calculated the 0%, 3%, 6%, 9%, 12% and 15% of optimum bitumen content.

Instrument

First, provide densest samples to determine the optimum bitumen content based on the Marshall test (ASTM D 1559). Secondly, the preparation of samples for analyzing rubber densest altered several parameters based on tests Indirect Tensile Test (ASTM D4123-82) and slip resistance testing based on Skid Resistance (BS812: Part III), with different percentages of rubber.

Marshall Test

Marshall test (ASTM D1559) is a method of design standards set by the Asphalt Institute Manual 1979, American Association of State Highway and Transportation Officials (AASHTO). The following shows the specifications according to Marshall mix design for JKR/SPJ/1988 layer of thirst.

Preparation of Brim stone

Preparations miles rampage in this study are in accordance with specifications Public Works Department (JKR / SPJ / 1988). Densest mixed grades will be used. Brim stone will be determined first and then of course gravity sieve analysis conducted.

Determination of Effective Aggregate Gravity course and course maximum gravity theory Mixed Bitumen

Gravity certainly effective combination of stone used is determined using the overflow method Rice, while providing maximum value of gravity would mix berbitumen (AASTHO T209 and ASTM D204). Rice method is a method that can provide a maximum theoretical value of gravity would easily and more accurately.

Determination of Mass Material

Tests carried out before Marshall, specimens should be prepared prior densest. Test for determining the optimum bitumen content, levels are initially determined that the weight of 1200 grams of sample set. Thereof, heavy rock rampage, filler and bitumen calculated. Sample consisting of 5.0%, 5.5%, 6.0%, 6.5% and 7.0% respectively have the same three samples of percent. Percent filler content determined by 3% while the percentage of rubber modified bitumen content that will be used derived from analysis of optimum bitumen content.

Parameter	Unit	Thirst Layer
Stabiliztion (S)	N	> 8000
Flow (F)	Mm	2.0 – 4.0
Violence (S/F)	N/mm	> 2000
Gap in air mixture (VTM)	%	3.0 – 5.0
Gap in agregat filled by bitumen (VFB)	%	70 – 80

Stabiliztion and Flow Test

This test is conducted to determine the maximum load that can be borne by the sample before it failed and recorded as Marshall stability value. Flow value is taken as the difference in height of the sample before and after testing.

Optimum Determination of Bitumen Contain

Optimum bitumen content determined as specified in JKR/SPJ/1988. All data obtained on the graph should diplotkan separate the bitumen content against the density, the stability against bitumen, bitumen content against the flow, against the gap terisi bitumen content and bitumen content bitumen against air gap. Values determined later following:

i. Bitumen content at maximum stability.
ii. Bitumen content at maximum density.
iii. Bitumen content in the value stream 2mm.
iv. Bitumen content in the VTM value = 4.0%.

v. Bitumen content at VfB equivalent value 78.5%. All values obtained on the value averaged over to obtain the optimum bitumen content. Values for a new stability, density, and VTM VfB based on optimum bitumen content can be determined. Once the optimum bitumen content obtained in a mixture of conventional, rubber percentage of 0%, 3%, 5%, 6%, 9%, 12% and 15% replaced the optimum bitumen content in the preparation of rubber modified samples.

Indirect Tensile Test

The purpose of this test is conducted to determine the strength of a mixture berbitumen under the burden GHz based on ASTM D4123-82. From these experiments, elasticity modulus, and scorching maximum load that could be borne by the sample can be determined. A total of 18 samples available for the implementation of the modified rubber test with a different value of the percentage of rubber.

Slip Resistance Testing

Slip resistance testing is done to obtain values for friction and slip rubber modified samples (BS812: Part III). The aim is to see the capability of modifying the surface of a sample mixture of action surface load.

Data Analysis

All data were analyzed to compare with the standard specification in the Public Works Department (SPEC/JKR/1988). Analysis of five studies conducted to meet the objectives of:

i. Aggregate Analysis
ii. Bitumen Analysis.
iii. Optimum Bitumen Content Analysis.
iv. Rubber Optimal Content Analysis.
- Elasticity Analysis
.- Analysis Terikan.
- Max Load Analysis.
v. Analysis of slip resistance.

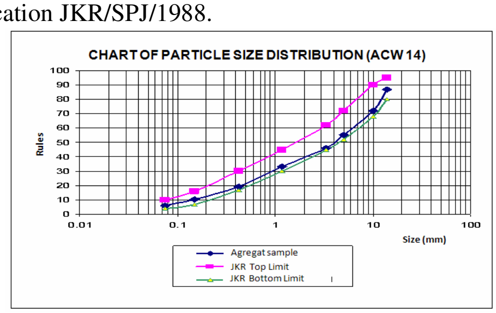
Agreget Analysis

Two aggregate analysis has been done and sieve analysis of gravity for the purpose of determining the aggregate kepiawaian.

Test Sieve

Test sieve is carried out according to the design of mixed surface layer for the road penghausan ACW 14. Sieve analysis done to get that is permitted by the specification JKR/SPJ/1988. Sieve size is used in accordance with standards set by the PWD of 14mm, 10mm, 5mm, 3.35mm, 1.18mm, 0.425mm, 0150 mm, 0.075mm and pan.

Figure 4.1 below shows the particle size distribution chart that is used for sample preparation ACW 14. Where, for particle size distribution of samples within the range defined by the specification JKR/SPJ/1988.



Graph of Mix Agregat (ACW 14)

Test Gravity

Test gravity would be divided into two, namely gravity and gravity fine course Aggregate Aggregate gross course. Gravity of course for bitumen and cement which is still 1:01 and 3:20. Value of gravity obtained is important to determine the Optimum Bitumen Content (OBC) for designing mixed ACW 14. Based on the analysis that has been done, simply results obtained can be seen in Table 4.2.

Table 4.2 :Fixed Gravity Material and Mixed Gravity Value.

Material	Fixed Gravity
Agregat 14mm	2.519
Agregat 10mm	2.524
Kuari powder	2.595
Cement	3.20
Bitumen	1.01
SG $_{mixer}$	2.562

Bitumen Analysis

In this study, conducted by 3 analysis of bitumen that is pricking, temperature and Blowing Point Index pricking. .

Pricking Analisis

A total of 18 samples were prepared to test the value of pricking the bitumen. Of the total sample, 3 of which are not native bitumen mixed with pieces of rubber. The three samples of this act as control samples. While the rest are rubber modified bitumen samples with different percentages of 3%, 6%, 9%, 12% and 15% rubber. Each sample was charged in the pricking of 5 different places. Only three pricking the nearest value readings taken into account. Pricking the value averaged over the average reading obtained for a sample. The three samples for a certain percentage averaged over to obtain more precise results.

Figure 4.3 : Avarage pricking value for each percent of rubber

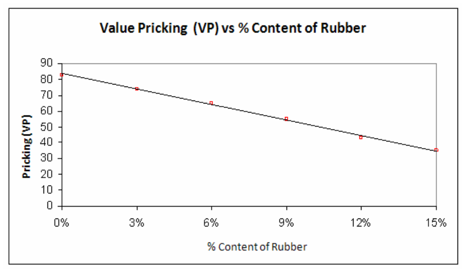


Figure 4.2 above shows the graph pricking against the rubber

Pricking value is inversely proportional to the percentage increase in the value of rubber. From the analysis has been done, found a mixture of natural rubber in the bitumen can help improve bitumen violence. Pricking natural bitumen value obtained is 82 mm and pricking the lower value obtained when increasing the percentage of rubber in the bitumen.

Soft Point Temperature Analysis

A total of 18 samples are also available, 3 samples of rubber and not mixed with acted as control samples. The remaining samples have been prepared based on the percentage described previously. Each sample tested will provide two-point temperature reading value of different soft and values must not exceed 1 º C.

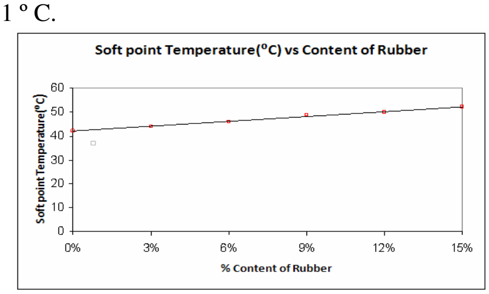


Figure 4.3 shows a graph of temperature points against the soft rubber obtained. From the graph, the value of temperature Blowing Point is directly proportional to the increase in the percentage of the value of rubber. Analysis of samples found that the value of the temperature control point is achieved a successful soft 42 ° C. This value is increasing in the sample modify the value until the temperature reaches the highest point on the soft temperature of 52 ° C.

Pricking Indeks Bitumen

Through analysis and pricking point soft bitumen that is obtained, Penuskan Index can be obtained. Pricking index used to determine the level of temperature sensitivity of bitumen.

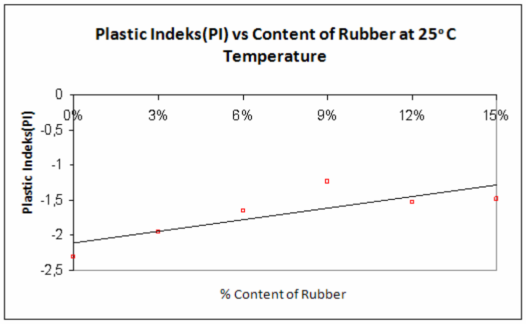


Figure 4.4 shows the graph index pricking against the percentage of Rubber Content. Based on the graph, the index obtained by pricking the proportional increase of rubber content. From the analysis done, found the value of pricking within - until 2:31 - 1:48. This value indicates that, bitumen bitumen is in the normal group. Index pricking for bitumen normal is between -2 to + 2 based on the standard ASTM D5-97 (Standard Test Method for Penetration of Bituminiuos Materials).

Optimum Bitumen Content Analysis

By 5 percentage of original bitumen were prepared from the 5.0%, 5.5%, 6.0%, 6.5% and 7.0% by weight sample. Therefore, 15 samples are prepared to undergo tests to determine the Marshall parameters involved. Based on the analysis of Marshall test, the graph has six diplotkan the density, stability, air gap (VTM), gap contain bitumen (VfB), and violence against the flow of bitumen. Test Marshall full analysis as attached in Appendix G.To obtain the optimum value bitumen content (OBC), the analysis conducted is based on the value of air gap (VTM) 4% which refers to the Asphalt Institute Manual Series No.. 2 (1997). According to analysis carried out, found the optimum bitumen content values (GEN) at 4% VTM value indicates the optimum bitumen (SC) is 5:10%.

Data Analysis and Relationship Characteristics Test Marshall

Analysis of the Marshall test was displaying a pattern consistent to identify the properties of materials. Comparison can be made through the analysis of experimental data obtained with the existing specification limits. The following is based on the general nature of relations and graphs plotan made, namely:

i. Stability is the maximum value at 5.0% bitumen content and it was found decreasing with the increase or decrease up to 7.0% bitumen content.

ii. Value increased with increasing flow available bitumen content.

iii. Value density is found to increase from 5.0% to 6.0% bitumen content and began to decline again from 6.0% to 7.0% bitumen content. Maximum density value is at 6.0% bitumen content.

iv. Such as stability, soundness is a maximum value at 5.0% bitumen content and found to decrease with the increase up to 7.0% bitumen content.

v. The percentage of air gap decreases when the bitumen to increase until the gap to a minimum.

Test Tense Indirect

Through this experiment, there are 12 samples available to analyze the characteristics of bitumen modification. Indirect Tense Test was conducted to see the features of this modified bitumen. Rubber content Optimum value can also be obtained through the analysis conducted.There are 3 analysis made, namely:

i. Elasticity
ii. Scorching
iii. Maximum load

Elasticity Modulus

Figure 4.6 (a) and 4.6 (b) below shows the results of Elasticity modulus tests conducted at a temperature of 25^0C and 35^0C.

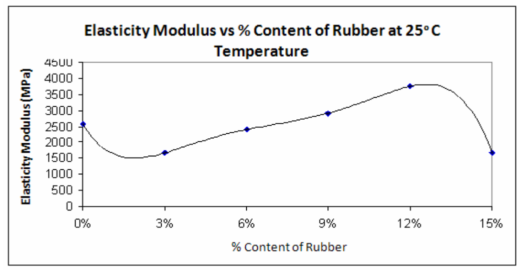


Figure 4.6 (a) :Elasticity Modulus vs Content of Rubber at 25^0C

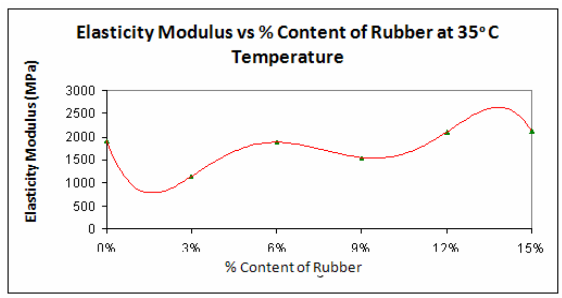


Figure 4.6 (b) : Elasticity Modulus vs Content of Rubber at 35^0C

Elasticity modulus value of control samples at temperatures 25^0C and 35^0C respectively and 1901Mpa is 2567Mpa optimum bitumen content in 5:10%. This value is used as a control value for comparison with samples altered.

Scorching

Figure 4.7 (a) and figure 4.7 (b) respectively show the results Scorching from indirect tensile tests conducted at a temperature of 25 ^{0}C and 35^0C. Tests conducted on the percentage of optimum bitumen content by 5:10% and the percentage of rubber content different.

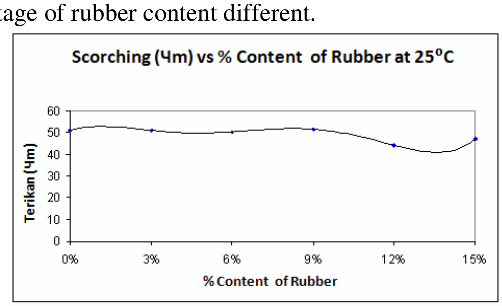
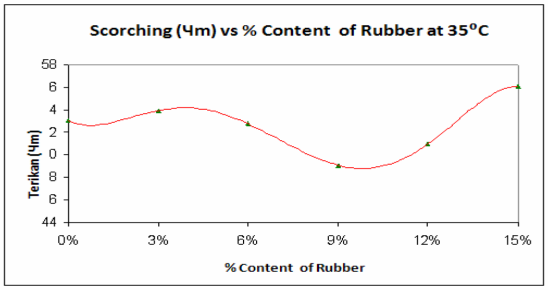


Figure 4.7 (a) : Scorching vs Content of Rubber at 25°C



Figuer 4.7 (b) : Scorching vs Content of Rubber at 35^{0}C

Based on the two graphs against Scorching percent rubber content obtained show that reading is not consistent for each sample. At temperatures 25^{0}C value Scorching control sample is at a temperature of 35^{0}C while 50.94µm value Scorching is 50.03µm. This value is used as a control value for comparison with samples altered. Tests of samples from altered at temperatures below 25^{0}C value Scorching value in control samples is 6%, 12% and 15% rubber content. While at temperatures below 350C value Scorching value in control samples is 6%, 9% and 12% rubber content.

Maximum Load

Figure 4.8 (a) and figure 4.8 (b) respectively show the results obtained from the burden Maximum indirect tensile test conducted at a temperature of 25 ^{0}C and 35 ^{0}C. Tests conducted on the percentage of optimum bitumen content of 5:10% and the percentage of rubber with different.

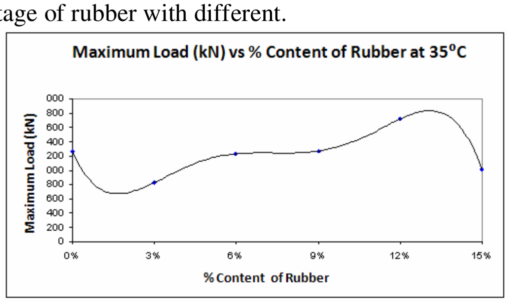


Figure 4.8 (a) : Maximum Load vs % Content of Rubber at 25 ^{0}C

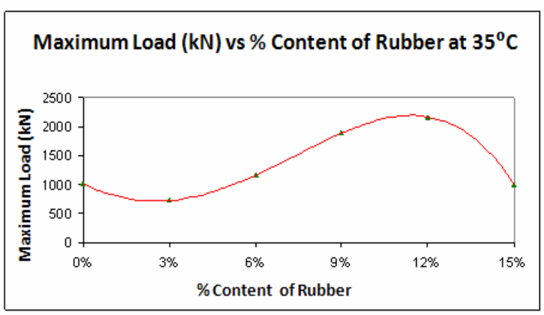


Figure 4.8 (b) : Maximum Load vs Content of Rubbera at 35 ^{0}C

Based on the graph, maximum load values obtained for both the temperature of 25^{0}C and 35^{0}C at the optimum bitumen 5:10% respectively are 1268.6kN and 1016.8kN. This value is used as a control value for comparison with samples altered. This situation shows the large temperature when charged, the more less maximum load that can be borne by the mixture ACW 14. Maximum load value is found in conditions of temperature 25^{0}C for samples that exceeded the value of modifying the control samples was 9% and 12%, while the temperature of 35^{0}C maximum load value that exceeds the value of control in samples was 6%, 9% and 12%. Obtained the highest maximum load value at the temperature 25^{0}C and 35^{0}C respectively 1714.3kN and 2165.9kN is altered in the samples with 12% rubber content.

Rubber Optimal Content Analysis

Results are analyzed from the indirect tensile test, can determine the optimum rubber content. From the analysis, samples obtained at 12% rubber content with 5:10% bitumen content is optimum to meet the three parameters measured results and provide a better quality and value of the control point and other sample altered. But optimum rubber content is at 12%.

Analysis of slip resistance

Based on the analysis of resistivity slip, slip resistance values found in control samples was 59.9. While in the altered samples (12% rubber content) give 63.8 reading both these values obtained after correction of the raw data is done. Value 63.8 indicates that it is in category B.

Where it is appropriate for use in all motor vehicles, trucks and road construction class 1. Besides, also, the ability of the ability to bear the burden of traffic in urban areas up to over than 2000 vehicles per day. On the whole, found role as a partial replacement of rubber bitumen layer has been able to increase capacity penghausan (ACW 14) of resistivity slip.

Conclusion

Obtained samples of rubber modified bitumen mixture gave better results than conventional bitumen samples used. When comparisons made to results obtained in the final analysis sample altered rubber (rubber content 12%) found the three study parameters (modulus Elasticity, Scorching and Maximum Load) showed a good performance.

Boundaries that apply when value is altered samples Elasticity modulus obtained is larger than the value of control samples. This shows the level of elasticity of the sample has a good level of elastic and can provide better value for flexible applied. While the value scorching samples must be smaller than the altered test results of control samples.

Similarly, the maximum load, maximum load results can be borne by the sample need to modify more than control samples.

When all criteria was included, indirectly can further enhance the capability mixture to be applied. When the altered samples can bear a higher burden than the control samples showed that the altered samples can give a large contribution in controlling the source of surface damage caused by the actions turapan load vehicles. While elasticity and scorching will act as a stabilizer of samples from the action of vertikal and horizontal directions.

The ability of potential slip resistivity also contributes to the suitability of modified rubber mixture to be applied as one of pave capable of reducing the surface damage and increase life expectancy pave. When all the elements studied in this survey, a plan to use new innovations to reduce costs and increase purchasing bitumen pave capability the burden and environmental action.

Overall, the mixture obtained as a partial replacement rubber in the bitumen mixture pave layer of thirst (ACW 14) can increase capacity and help enhance the features of bitumen. Thus, available pieces of rubber can be used as a partial substitute in the bitumen layer of thirst (ACW 14) at the optimum 12% rubber content.

Proposed

For the purpose of improvement of the proposed study of additional laboratory tests that identified appropriate to implement the study are as under:

Stolon Test (Creep Test)

Test sluggish (Fatigue Test)

. Test Track Wheel (Wheel Tracking Test)

All laboratory tests are recommended to assess the capacity and ability to blend aspects of this altered resistance rebakkan fractures and soundness mixture berbitumen.

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