UNIVERSITI PUTRA MALAYSIA

WASTE OIL-BASED PAINT AS ADDITIVE IN STONE MASTIC ASPHALT

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By

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Thesis Submitted to the Sehool of Graduate Studies, Universiti Putra Malaysia, in Fulftllment ofthe Requirement for the Degree of Master of Science

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ABSTRACT

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

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CHEONG SIN SOON

November 2013

Chair: Professor Ratnasamy Muniandy, PhD
Faculty: Engineering

The cost of asphalt is crucial in determining the cost of road construction. In the year 2008, the average price of Malaysian crudes is more than 100 USD per barrel. As a result, a hike in the price of asphalt is observed within the same year. Studies on replace asphalt as binder or reduce the amount of asphalt used should be carried out to reduce the construction cost. On the other hand, there is more than 15000 metric tonnes of ink and paint sludge generated yearly since the year 2006. Thus waste oil-based paint was chosen to blend with asphalt since it has better bonding when mixed together.

Three type of binders, i.e. 80/100 penetration graded asphalt, 60/70 penetration graded asphalt and performance grade, PG 76 were used to blend with waste oil-based paint. The amount of waste paint used in the blending with asphalt binders were 5%, 10% and 20% of the total weight. The physical tests on asphalt binder were carried out in accordance with ASTM standards. The maximum amount of waste paint blended into these three binders that met the minimum requirement of PWD standard were chosen. It was found that the 80/100 penetration graded asphalt blended with 5% of waste paint, the 60/70 penetration graded asphalt blended with 10% of waste paint and the PG 76 blended with 20% of waste paint met the minimum requirement of the PWD standard.

SMA was used in this study. It is hot mixture asphalt consisting of a coarse aggregate skeleton and a high binder content mortar. The performance tests such as Resilient Modulus, moisture susceptibility and permanent deformation tests were carried out on the paint modified asphalt binder specimens. These results were compared with the samples that used original binder as control. It was found that the asphalt mixtures with paint modified asphalt had lower performance compared to the control asphalt mixtures. However they still meet the requirements of the PWD standard. Therefore waste oil-based paint can be used to replace 5% of 80/100 penetration graded asphalt, 10% of 60/70 penetration graded asphalt and 20% of PG 76 used in road construction.

The length of PLUS highway is 772 km. Assume that PLUS highway undergo rehabilitation yearly with overlay thickness of 50 mm, the cost of asphalt for rehabilitation (one lane per km) can be saved up to RM 902.50 if 80/100 penetration graded asphalt is used, RM 6,136.50 if 60/70 penetration graded asphalt is used and RM 25,258.50 if performance grade, PG 76 is used.

ABSTRAK

Abstrak tesis yang dikemukan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Sarjana Sains

SISA CAT BERASASKAN MINYAK SEBAGAI BAHAN TAMBAHAN DALAM ASFALT BATU MASTIK

Oleh

CHEONG SIN SOON

November 2013

Pengerusi: Profesor Ratnasamy Muniandy, PhD
Fakulti: Kejuruteraan

Kos asfalt adalah penting dalam menentukan kos pembinaan jalan raya. Pada tahun 2008, purata harga minyak mentah keluaran Malaysia melebihi 100 USD setong. Sehubungan itu, harga asphalt pada tahun tersebut turut meningkat. Kajian dalam menggantikan asfalt sebagai pengikat atau mengurangkan kandungan asfalt patut dijalankan untuk mengurangkan kos pembinaan. Kumbahan dakwat dan cat yang terhasil setiap tahun melebihi 15000 ton metrik sejak tahun 2006. Dengan ini, sisa cat berasaskan minyak dipilih untuk bercampur dengan asfalt kerana mempunyai ikatan yang lebih baik apabila dicampur.

Tiga jenis pengikat iaitu asfalt gred penembusan 80/100, asfalt gred penembusan 60/70 dan PG 76 digunakan untuk bercampur dengan cat berasaskan minyak. Kandungan cat yang dicampur ke dalam pengikat adalah sebanyak 5%, 10% dan 20% berdasarkan jumlah berat masing-masing. Ujian fizikal yang dijalankan ke atas pengikat berdasarkan piawai ASTM. Kandungan cat maxima yang dicampur ke dalam tiga jenis pengikat tersebut yang memenuhi kehendak minima piawai JKR dipilih. Didapati asfalt gred penembusan 80/100 bercampur dengan 5% cat, asfalt gred penembusan 60/70 bercampur dengan 10% cat dan PG 76 bercampur dengan 20% cat memenuhi kehendak minima piawaian JKR.

SMA telah digunakan dalam kajian ini. SMA adalah asphalt campuran panas yang terdiri daripada rangka aggregat yang kasar dan kandungan pengikat mortar yang tinggi. Ujian prestasi seperti Modulus Resilient, ujian kerentanan kelembapan dan ujian ubah bentuk kekal dijalankan ke atas sampel yang menggunakan asfalt diubahsuai cat sebagai pengikat. Keputusan dibandingkan dengan sampel yang menggunakan pengikat asal sebagai kawalan. Didapati campuran asfalt yang mengandungi cat mempunyai prestasi yang lebih rendah berbanding dengan campuran asfalt kawalan. Walau bagaimanapun, campuran asfalt diubahsuai cat masih memenuhi kehendak piawaian JKR. Oleh itu, sisa

cat berasaskan minyak boleh digunakan untuk mengganti 5% asfalt gred penembusan 80/100, 10% asfalt gred penembusan 60/70 dan 20% PG 76 dalam pembinaan jalan raya.

Panjang lebuh raya PLUS adalah 772 km. Andaikan PLUS lebuh raya menjalankan rehabilitasi setiap tahun dengan ketebalan hamparan sebanyak 50 mm, kos asphalt untuk rehabilitasi (satu lorong bagi setiap km) boleh dijimat sebanyak RM 902.50 jika asfalt gred penembusan 80/100 digunakan, dijimat sebanyak RM 6,136.50 jika asfalt gred penembusan 60/70 digunakan dan dijimat sebanyak RM 25,258.50 jika PG 76 digunakan.

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I certify that a Thesis Examination Committee has met on 29th November 2013 to conduct the final examination of Cheong Sin Soon on his thesis entitled "Waste Oil-bases Paint As Additive In Stone Mastic Asphalt" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follow:

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