

UNIVERSITI TEKNOLOGI MARA

**MODIFICATIONS OF BINDER FOR ROAD
SURFACE DRESSING**

SYARIFAH ANOM IBRAHIM

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ABSTRACT

Higher traffic density and heavier axle load in Malaysia have increased tremendously in time with the country's economic growth. This phenomenon has contributed problems to the road pavement. As far as the traffic factor is concerned, increased in traffic loads have contributed to the premature failure of pavement that is associated with over-loading stresses. Surface cracking, rutting and stripping now becoming very serious problems. Previous studies have shown that by using conventional bitumen (unmodified bitumen) only as a binder cannot overcome such problems. Therefore, rubber or polymers as a modifier is now widely adopted in Europe and other developed countries. Surface dressing is quite commonly used for road rehabilitation as it provides low cost and the process of application is quite simple and straight forward.

In this research, 40-mesh tyre crumbs and two types of polymers (Styrene-Butadiene-Styrene and Ethylene-Vinyl-Acetate) were used as additives to investigate their physical properties with respect to differences between unmodified bitumen and rubber-polymer blends modified binder. The percentage of rubber and polymers content varies from 1% up to 5% by weight of bitumen. In order to examine the basic physical characteristics of the modified binder, three tests were carried out, viz; penetration test, softening point test and dynamic shear rheometer test. The aging process was carried-out in the laboratory using rolling thin film oven test (RTFOT). Vialit and lap shear tests were carried-out to evaluate the bonding characteristics of the binders.

The findings from this research work had shown that the addition of rubber- polymer into bitumen had increased the quality of the binder. The addition of rubber - polymer had significantly increased the viscosity and elastic properties of the binder, reduction of its temperature susceptibility and increased the bonding strength. Binder modification with rubber- polymer had shown better results when compared to modified binder with rubber only (no polymer). Almost similar findings in term of performance when compared with modification of binder with polymer only. In addition, modified binder with rubber-polymer would reduce the effect of aging and the results had shown a significant effect at high polymer concentration.

In conclusion, this study had shown that for both physical and bonding tests, polymer SBS produces better results as compared to polymer EVA. With added polymer ranges from 1% to 5%, it was found that the optimum binder content for polymer EVA was 4% tyre crumbs – 4% polymer EVA, while as modified binder with SBS, the optimum mix composition was 5% tyre crumbs – 5% polymer SBS.

Candidate's Declaration

I declare that the work in this thesis was carried out in accordance with the regulations of University Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

In the event that my thesis be found to violate the conditions mentioned above, I voluntarily waive the right of conferment of my degree and be subjected to the disciplinary rules and regulations of Universiti Teknologi MARA.

Candidate's Name : SYARIFAH ANOM BT. IBRAHIM

Candidate's Signature :

Date : 17/10/2005

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Premature failures of road surfaces which are associated with surface cracking and rutting are becoming very serious problems not only to the highway authority in terms of maintenance but also to the road users in terms of road safety and comfort (Azemi et al, 1991). There are two major factors that contribute to road defect problems, namely; climate and traffic conditions. In terms of climate factor, Malaysia has an equatorial climate, with heavy rainfall, high temperatures and intense sunlight. High temperatures and ultra violet can lead to rapid aging of bitumen. Increased of traffic loads also contribute to premature failure associated with over-loading stresses (Azemi et al, 1991). The analysis of the data by Road Branch of Public Works Department (JKR) indicated that some of our roads deteriorate to an unacceptable condition within a short time (Azemi, 1997). Premature pavement failures, in the forms of cracking and rutting, were observed as early as four to five years after trafficking. These observations have highlighted some critical deficiencies in our road pavement quality (Azemi, 1997). Therefore, road maintenance plays an important part to overcome these problems.

Road maintenance is related to repair of faults of road structures and facilities. The purpose of road maintenance is to ensure that the road is able to function as efficient as when it was first constructed. In Peninsular Malaysia, about 55% of the maintenance cost is used for maintaining of the roadway surface, whereas 25% is spent on shoulders and drainage (Waage, 1975). Road maintenance can be classified into three categories,