Effect in The Properties of Bitumen Due to Waste Rubber

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***Abstract*— A lot of research has been conducted to find alternative material in pavement construction that acts as additive or modifier which could improve the performance of its properties. Bitumen is sensitive to temperature and rate of loading. In this study, rubber waste is referred as a free fine rubber particle made by size reduction from byproduct of rubber tire making industry was used.The tests conducted were bitumen ductility test, softening point test and penetration test. In this study, an attempt was made to evaluate the relationships between Ductility, Softening Point and Penetration of the bitumen with the amount of rubber waste in bitumen. After, conducting these tests on various sample of bitumen this was found that the property of bitumen varies consecutively with the application of rubber on the bitumen.**

Keywords*— Bitumen, Rubber Waste, Ductility Test, Softening Point Test, Asphalt Concrete (AC).

I. INTRODUCTION

Conventional bituminous materials performed their function satisfactorily in most of the pavements. However, existing highway systems have been dealing with increased traffic volume, higher axle load and tire pressure and extreme environmental impacts. The situation is evident for the last three decades, that the pavement has been facing more damages than before resulting in the need for an enhancement in the properties of bituminous materials [1]. The study conducts focus on the application of rubber waste as modifier in bitumen. Therefore, the laboratory test is concentrates on bitumen tests. This study is conduct to study the effect used of waste material in bituminous mixture. Rubber waste product used to improve the bitumen used in mixture and increase the strength of the pavement due to its rubbery characteristic. Besides that, the performance of the bituminous mixture need to improved due to the changes in the weather and increased in traffic loading. Waste product is cheaper and can be obtained directly from the factory where these waste products are not reused by the factory. In directly, it will minimize construction cost. Reused waste product can ideally reduced pollution problem due to disposal aspect. The commercial value of waste material will increase if it was found suitable to be used in highway construction.

II. OBJECTIVE

The objective of this study is to determine the effect of rubber waste on bitumen index at different concentration, to compare the bitumen properties between rubber wastes modified sample and with control sample without additive.

III. RESEARCH METHODOLOGY

The purpose of this study was to investigate the effects of rubber waste on bitumen. This paper discusses several tests that will be conducted to achieve the objectives of the study. In order to evaluate the quality of rubber waste on road asphalt, laboratory experiments have to be done to identify the performance of the modified bitumen with rubber waste compared to the unmodified bitumen. All the laboratory experiment is based on the standard specification on ASTM and AASHTO.[3] Study will be carried out by using experimental methods to evaluate the quality of rubber waste and its suitability in road pavement. The sample testing on rubber waste as modifier in bitumen is carried out through the bitumen tests.[4] Testing on bitumen have to be carried out is Ductility Test, Penetration Test and Softening Point Test in order to ensure it performs well on the specification. Tests were carried out to test whether the modified binder was appropriate. Ductility Test is the consistency test to determine the material stiffness meanwhile Softening Point Test is the consistency test to determine the temperature where the phase change occur in bitumen.[5]

A. Penetration Test

In this test we examine the consistency of a sample of bitumen by determining the distance in tenths of a millimeter that a standard needle vertically penetrates the bitumen specimen under known conditions of loading, time and temperature. It measures the hardness or softness of bitumen by measuring the depth in tenths of a millimeter to which a standard loaded needle will penetrate vertically in 5 seconds. Penetration test were done for normal bitumen and modified bitumen with 4%, 8%, 12% and 16% of rubber waste content. The result was shown in Table 1. The penetration value decreases as the rubber content increase as shown in Graph 1.

B. Ductility Test

Ductility test were done for normal bitumen and modified bitumen with 4%, 8%, 12%, and 16% of rubber waste content. The result was shown in Table – 2. The ductility value decrease as the rubber content increase as shown in Graph – 2. The result shows that the rubber waste added will harden the bitumen. The bitumen becomes more viscous and harder, which would be useful to obtain stiffer bitumen asphalt.[2]

C. *Softening Point Test*

Softening Point Tests were done for normal bitumen and modified bitumen with 4%, 8%, 12% and 16% of rubber waste content. The result was shown in Table – 3. From the plotted graph, the softening point for normal bitumen was 83.5°C.
The relationship between the rubber waste added and the softening point of the bitumen are almost linear as shown in Graph – 3. Softening Point increased with the increased amount of the waste added. This showed that, the bitumen become less susceptible to temperature changes as content of rubber waste increased.

D. *Tables and Graphs*

Table 1: Penetration Test

Rubber Waste (%)	Sample Reading (mm)			Average
	Reading 1	Reading 2	Reading 3	
0	39	43	41	41
4	34	33	37	35
8	29	31	27	29
12	25	22	25	24
16	18	21	16	18.33

Graph 1: Penetration Test

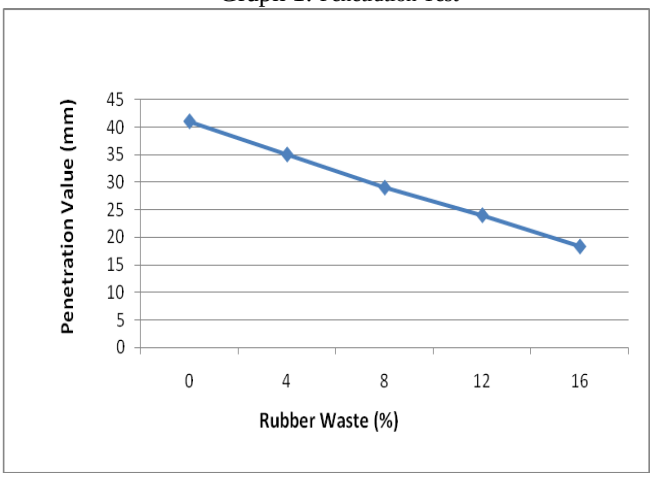


Table 2: Ductility Test

Rubber Waste (%)	Sample Reading (cm)			Average
	Reading 1	Reading 2	Reading 3	
0	25	24	27	25
4	21	23	23	22
8	18	19	20	19
12	14	16	17	16
16	13	15	16	15

Graph 2: Ductility Test

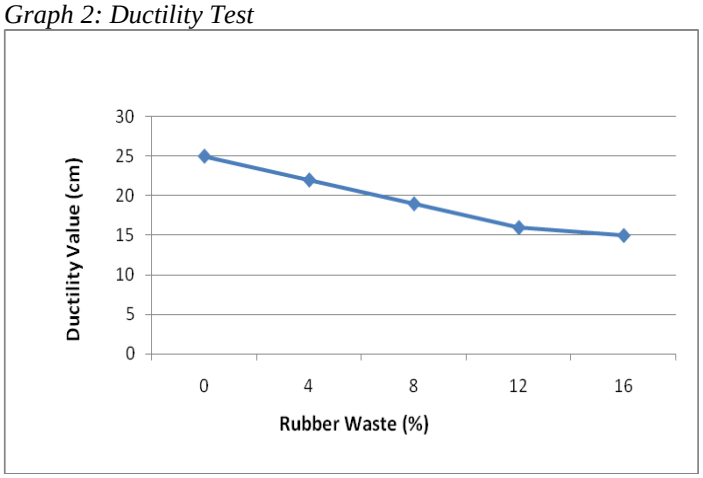
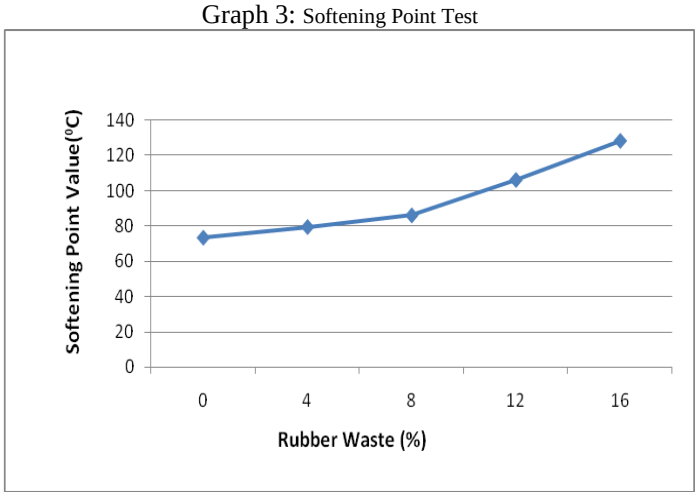


Table 3: Softening Point Test

Rubber Waste (%)	Reading (^{0}C)		Mean Specific Gravity
	Ball 1	Ball 2	
0	72	75	73.5
4	80	79	79.5
8	85	87	86
12	102	110	106
16	130	126	128

Graph 3: Softening Point Test



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