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Poster Book

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*International Invention, Innovation & Design Exposition
for Built Environment and Engineering 2023*

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**Unleashing Potentials
Shaping the Future**

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LIGNIN: GREEN MODIFIER FOR ROAD PAVEMENT

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INTRODUCTION

- Bitumen is a petroleum-based hydrocarbon, obtained from a crude petroleum distillation, has been widely used as a binding material in pavement construction.
- To improve pavement performance for long term condition, the properties of the bitumen need to be modified by adding modifiers. The modified bitumen can provide an improvement in rutting resistance, fatigue cracking resistance, and cracking resistance to binder hardening.
- Lignin is an organic renewable resource, one of the most abundant material available and can be obtained commercially from pulp and paper mills industry (Gosselink and Guran, 2004) or production of ethanol (Bajwa et al., 2019).
- Lignin is a hydrocarbon mainly consists of carbon, hydrogen and oxygen, a chemical similarity to bitumen binder (Wang & Derewecki, 2013), and possess a good binding and antioxidant properties.
- Due to its antioxidant properties and chemical structure similarities, lignin might be beneficial in slow down the oxidation rate of bitumen and as partial substitutes for bitumen binder.

ISSUES/ PROBLEM STATEMENT

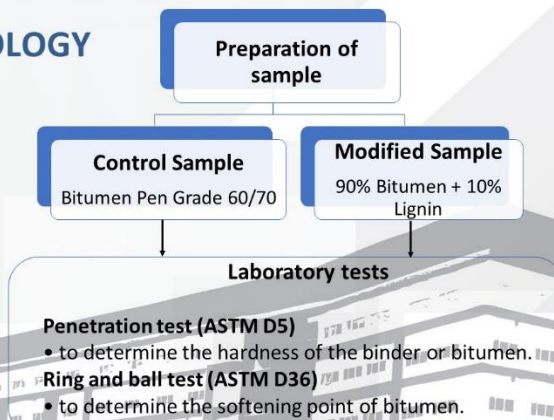
Limited study incorporated lignin as modifiers hinder its application in road pavement.



OBJECTIVES

- To determine the physical properties of lignin modified bitumen by ring and ball, and penetration tests.
- To compare the temperature susceptibility of conventional and lignin modified 60/70 bitumen.

METHODOLOGY



FINDINGS

- The finding (Fig. 1(a)) shows that the lignin has increase the hardness of bitumen by reduction in the penetration value from 68.3 PEN for bitumen grade 60/70 to 65 PEN for modified bitumen.
- It was found that the softening point temperature value of the modified bitumen is 52°C compared to conventional bitumen which is 48°C (refer Fig. 1(b)).
- As for the penetration index (PI), lignin improves the PI value from -1.0 to -0.07 (refer Table 1).

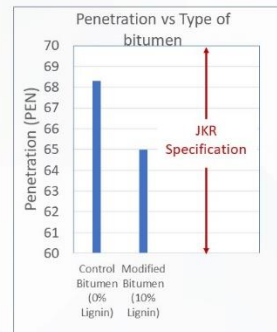


Figure 1(a)

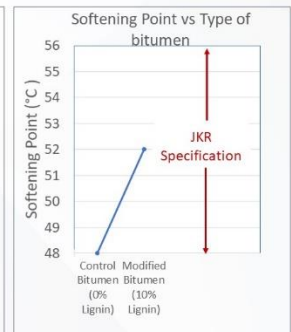


Figure 1(b)

Figure 1(a): Penetration of control and modified bitumen (b): Softening point of control and modified bitumen

Table 1: Temperature susceptibility of control and modified bitumen

Type of Bitumen	Penetration Index (PI)
Control (0% Lignin)	- 1.0
Modified (10% Lignin)	- 0.07

NOVELTY

Lignin is a renewable, sustainable and an alternative modifier that can partially replace bitumen while maintaining and improving the properties of the binder and pavement.

CONCLUSION

- Adding 10% of lignin lowers the penetration value which increase the hardness of bitumen.
- Lignin increase the softening point of binder therefore modified bitumen can withstand a higher temperature compared to conventional bitumen.
- Lignin give a better results for the PI of the modified bitumen which is -0.07 compared to conventional bitumen with -1. Lignin modified bitumen is suitable to be applied in pavement construction (within the range of -2 to +2).
- Modifying the bitumen with lignin will help in reducing the usage of bitumen in road construction thus lower the cost of materials.

COMMERCIALIZATION

Lignin modified bitumen – A sustainable green binder that environmentally friendly, economically feasible and abundantly available.