

# Full or Partial Replacement of Bitumen in Mix Design by the Use of Bio-Asphalt

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**ABSTRACT-** The experimental program of this research has been designed to characterize the different bio-oils and to study the applicability of developing bio-binders from them to be used in the pavement industry.

With the advent of new technologies, the use of bio asphalt in mix design or recycled asphalt pavement material has gained increasing importance. Using it is not only increasing the economic value of Asphalt production, but also decreases the demand of virgin materials. The limit in the use of bio asphalt proportion is restricted due to stiffness and workability issues. This problem is addressed with the help of warm mix bio asphalt producing mixes having the same properties, better workability, and minimizes the property of viscosity than hot mix asphalt at lower temperatures.

## I. INTRODUCTION

For the past many years, paving of flexible roads is done by the use of the most known petroleum based product which is bitumen. No doubt bitumen, whose modified form is known as asphalt, is a best binder for flexible pavement. But petroleum is a non-renewable source and rapid depletion of crude oil resources is also continuously increasing crude oil prices. These factors will surely create major problems in future developments for any developing country[1]. Some research also shows that the production of asphalt also shows adverse effects on the environment. Asphalt fumes produce large amounts of carbon dioxide which is increasing global warming. So it is compulsory to produce some good binder from any alternative source which can replace partly or completely asphalt from hot mix design to save the oil resources of the world as well as its adverse effect on the environment. Although on a small scale a few research works are being conducted worldwide to produce some alternative source for asphalt. Crude oil is a fossil which is used for the production of petroleum. Crude oil is a non-renewable source[2]. So researchers from some countries like the USA, China worked over some sources which can be renewable in nature.

Now the world is taking steps to set up an economy which is Bio based and where biological resources are the major sources as compared to petroleum fossil. Bio based resources are less costly, have no adverse effect on environment, renewable and efficient. So bio binder is an alternative binder which is a product of bio based material. A biological term given to this bio binder is bio asphalt[3]. To reduce the demand of traditional asphalt bio asphalt can

be used in 3 ways. 100% replacement of asphalt (full replacement). 35%-65% replacement of asphalt (asphalt extender) 0%-10% replacement of asphalt (asphalt modifier).

## II. OBJECTIVE

In this whole research I completely observe, it can be good that full or partial replacement of petroleum based asphalt. Therefore, the objective of the full or partial replacement of bitumen in mix design by the use of Bio asphalt are as follows:

- Wastes (including waste during agriculture production, waste during agriculture processing, Crop residues, mill wood waste, and organic waste.)
- Forests (including trees, shrubs, wood residue, sawdust.)
- Energy crops (includes woody crops, grasses, sugar crops, oilseed crops) Use of biomass as input for conversion totally depending upon its physical and chemical properties. Biomass consists of cellulose, hemicellulose and lignin. Figure 1 and 3 represent one sample of oak wood tree and field of switchgrass which is the most important biomass for bio-oil.



Figure 1: Picture of Oak wood

- Source of this asphalt is non-renewable in nature.
- No effect of petroleum costs on road development of any country.

- Minimum adverse effect on the environment. Can be a good full or partial replacement of petroleum based asphalt.
- Economical
- Long-lasting life because of the presence of antioxidants in it.
- Reduce carbon footprint.
- Can extend the grade range of the asphalt.

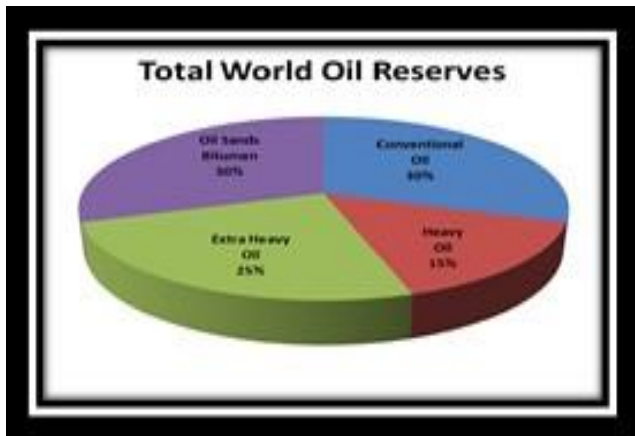


Figure 2: Total world oil reserves

Figure 2 shows the oil reserves of the world which shows that the total world oil reserve contains 30 % of oil and bitumen and 30 % of conventional oil and another 40% of extra heavy oil and heavy oil.

#### A. Biomass

Biomass is a general term for all living matter on this planet in which solar energy is stored by the process of photosynthesis plants make biomass[4-5].



Figure 3: Field of Switchgrass

Corn Stover is another biomass which is an integral and important component for bio-asphalt.

### III. RESEARCH METHODOLOGY

Mostly for paving flexible road binders that are derived primarily from fossil fuels are used. As we know petroleum oil reserves are becoming depleted day by day and it's compulsory to reduce fossil fuel usage, so there is a need to produce binders from alternative sources, basically from bio renewable resources.

Therefore research methodology is outlined here . The research considers different types of bio-oils, derived from different renewable biomass sources, which are Oakwood, switchgrass, and Corn stover, by the technique of fast pyrolysis. This whole research includes three important objectives: one to examine physical properties, second to examine chemical properties, third to examine rheological properties. For the physical properties examination the physical characteristics of the developed bio based asphalt are determined through various tests for various factors like test for separation potential, for specific gravity. , for penetration, for ductility, for softening point. For the chemical properties examination various tests are considered mainly about chemical characterization of the bio-asphalt through testing them by Gas Chromatography-Mass Spectrometry (GC/MS) and Fourier Transform Infrared Spectroscopy (FTIR). By examining these tests we will be capable of quantifying the amount of oxidative aging produced and identifying the possible types of chemical bonds (functional groups) presented in bio asphalt. For rheological based testing, there are many steps. Summarized as follows:

- Determine the viscosity of the bio-asphalt using the rotational viscometer from which the temperature and the duration for the development of bio-asphalt from bio-oils to be determined,
- Examine the effect of using different types of polymer modifiers with different percentage
- Using a dynamic shear rheometer (DSR)
- to examine the modified temperature for the rolling thin film oven (RTFO) that copy the effect of short- term aging during construction,
- Using a dynamic shear rheometer (DSR) to performance grade of the bio-asphalt
- Then pressure aging vessel (PAV) treatment of the rolling thin film oven (RTFO) for bio-asphalt and the low temperature performance grade of the pressure aging vessel aged of bio-asphalt as a binder is determined by using a bending beam rheometer (BBR).

### IV. CONCLUSION

The experimental program of this research was designed to characterize the different bio-oils and to study the applicability of developing bio-binders from them to be used in the pavement industry. In this chapter, the experimental materials used, the experimental plans designed, and the experimental procedures followed during testing are discuses

- To analyze the practice applicability of using the bio-oils in bio-asphalt.
- The positive and negative effect of different types of polymer modifiers on the different types of bio-oil based bio-asphalt.
- The thermal expansion coefficient of the developed bio-asphalt will be calculated.
- The resistance of the developed bio-asphalt against water and moisture content will be investigated in research.
- Viscoelastic behavior of bio oil will be investigated.
- Change in Stripping value will be studied as compare to petroleum based product
- Cracking or any other failure will be notable.

## REFERENCES

- [1] Xu Yang (2013) "The Laboratory Evaluation of Bio Oil Derived From Waste Resources as Extender for Asphalt Binder"
- [2] SHIN-CHE HUANG (2012) "Alternative Binders for Sustainable Asphalt Pavements"
- [3] Mohamed Abdel Raouf, R. Christopher Williams (2011) "Performance Properties of Fast Pyrolysis Bio- Oils Modified Asphalt"
- [4] Vignesh H\*, Ramesh Babu N.G, Manivasagan V, Suganya S and Eajas Basha (2013) "Emerging Trends in Greener Pavements"
- [5] Min He, Hongli Wang , Dongwei Cao , Meiyu The experimental program of this research was designed to characterize the different bio-oils and to study the applicability of developing bio-binders from them to be used in the pavement industry. Zhang, Haiyan Zhang , Yanju Chen, fang Yanjun Zhang (2015)