A Study on Use of Waste Polyethylene in Bituminous Paving Mixes

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Abstract - *Bituminous mixes are widely employed in the building of flexible pavements all over the world. It is made up of a binder (asphalt or bitumen) and mineral aggregate that are mixed together, placed down in layers, then compacted. Conventional bituminous pavements function admirably under typical conditions if correctly designed and installed, however bituminous mixes perform poorly in a variety of scenarios. Low density polyethylene (LDPE) has been discovered to be an effective bitumen modifier.*

Key Words: **Marshall Properties, Static indirect tensile strength, stone mix asphalt (SMA), dense bound macadam (DBM), OMFED polyethylene, Marshall Properties, Static indirect tensile strength.**

1.INTRODUCTION

In the case of pavement engineering, there are two key considerations: pavement design and mix design. The current research is limited to flexible pavement mix design concerns. Asphalt paving mixture design is a multi-step process that involves selecting binders and aggregate materials and proportioning them to achieve an appropriate compromise among several variables that affect mixture behaviour while taking into account external factors such as traffic loads and weather conditions. The amount of plastic garbage available nowadays is huge. The use of plastic materials such as carry bags, mugs, and other similar items is on the rise. Packing accounts for almost half to sixty percent of overall plastic consumption. Plastic packaging materials are dumped outside after usage and become garbage. Plastic garbage is long-lasting and not biodegradable. As a result, any approach that may use this plastic trash for construction purposes is always welcome. As a result, adding hydrophobic polymers to an asphalt mix via a dry or wet mixing procedure improves the mix's strength and water repellent properties. Polyethylenes are added to a hot bitumen mixture, which is then laid out on the road like a regular tar road.

1.1 Constituents of a mix

Bituminous mix is made up of aggregates that are continuously graded from maximum size (usually less than 25 mm) to fine filler (less than 0.075 mm). Bitumen is added to the mix in sufficient quantities to make the compacted mixture impermeable and have adequate dissipative and elastic qualities. The goal of bituminous mix design is to establish the proportions of bitumen, filler, fine aggregates, and coarse aggregates in order to create a mix that is workable, robust, long-lasting, and cost-effective. e a regular tar road.

The basic materials used are as follows:

- Aggregates
- Fly Ash
- Slag
- Bituminous Binder
- Polyethylene

1.2 Experimental Work

The experimental works carried out in this present investigation. It involves mainly 2 processes. i.e.

- Preparation of Marshall samples
- Tests on samples

Prior to the experimental work, the specific gravity, tensile strength, and softening point of polythene used in this investigation were calculated.

2. MARSHALL STABILITY

The Marshall stability value improves with increasing bitumen concentration up to a specific bitumen content and then declines, as seen in the graphs. Optimal binder content refers to the amount of bitumen in a given batch (OBC). The OBC for typical SMA, BC, and DBM mixes were determined to be 6%, 4.5 percent, and 4.5 percent, respectively, in the current investigation. For modified SMA, BC, and DBM mixes with polyethylene at various concentrations, OBC was found to be 4%. The graphs show that when the amount of polyethylene added increases up to a certain point, the stability value lowers, and as the amount of polyethylene added grows, the stability value declines. This could be due to an overabundance of polyethylene that is unable to mix effectively with asphalt. The optimum polyethylene content (OPC) of a mix is found to be 2 percent for SMA and DBM and 1.5 percent for BC mixes.

Indirect tensile strength test in a static state The static indirect tensile test of bituminous mix is used to determine the mix's indirect tensile strength (ITS), which aids in determining the mix's resistance to heat cracking. For both

cases, static indirect tensile tests are performed on SMA, DBM, and BC mixes created at their OBC and OPC.

(1) With stone dust as filler and

(2) With fly ash and slag

Table -1: Optimum binder contents

Types of mix	Optimum polythene content (%)	Optimum binder content (%)
SMA without polyethylene	0%	6%
SMA with polyethylene	2%	4%
DBM without polyethylene	0%	4.5%
DBM with polyethylene	2%	4%
BC without polyethylene	0%	4.5%
BC with polyethylene	1.5%	4%

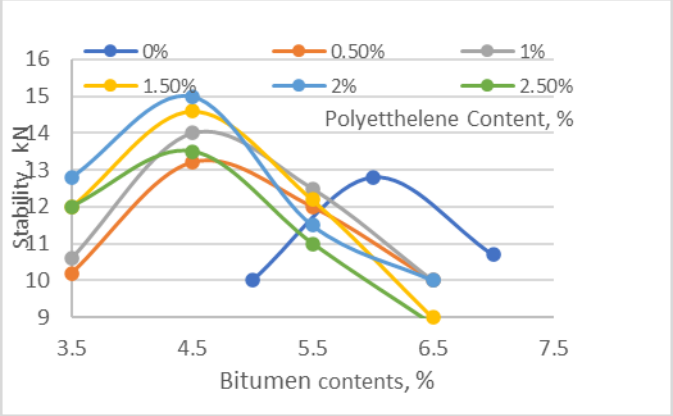

Chart -1: Variations of Marshall Stabilities of SMA with different binder and polyethylene contents.

Polyethylene's effect on static indirect tensile strength the indirect tensile strength of the mix is increased when polyethylene is added, compared to traditional mix. After replacement, the value of indirect tensile strength increases once more using slag to grade fine aggregates and fly ash as a filler, a typical mix is created. It can be seen from the graphs that adding polyethylene to the mixtures with fly ash and slag increases the indirect tensile strength more than both the conventional mixture and the combination with fly ash and slag. Polyethylene's effect on static indirect tensile strength The indirect tensile strength of the mix is increased when polyethylene is added, compared to traditional mix. After replacement, the value of indirect tensile strength increases once more.

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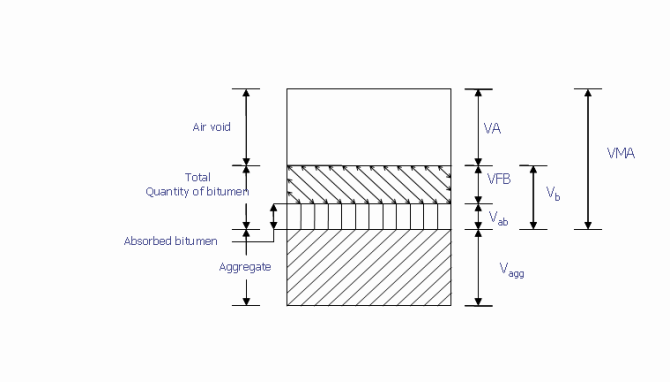

Fig -1: Volumetric phase diagram

Temperature has an effect on static indirect tensile strength. For all types of mixtures, the variations in indirect tensile strength with temperature are shown in the graph. When the temperature is raised, the ITS value lowers, but when polyethylene is added to the mix, it rises. The BC with polyethylene mixes have the highest indirect tensile strength than SMA and DBM for both mixes with stone dust as filler and mixes with fly ash and slag. Mixes comprising fly ash and slag have a greater indirect tensile strength than mixes using stone dust as a filler.

3. CONCLUSION

Three types of mixes, SMA, DBM, and BC, are created in this study using VG30 grade bitumen as a binder. The effect of adding waste polyethylene in the form of locally available artificial milk with brand OMFED packages to bituminous mixes was investigated by altering polyethylene concentrations from 0 to 2.5 percent with a 0.5 percent increment. Using Marshall Method of mix design the optimum bitumen content (OBC) and optimum polyethylene content (OPC) have been determined for different types of mixes. It has been observed that addition of 2% polyethylene for SMA

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