

# Polythene Recycling Utilized to Improve Bituminous Concrete Mixture Properties

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## Abstract

Bituminous Concrete (BC) is a composite material mostly utilized in construction projects like, airports terminals, road pavement, parking lots etc. It consists of asphalt or bitumen (used as a binder) and mineral aggregate which are mixed together & laid down in layers then compacted. Today's life consist the steady increment in high traffic intensity in terms of commercial vehicles, and the significant variation in daily and seasonal temperature which arises due to global warming because of excessive carbon emission, put us in a demanding situation to think of some alternatives for the improvisation of quality assurance and the pavement characteristics by applying some necessary modifications which shall be satisfy both the strength as well as economical aspects. We have to considering the environmental approach, due to excessive use of polythenes in day to day life, the pollution to the environment is enormous. Here we know, the polythenes are not biodegradable, the need of the current hour is to utilize the waste polythene through recycling in some beneficial purposes. This paper presents a research conducted to analysis the behavior of BC mix modified with waste polythene. As per IRC code, it recommended the various percentages of polythene are used for preparation of mixes with a selected aggregate grading. The role of polythene in the compacted mix is studied for various engineering properties by preparing Marshall Samples of BC mixtures with and without polymer. Marshall Properties such as unit weight, flow value, stability, air voids are used to determining the optimum polythene content for the given grade of bitumen (80/100).

**Keywords:** Polythene Recycling, Bituminous Concrete, Flexible Pavement, Rigid Pavement.

## 1. Introduction

Bituminous binders are major binders which are largely used in pavement construction. The pavement

is done with a no of layers. The bituminous concrete (BC) is mainly consist of aggregate and bitumen. There are two types of pavements: (i) Flexible Pavement and (ii) Rigid Pavement

### (i) Flexible Pavement

Flexible pavements consists of multiple layers constructed using granular materials. To serve in all weather conditions, its top layer is constructed to be impervious by using different types of binders, viz. bitumen, tar and modified bituminous materials. Such layers are termed as bound layers and resist loads by developing tensile stresses at its bottom fibers. The particles that make up the granular layers are not bound together by any binder. Such layers are termed as unbound layers. The unbound layers are stabilized either by mechanical action or treated with additives by which the unbound layers possess very low tensile strength. Unbound layers are constructed as sub-base and base courses since they lie under the impervious surface course. A typical flexible pavement consists of four components: (a) Soil subgrade, (b) Sub-base course, (c) Base course and (d) Surface course.

### (ii) Rigid Pavement

In rigid pavement, the surface course consists of a cement concrete slab with or without reinforcements. Under wheel load; the top and bottom fibers of the slab experience compressive and tensile stresses respectively. The stresses developed are resisted by beam action or flexural strength of the cement concrete slab which bridges over soft spots in the supporting layers of the slab.

## 2. Mix Design Overview

The road construction projects involve a large amount of resources like money, man, material, machine etc. So it is necessary to prevent wastage of resource which is possible only by a perfect engineering design with increased road life.

The aim is to calculate the proper proportion of bitumen, polythene, filler, fine aggregates, and coarse aggregates to produce a bituminous mix design which is workable, strong, durable and cheap. The mix design is categorized into two categories: (i) Dry mix design and (ii) Wet mix design.

### 2.1 Objectives of Mix Design

The accurate bituminous mix design leads to a durable pavement. For the present work following was the objectives:

- Sufficient workability
- Sufficient strength to bear heavy loads.
- Adequate durability
- Adequate flexibility to avoid cracking
- Adequate amount of air voids in the compacted bitumen.
- Should be less costly

## 2.2 Types of Mix

- Hot mix asphalt concrete
- Warm mix asphalt concrete
- Cold mix asphalt concrete
- Cut-back asphalt concrete
- Mastic asphalt concrete or sheet asphalt

## 3. Analysis of Results

Variables were plotted i.e.

- i. Marshall Stability Value vs. Polythene Content
- ii. Marshall Flow Value vs. Polythene Content
- iii. VMA vs. Polythene Content
- iv. VA vs. Polythene Content
- v. VFB vs. Polythene Content
- vi. Bulk unit weight vs. Polythene Content

Three samples have been tested for each % of polythene. So the average values of the 3 were taken. The mean values are shown.

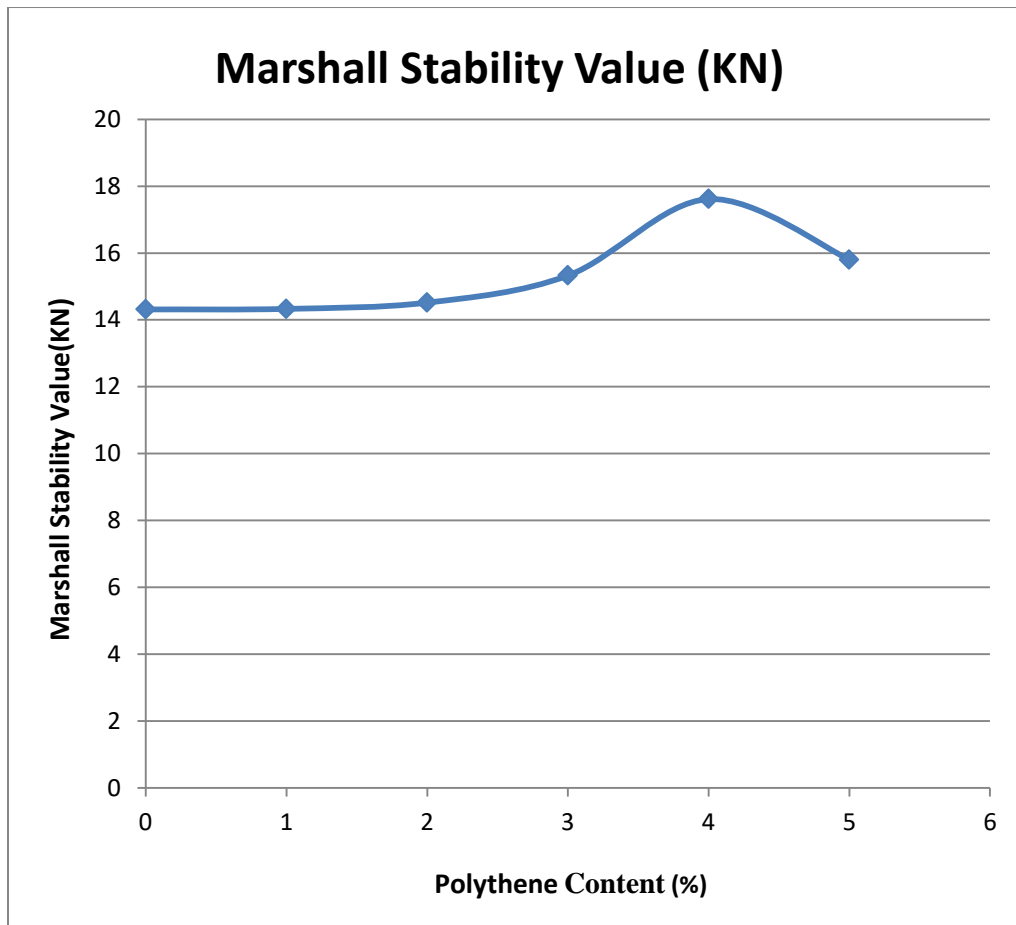
**Table 1: Parameters for Different % of Polythene Content**

Polythene Content (%)	Unit weight (G <sub>mb</sub> )	Mean VMA (%)	Mean VA (%)	Mean VFB (%)	Mean S (Kn)	Mean F (mm)
0	2.314612	15.891665	4.046368	74.554896	14.31333	4.06666
1	2.302888	15.074159	3.289005	78.195278	14.33333	3.46666
2	2.282829	14.561341	2.620872	82.066657	14.51666	3.1
3	2.252812	14.440747	2.254444	84.411886	15.32666	2.93333
4	2.220439	14.397424	2.197120	84.900807	17.61333	2.83333

5	2.194356	14.214917	1.783908	87.459984	15.80333	2.8
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### 3.1 Marshall Stability

The graph is shown between Marshall Stability value and polythene content. It is observed that the stability value of mix is increase with increase of polythene content. The graph show that Marshall Stability value rises up with polythene content up to 4.0 % and thereafter decreases.



**Figure 1: Variation of Marshall Stability Value vs. Polythene Content**

The graph is shown between Marshall Stability value and polythene content. It is observed that the Flow value of mix is decrease with increase of polythene

content. Variation of Flow value with different polythene contents are shown in graph below.

#### **4. Conclusions**

The experiment concluded that the properties of bituminous concrete mixtures improved by addition of waste polythenes. The waste polythene coated aggregates of the mixture reduces porosity, absorption of moisture and improves binding property. The modified bitumen with 4.0 % polythene waste is showing better performance as compared other mixes. It is observed that Marshall Stability value rises up with polythene content up to 4.0 % and thereafter decreases. That's why the use of higher value of percentage of waste polythenes not preferable.

While talking about ecological problem due to non-biodegradable plastics waste, disposal of such materials has become a serious problem which causing global warming. Its use in construction of flexible pavement will give providing a better flexible pavement with improved performance and a better place for their burying on one hand and thus solving the problem of their disposal on other hand. The properties of aggregates which mainly cause rutting action are improved using plastic coated aggregates. Considerable increase in the optimum bitumen content & Marshall Stability value is also reduced. Above all the waste plastic which is a pollution menace can find its use in road construction and thereby solving the problem of pollution to a certain extent.

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