

# EXPERIMENTAL STUDY ON THE BEHAVIOUR OF FLEXIBLE PAVEMENT WITH POLYPROPYLENE FIBER

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**Abstract** - The idea of using different kinds of fibers to improve the conduct of pavement is not new nowadays. There are several kinds of fiber materials are available in the market such as carbon fiber, glass fiber, polyester fiber, polypropylene fiber, etc.,. Among these fiber materials we have choosed polypropylene fiber in light of the fact that the consequence of this project demonstrates that the strengthening of flexible pavement with polypropylene fiber upgrades the general execution of pavement and the effect of pavement when it is partially replaced with polypropylene fiber and how the ductility value, penetration value, softening point value is varying by adding 1%, 2%, 3%, 4%, 5% polypropylene fiber by modifying bitumen. The present study was carried out to propose the use of polypropylene coated aggregate in the flexible pavement in order to improve their performance and physical properties. The main aim of our project is not only strengthening the flexible pavement but also improves the road life by reducing the cracks and path holes.

**Key Words:** Flexible Pavement, Polypropylene Fiber, Bitumen, Aggregate, Fiber.

## 1. INTRODUCTION

A country development depends on the connectivity of different places with road networks. Roads play major role in the transportation of carrying goods and passengers. India is a larger country where having huge resource of materials. If these resources are used properly, the cost of road construction can be reduced. In India, there are 98% roads are having flexible pavements. There are lot of researches have been made by using the Waste materials but the role of these materials is still limited. As we know that life and strength of the rigid pavement is more than the flexible pavement. The cost of rigid of the pavement is high when compared to flexible pavement. It is necessary to increase the strength of the flexible pavement. So we are using polypropylene fiber.

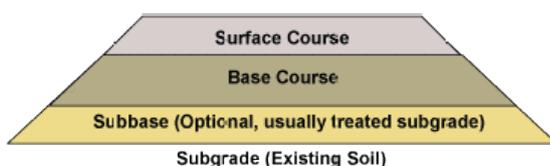


Figure 1 - Flexible Pavement

## 1.1 Polypropylene Fiber

It is a thermoplastic compound used for various applications in civil engineering. It is created through the chain growth of chemical change of the monomer propylene. Chemical formula of polypropylene is  $(C_3H_6)_n$ . These fibers are used as a concrete additive to increase its strength and to reduce cracking. These fibers are also used to produce bottles and lots of plastic items for medical laboratory because they can withstand high temperature. In this project we are using 6mm fiber length.

## 1.2 Physical Properties of Polypropylene Fiber

Table -1 : Physical Properties

Tensile strength (gf/den)	3.5 to 5.5
Elongation (%)	40 to 100
Abrasion resistance	Good
Moisture absorption (%)	0 to 0.05
Softening point (°C)	140
Melting point (°C)	165
Chemical resistance	Generally excellent
Relative density	0.91
Thermal conductivity	6.0 (with air as 1.0)
Electric insulation	Excellent
Resistance to mildew	Excellent

## 2. OBJECTIVE

- To increase the life and stability of the flexible pavement.
- To increase the load withstanding capacity of the flexible pavement.
- To study the effect of pavement when the bitumen is partially modified with the polypropylene fiber.
- To conduct the various tests on conventional bitumen and modified bitumen.
- To reduce the cost of flexible pavement construction.

### 3. METHODOLOGY ADOPTED

- To conduct the Standard tests for Conventional aggregate and Nominal Bitumen.
- To use polypropylene fiber as additive with aggregate and test all the basic test parameters.
- To use polypropylene fiber as additive with bitumen and test all the basic test parameters.

### 4. TESTS ON MATERIALS

The tests are conducted on aggregate and 60/70 grade bitumen.

#### 4.1 Aggregate

Aggregates form the major portion of pavement structure and they form the prime materials utilized in pavement construction. Aggregates have to bear stresses occurring due to the wheel masses on the pavement and on the surface course they even have to resist wear because of abrasive action of traffic.

**Table -2** Test On Conventional Aggregate

S.NO	NAME OF TEST	RESULTS	IS STANDARDS
1.	Aggregate Impact Value	25.1 %	Not exceed 30%
2.	Aggregate Crushing Value	5.9 %	< 10%
3.	Aggregate Abrasion Value	29.6 %	Max. 35%
4.	Specific Gravity Value	2.51	2.5 - 2.9



**Figure 2** - Aggregate Impact Test

#### 4.2 Bitumen

Bitumen is a common binder utilized in the flexible pavement construction. It is principally obtained as a residual product in petroleum refineries after higher fractions like gas, petrol, kerosene, diesel, etc., are removed. In this project, we are used 60/70 grade bitumen.

**Table -3** Test on Nominal Bitumen

S.NO	NAME OF THE TESTS	RESULTS	SPECIFIED VALUES
1.	Penetration Test	60 mm	60-70 mm
2.	Softening Point Test	70 °C	Min 67 °C
3.	Ductility Test	45 cm	Min 40 cm



**Figure 3** - Penetration Test of Bitumen

### 5. METHODS ADOPTED FOR ADDING POLYPROPYLENE FIBER

There are methods adopted in the addition of polypropylene fiber in the flexible pavement such as:

- Wet Mix Process
- Dry Mix Process

#### Wet Mix Process

In this process, the polypropylene fiber is blended with hot bitumen at 160°C and then stirred effectively. Then the polypropylene fiber is mixed with the bitumen and modified bitumen is prepared. This modified bitumen is carried out for conducting tests.

#### Dry Mix Process

In this process, the polypropylene fiber is blended with the hot aggregate at 160°C and mixed thoroughly. Polypropylene gets coated on the surface of aggregate uniformly, this is

called as Polycoated aggregate. This Polycoated aggregate is carried out for conducting tests.

### 5.1 Test on Polycoated Aggregate

**Table -4** Test Of Polycoated Aggregate

S.No	NAME OF TEST	1% P.P	2% P.P	3% P.P	4% P.P	5% P.P
1.	Aggregate Impact Value (%)	23.7	20.2	18.6	15.1	13.2
2.	Aggregate Crushing Value(%)	5.4	4.83	4.3	3.55	3
3.	Aggregate Abrasion Value (%)	28.8	28.1	27	22	20.6

### 5.2 Test on Modified Bitumen

**Table -5** Test of Modified Bitumen

S.No	NAME OF TEST	1% P.P	2% P.P	3% P.P	4% P.P	5% P.P
1.	Penetration Test	51	49	28	14	10
2.	Softening Point Test, °C	75	90	102	110	120
3.	Ductility Test, cm	30	25	16	13	10



**Figure 4 -** Ductility Test of Modified Bitumen

### 6. CONCLUSIONS

Based on the study and experimental data for the modified bitumen and polycoated aggregate compared with nominal bitumen and conventional aggregate, the following conclusion can be drawn-

- i) The test results showed that polypropylene fiber can be conventionally used as a modifier for the bituminous mix.

- ii) By the addition of polypropylene fiber to the bitumen, the penetration value, softening point value is increased and the ductility value is decreased as compared to the nominal bitumen.
- iii) By the addition of polypropylene fiber to the aggregate, the physical properties like Aggregate Impact Value, Aggregate Abrasion Value, Aggregate Crushing Value of polycoated aggregate were improved appreciably as compared to conventional aggregate.
- iv) The process is cheap and eco-friendly and it can be used effectively in the relatively weak stone aggregate by making them comparatively stronger by providing suitable plastic coating over it by the dry process method.

This shows that the use of polypropylene fiber will strengthen the flexible pavement, increases the life period and there will be less maintenance for a long period of time

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