

Use of Plastic Waste in Enhancing the Properties of Course

Aggregate use for rigid pavement

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Abstract - Plastic waste and its disposal is a major environmental hazard, resulting in pollution and global warming. The use of plastic waste in bituminous mixes enhances its properties and strength. In addition, these are various defects in plastic disposal and paving e.g. the pot will also be solved for holes, wells, pastures, etc. The plastic used in waste is poly-ethylene, poly-polystyrene, polypropylene. The waste plastic is singled out and mixed with hot bitumen, and the resulting mixture is used for paving construction. This will not only strengthen the pavement but will also enhance its durability. Titanium-dioxide is used as an absorbent material for smoke, which will absorb smoke from vehicles. This innovative technology will be a boon to the Indian climate. It is economically and environmentally friendly. In this paper, we have discussed the properties of clay to be considered in the design of paving, paving design, construction process elastic and plastic-smoke absorbent pavement.

Key words: Plastic waste, flexible paving, strength, pot hole elimination.

1. INTRODUCTION

The greatest danger to the environment is the disposal of waste plastic. Pits and foliage are major problems in the highway. Plastic paving will be a good solution to the problems mentioned above. A material with one or more organic polymers of large molecular weight, which is solid in its ready state, can be shaped into a stream called "plastic." Plastic durability is high and it gradually decreases. And plastic is also less resistant to degradation. Plastic can be divided into two major sections - Thermosets and Thermoplastics. Thermosets have high durability and strength because they are irreversibly solid when heated, no longer used primarily in construction applications. Plastic is a non-degradable waste, causing greenhouse effect and global warming. Various experiments have been carried out to determine whether waste plastic can be productively reused. Various materials have suggested that when combined with waste plastic hot, a good layer of plastic will form together and when mixed into the binder, high strength, high resistance and good efficiency have been observed for some time. With bitumen, using waste plastic can make it life longer and smoother. It is economically and environmentally friendly. The addition of plastic waste to the pavement construction reduces plastic shrinkage and drying shrinkage. The use of waste plastic improves the friction and slip resistance of the asphalt pavement. In India, because of the hot and humid climate, plastic paving is the most beneficial.

1.1 PLASTICS ROADS - GENERAL INTRODUCTION

Using plastic in road construction is not new. This is similar to making PVC (polyvinyl chloride) or HDPE (high-density poly-ethylene) pipes already using PVC or HDPE pipe mat crossings together. The plastic mats include transition mats to facilitate the passage of tires from the crossing down. Both options help protect the road from carrying loads by distributing them across the surface. A recent study in this direction has shown some hope that plastic waste, i.e. plastic roads, will be used in road construction. A firm in Bangalore and R.R. of Bangalore. V A team of engineers from the College of Engineering has developed a method to use for plastic waste road construction. A preliminary study was conducted in 1997 to test team and strength and durability. Plastic roads are mainly used in plastic carry-bags, disposable cups and PET bottles which are collected from garbage waste, which is an important component of construction materials. When mixed with hot bitumen, the plastic melts to form an oil coat, and the mixture is like ordinary asphalt on a road surface.

2. OBJECTIVE

- Combined-plastic-asphalt paving with bitumen mix.
- Combining aggregate with plastics and incorporating titanium dioxide.
- Testing bitumen and modified bitumen.
- Examining the soil.

3. ADVANTAGES

- Reduce the need for bitumen by about 10%.
- Develop environmentally friendly technology.
- Improve the fatigue life of roads.
- Increase Strength and road performance.
- Use higher percentage of plastic waste.
- The gases released during traffic conditions are absorbed by smoke absorbent.

DISADVANTAGES

- Leaching will start with toxins in plastic waste.
- The presence of chlorine will definitely decrease HCl gas.

4. LITERATURE REVIEW

Dr.R.Vasudevan,(2007) – Stated that polymer bitumen mixture is a better binder than the plain bitumen. Blend increased the softening point with soft duty and reduced the penetration value.

Zahra Niloofar Kalantar (2012) – A lot of analysis has been done on PMA admixture over the past twenty years. Though the application of virgin polymers for the aim of enhancing asphalt properties in an exceedingly wide temperature range in optical phenomenon applications has been thought of for a few times, recycled polymers additional to asphalt have additionally shown nearly similar ends up in road pavement performance. Compared to virgin polymers, his paper could be a review of the utilization of polymers in asphalt pavement. During this study, a literary criticism on the history and edges of victimization waste and virgin chemical compound in asphalt is conferred. Followed by a review of general studies on victimization polymers in asphalt so as to boost the properties of pavements.

Amit Gawande (2012) - Due to population, urbanization, development work and lifestyle changes, the amount of plastic waste in municipal solid waste (MSW) is increasing which leads to widespread waste on the landscape. Thus disposal of waste plastics is a dangerous issue and due to their bioavailability and non-aesthetic approach it has become a serious problem globally. Since it is not scientific and unlikely to cause pollution in the ground and water.

These waste plastics partially replace traditional materials to improve the mechanical properties desired for certain road mixing. Bitumen is used as a binder in the process of making traditional roads. In such bitumen the waste can be modified with plastic pieces and a bitumen mix is made that can be used as an upper layer coat of elastic pavement. This waste plastic modified bitumen mix shows good binding properties, stability, density and water resistant.

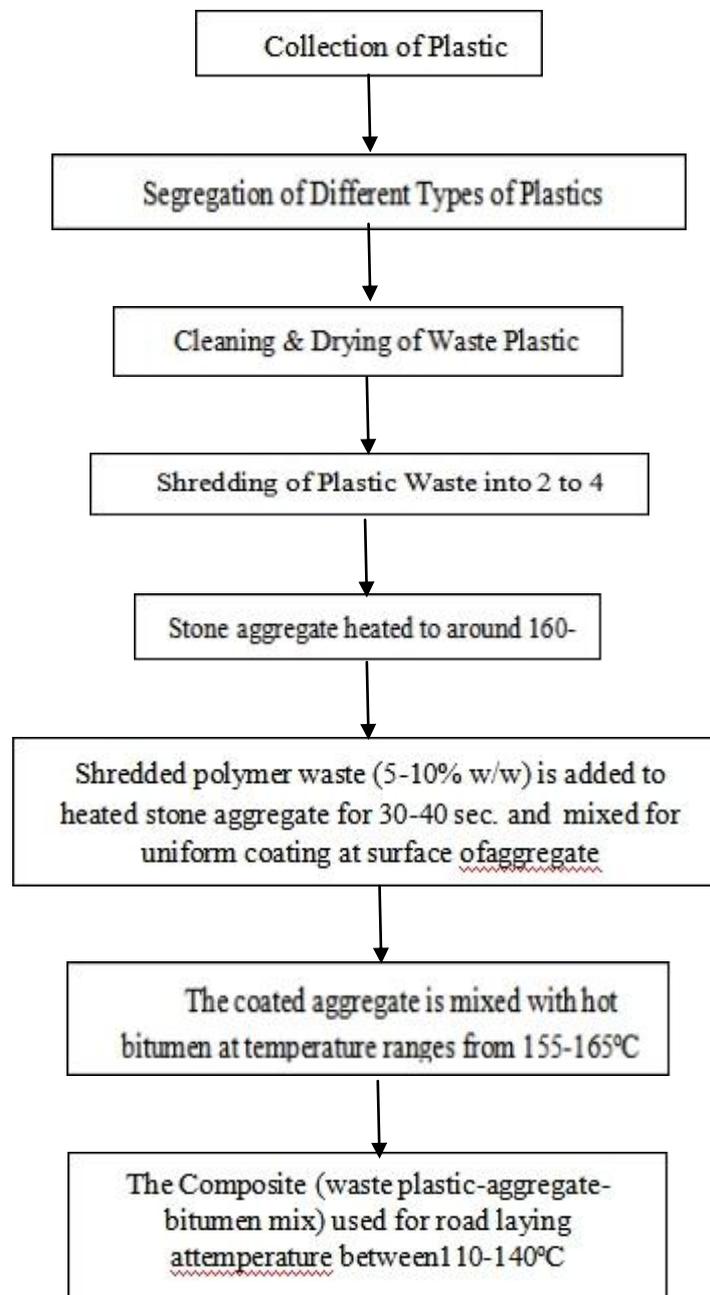
Sunil J. Kulkarni (2015) - Reducing waste content is a vital part of fashionable growth and development initiatives. Plastic is employed in numerous domestic and industrial applications. The employment of plastic baggage and bottles is extremely common. Disposal of plastic waste may be a major downside because of the bio-expandable sort of plastic. The plastic is used as feedstock for grain alcohol like product. It is used for construction and alternative construction connected activities. The present review summarizes the analysis on use of waste plastic.

Rishi Singh Chhabra (2014) - A large number of original materials and technologies have been invented to determine their suitability for the design, construction and maintenance of these sidewalks in highway infrastructure. Plastic and rubber are one of them. Considering the environmental outlook, excessive use of polythene in the business day-to-day can result in huge environmental pollution. The use of plastic items such as carry bags, cups, etc. is constantly increasing day by day. Since polyethylene is not biodegradable, the need of the present day is to use waste polyethylene for some profitable purpose. The use of this material as road construction enables the sub-base course of the paving to be used in an environmentally friendly, economical and plastic manner.

Akshay Gulghane (2015) - Construction waste is another significant issue in industry. The economic and environmental edges should be gained from construction waste decrease. This offers light-weight to the very fact that pre-planning and material acquisition are equally necessary in dominating the full project value. Waste Generation Rate is a good indicator for measurement construction waste and benchmarking construction waste management performance.

5. METHODOLOGY

5.1 PROCESS OF FLOW DIAGRAM OF PLASTIC COATED BITUMEN MIX ROAD.



5.2 COMPARATIVE STUDY CENTRAL MIXING PLANT (CMP)

The drying method can even be done through a central admixture plant. A sliced plastic is value-added to the conveyor along. it's transferred to the new cylinder. the whole plastic is coated there then with hydrocarbon. The ready mixer is then loaded into the dipper lorry and transported for road bedding. CMPs facilitate higher to raised to higher} management the temperature and mix in better with this material, making an identical coating. This can be adopted in our project. The comparative study is completed by testing the traditional aggregates & plastic coated

aggregates, and also the hydrocarbon and changed hydrocarbon (10% of hydrocarbon replaced by plastic). The assorted tests that area unit administrated for the comparative study area unit.

Waste plastic bags were collected from Canteen; Household plastic was also collected for the project work, like empty milk bags, used plastic bags etc. It is clean if required. The collected Plastic waste was sort out as per the required thickness. Generally, polyethylene (LDPE) of 60 micron or below is used for the further process. Less micron plastic is easily coated with aggregate at higher temperature (160°C-170°C). Collected Plastic was cut into fine pieces 2.36mm to 4.75mm with the help of shredding machine, but here we have cut the plastic using scissor. Firstly, Stone aggregate was heated up to the temperature about 160°C-170°C. The shredded plastic waste is added in hot aggregate for the coating, the proportion of plastic is taken 10% by weight of Bitumen. Immediately the hot Bitumen 60/70 or 80/100 grade (160°C) is added after that the mixture is transferred to road and the road is laid.

5.3 TESTS PERFORMED

5.3.1 Test on aggregates

- i. Aggregate crushing test
- ii. Los Angeles abrasion test
- iii. Impact test

5.3.2 Test on bitumen

- i. Penetration test
- ii. Softening point test

Aggregate Crushing Test

The strength of the coarse mixture is also assessed by mixture crushing check. the mixture crushing price provides a relative live of resistance to crushing beneath bit by bit applied compressive load. To attain a top quality of pavement, mixtures possessing high resistance to crushing or low aggregate crushing price re most well-liked.

In crushing test coarse aggregate passing 12.5mm IS sieve and retained on 10mm IS sieve are selected and heated at 100 to 110°C for 4 hours and cooled to room temperature. The aggregate ratio is such that the depth of the material in the cylinder after the tempering mentioned below will be 10 cm.. The right amount of cylinder filling can be conveniently found. Measure three layers of approximately the same depth, each layer being tempered 25 times by the temping rod and finally leveled using the temping rod as a straight edge. Care is being taken in case of weak material not to break the particles. The weight of the material containing the test sample will be determined (weight A) and the same weight of the sample will be taken for the repeat test.

Abrasion Tests

Due to the movements of traffic, the road stones utilized in the surface course area unit subjected to carrying action at the highest. Thence road stones ought to be onerous enough to resist the abrasion thanks to traffic. Abrasion tests area unit applied to check the hardness property of stones and to make a decision whether or not they area unit appropriate for the various construction works. The abrasion take a look at on combination could also be applied exploitation anyone of the subsequent 3 tests

- Los Angeles abrasion test
- Deval abrasion test
- Dory abrasion test

However L.A. abrasion takes a look at is most well-liked because the take a look at results are related with pavement performance.

Los Angeles Abrasion Test

The principle of the Los Angeles Abrasion Test is to find the percentage wear due to the relative rubbing action between the aggregate and the steel balls used as friction charges. The pounding of the ball also exists during the test and therefore the wear resistance and the result are tested by this test.

In this method, the specified weight, 5 to 10 kg and 20, 10 mm size aggregate sample is taken. The aggregate is placed in cylinder of Los Angeles abrasion testing machine along with the abrasion charges and the machine rotated at a speed of 20 to 33 rev/min for the specified number of total revolution (500 to 1000) depending upon the grade of sample. It is then sieved on a total 1.75 mm IS sieve. The total weight passing through the sieve is found and expressed as a percentage of the original weight of the sample which gives the total friction value.

Impact Test

The take a look at is intended to gauge the toughness of stone or the resistance of the aggregates to fracture beneath perennial impacts is termed impact take a look at. The mixture impact take a look at is often distributed to gauge the resistance to impact of aggregates and has been standardized by international intelligence agency. Combination the mixture the combination impact worth indicates a relative live of aggregate to impact, that contains a totally different impact than the resistance to bit by bit increasing compressive stress.

In this method, the specified weight, 20 mm size aggregate sample is taken. The impact machine will rest on the discharge plate, block or floor without attaching or packing, so that it is rigid and the hammer guide columns are vertical. The cup will be placed firmly on the base of the machine and on the entire test specimen placed on it and will be compacted by a single tamping of 25 strokes of the tamping rod. The hammer will lower its lower face into the cup more than 380 mm above its total surface area and allow it to fall completely freely. Each time a test sample is sent at a distance of less than one second, a total of 15 slaps will be struck. Then the whole mass will be removed from the cup and the whole thing will continue for a minute. Mm shifted to IS sieve. The fraction passing through the sieve is 0. g will be weighed with an accuracy of gram (weight B). Fractions.

TESTS ON BITUMEN

Bitumen is a viscous, black and highly viscous liquid or semi-solid in some natural deposits. It is also residues or by-products of partial distillation of crude petroleum. Bitumen is mainly composed of highly solidified polycyclic aromatic hydrocarbons, which contain 95% carbon and hydrogen. There is also bitumen A mixture of about 300 - 2000 chemical elements, about 500 - 700 on average. This is the heaviest Crude oil fraction, with highest boiling point 5250c. In following test we have to use the 60/70 grade bitumen.

Penetration Test

Penetration take a look at is to see the hardness of the hydrocarbon. The penetration of a hydrocarbon is that the distance in tenths of metric linear unit that a regular needle can penetrate into the hydrocarbon below a load of weight unit applied for a seconds at penetration worth indicates the softness of hydrocarbon higher the penetration softer is that the bitumen.

The pentrometer consists of a needle assembly with a total weight of 100 grams and a cathartic and protective device in any position. The hydrocarbon is softened to ongoing consistency, it is thoroughly stirred, and poured into a container at least fifteen metric linear unit depths beyond the expected penetration. It is necessary to take a look at a temperature of 25C. It is worth noting that the current temperature, the size of the needle, the weight placed on the needle and therefore the temperature can affect any quality at the cost of admission. A grade of 60/70 grade indicates that the infiltration value varies from 60 to 70 in a normal place, and look at the situation after that. In hot climates, low access grades are most popular.

Softening Point Test

The principle behind this test is that the softening point is the temperature at which the substance attains the mooring of a particular substance in a particular state of matter. The soft point indicates the temperature at which the bitumen gains a certain degree of softness according to the characteristics of this test.

The test is conducted by a ring and ball apparatus. A brass ring containing test specimens of bitumen is suspended in water or glycerin-like liquid at a temperature. A steel ball is placed over the bitumen. The sample and the

liquid medium are heated at a rate of C min. Temperature is recorded when softened. The bitumen touches the metal plate at the specified distance below. Fill the bath to a height of 50 mm above the upper surface of the rings with the freshly boiled distilled water or pure glycerin at a temperature of 5°C. The water bath liquid shall be freshly boiled distilled water when testing materials having softening points below 80°C and pure glycerin for material having softening points above 80°C. There shall be exactly 25mm difference between the bottom of the rings and the top surface of the bottom plate of the support, if any, and the bottom of the bath. Maintain the bath at a temperature of 5°C for 15 minutes after which place the balls previously cooled to a temperature of 5°C by forceps in each ball guide. Apply heat to the bath and stir the liquid so that the contents rise at the same rate of 5 + 0.50 C per minute until soft and allow the ball to pass through the ring.

6. RESULT AND DISCUSSION

- The crushing value reduces from 22.07 to 15.88 for normal and plastic coated aggregate. The value was reduced by 45%. Lower the aggregate crushing value higher is the strength.
- The aggregate impact value of plastic coated aggregate was reduced by 10% than the normal aggregate. This is the high hardness of the coated set of plastics..
- Los Angeles abrasion value indicates the hardness of the aggregates. The abrasion value plastic coated aggregates were 25% less than the normal aggregates.
- The penetration value of bitumen is higher than the bitumen mixed with the plastic.
- The bitumen softens 22°C less than the bitumen replaced with plastic.

Test Result- Aggregate crushing Value:-

Aggregate Crushing value (Normal Aggregate) %	Aggregate Crushing Value (Plastic coated Aggregate) %
22.07	15.88

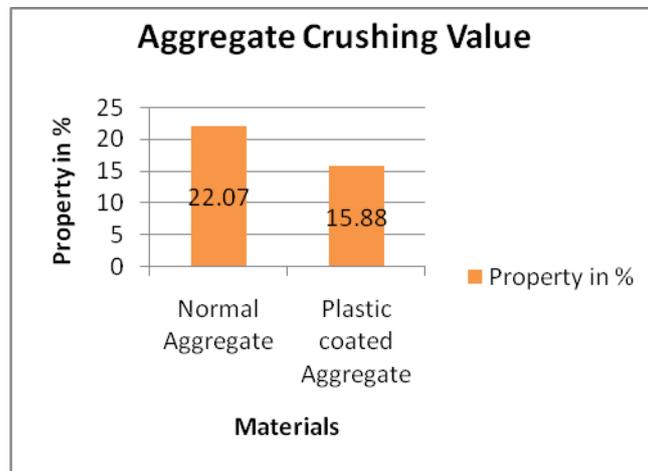


Chart -1: Aggregate Crushing Value %

Test result- Abrasion test value:-

Abrasion Test value (Normal aggregate)	Abrasion Test Value (Plastic Coated Aggregate)
7.5	6.4

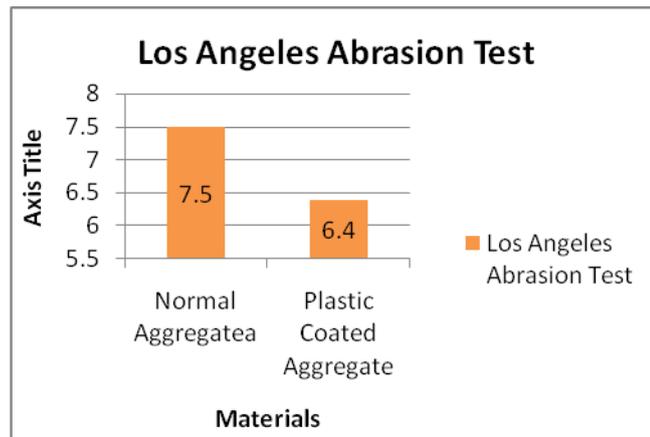


Chart -2: Aggregate Abrasion Value

Test result- aggregate impact value:-

Aggregate impact value (Normal aggregate)	Aggregate impact value (Plastic Coated Aggregate)
6.5	5.9

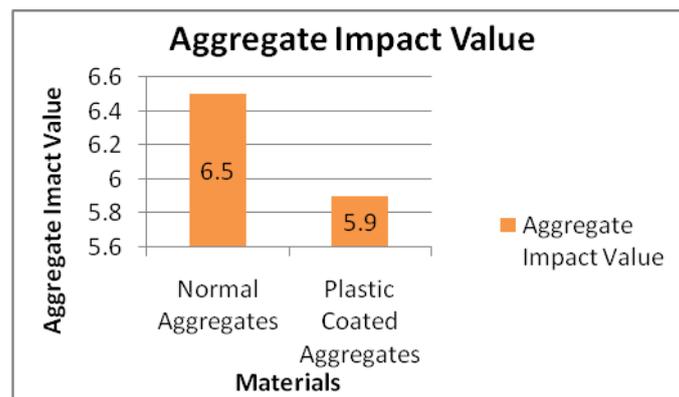


Chart -3: Aggregate Impact Value

Test result- Penetration Value:-

Sr. No	Penetration Value (mm) Plain Bitumen	Penetration Value (mm) Modified Bitumen (10% Plastic Replaced)
1	65	36

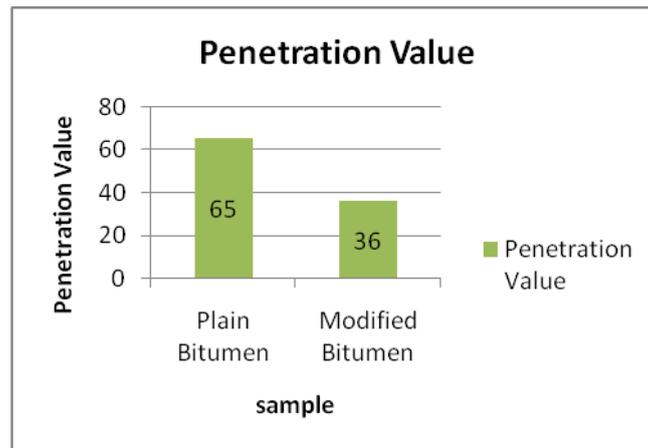


Chart -4: Penetration test Value

Test Result- Softening point Test

Sr.No	Softening point(°C) (plain bitumen)	Softening point(°C) 10% bitumen replaced by plastic
1	62	71.1

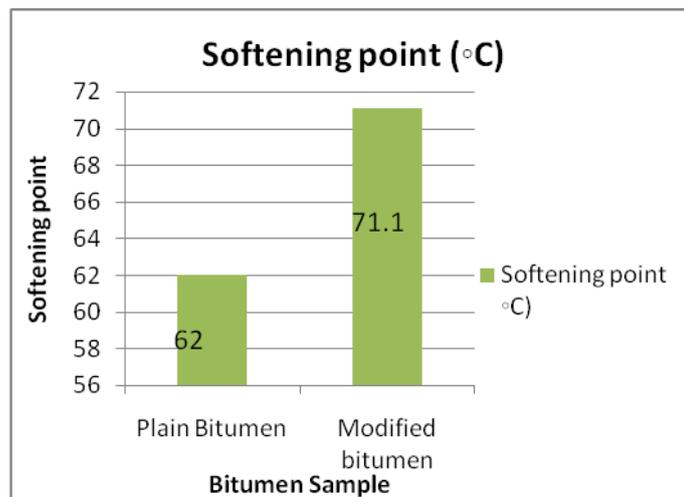


Chart -5: Softening Point Value

7. CONCLUSION

Polymer coating on the overall surface has many benefits and ultimately helps to improve the quality of flexible paving. Total aggregate plastic coating also improves overall quality. Plastic pavements can withstand heavy traffic and are more durable than flexible pavements. The use of plastic mix will reduce the bitumen content by 10% and increase the strength and efficiency of the road. The use of modified bitumen in addition to processed waste plastics by about 5-10% by weight of bitumen helps to greatly improve the strength, fatigue life and other desirable properties of bituminous concrete mixes, thereby improving longevity and paving performance savings in bitumen use.

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