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# REVIEW ON LABORATORY INVESTIGATION OF DENSE BITUMINOUS MACADAM MIX USING GRANITE POWDER AND WAST PLASTIC BOTTLE PIECES AS ADDITIVES

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***Abstract—This article reviews current research into the effects of Granite Powder And Small Pieces of Waste Bottles on bituminous mixtures. Bituminous mixtures are most regularly used global. Day by day, the economic costs of bitumen and the lack of accessibility of ordinary material resources increase. For this reason, the possibility was discovered of locally available waste material such as Granite Powder, fly ash, lime, fibers, ceramic waste, silica fumes, slag, Small Pieces of Waste Bottles plastic, etc. to discover. Granite Powder And Small Pieces of Waste plastic Bottles (Polyethylene Terephthalate(PET)) are by-products that cause excessive environmental hazards, damage to the land and the environment in which it is disposed of. To solve this problem, a laboratory evaluation of the mechanical performance of Dense Bituminous Macadam mixtures using Granite Powder and Small Pieces of Waste plastic Bottles as a partial replacement of fillers is carried out here. In this experimental study, the Marshall Stability Test was considered to be a design and evaluation of bituminous pavement mixtures. The mechanical properties of these two materials are tested, whether or not it is advantageous for the bituminous paving mixes***

***Keywords— Dense Bituminous Macadam, Marshall Parameters, Granite Powder, Small Pieces of Waste plastic Bottles, Environment.***

## I. INTRODUCTION

Dense Bituminous Macadam mixtures is the most commonly used paving material due to its construction. The ever-increasing economic costs and the lack of availability of natural material have opened the possibility to explore locally available waste material. When industrial waste materials are properly used in road construction, the problems of pollution and disposal can be partially reduced. to go, and make the material less stable by allowing it to shift under changing pressure, temperature and moisture condition. Improving an in situ soil engineering properties is referred to as either soil modification or soil stabilization. The term modification implies a minor change in the properties of soil, while stabilization means that thethat the engineering properties of the soil have been changed enough to allow field construction to take place.

As stated, the ceramic industry of India, which consists of sanitary ceramics, wall and floor tiles, tiles and bricks, Granite ceramic materials and refractory materials for household and other purposes, produces about 17 to 35 tons of waste per year. The state of Gujarat is responsible for about 71% of the cost of production of production in India, and 31% of the total production of open space.

The benefits of using Granite powder in highway construction as mineral filler are:

- Economic cost is zero.
- Mechanical and chemical properties will be steady.
- Road construction activity approaches to become green.
- Hard, durable and highly resistant to chemical, biological and physical degradation forces.

The use of Granite Powder is potential advantageous in road pavement. Small Pieces of Waste plastic Bottles is a light white color. it is a by product of Waste plastic Bottles bring from combustion of Acids- concentrated Acids – dilute , Alcohols, Greases and Oils, Halogens, Ketones etc Good chemical Resistance . The mostly rice production in U.S.A and Europe. Waste plastics, littered both by domestic and industrial sectors was found to be a source of raw material for the flexible pavement. The use of plastics in India is hoped to reach 12 million tonnes by the end of 2010. Around 55% is being used for packing. They are mostly littered after their use. The littered plastics, a non biodegradable material, get mixed with domestic waste and make the disposal of municipal solid waste difficult. The municipal solid waste is either incinerated or used for land filling.

In today's world too many researchers taken interest into waste materials and byproduct material coming from the industries, refineries, factory etc. in India Punjab, Haryana, Andhra Pradesh etc. produce bigger rice factories. in construction industry was taken the interest towards the waste material that is similar content of pozzolanic material from industry and biomass such as a Granite powder because of that reason demand of byproduct material increasing in India. a technique to use The Granite powder and waste plastics for the construction of asphalt pavement that gives the positive impact on towards the environment.

## II. MATERIALS

**Granite Powder—**Granite powder can be used in bitumen to improve its strength and other durability factors. It is predictable that 17 to 31% wastes are produced of total raw material utilized. In India Ganite Powder found in himmatnagar, Lucknow, Morbi region. Specific gravity of ceramic waste powder is 2.30 and water absorption is 2.40%. ceramic waste powder with the chemical properties presented in Table1 has been used in this study.

**Chemical Properties—**The Table1 below provides the chemical properties of these ceramic Waste Powder

**Table.1:-** Chemical Properties of Granite powder powder.

| Particular materials | Ceramic Powder (%) |
|---|---|
| Silica(SiO2) | 7077% |
| Alumina(Al2O3) | 11 14% |
| Potassium Oxide(P2O5) | 3 – 5% |
| Soda(Na2O) | 3 – 5% |
| Lime | 1.00% |
| Iron(Fe2O3) | 12% |
| Iron(FeO) | 1 – 3% |
| Magnesia(Mg0) | 5 – 1% |
| Titina | Less than 1%(.38%) |
| Water(H2O) | 0.03% |

**Physical Properties**—The Table2 below provides the Physical properties of these Granite powder

**Table.2:-** Physical Properties of Granite powder.

| Particular | Properties |
|---|---|
| Colour | White |
| Shape texture | Irregular |
| Minerology | Non crystalline |
| Particle size | <45 micron |
| Odour | Odourless |
| specific gravity | 2.3 |
| Appereance | Very fine |

**Waste Bottle—** Plastic is everywhere in today's lifestyle. It is used for packaging, protecting, serving, and even disposing of all kinds of consumer goods. With the industrial revolution, mass production of goods started and plastic seemed to be a cheaper and effective raw material. Today, every vital sector of the economy starting from agriculture to packaging, automobile, building construction, communication or info tech has been virtually revolutionized by the applications of plastics. Use of this non-biodegradable (according to recent studies, plastics can stay unchanged for as long as4500 years on earth) product is growing rapidly and the problem is what to do with plastic- waste. Studies have linked the improper disposal of plastic to problems as distant as breast cancer, reproductive problems in humans and animals, genital abnormalities and even a decline in human sperm count and quality. If a ban is put on the use of plastics on emotional grounds, the real cost would be much higher, the inconvenience much more, the chances of damage or contamination much greater. The risks to the family health and safety would increase and, above all the environmental burden would be manifold. Hence the question is not 'plastics vs no plastics' but it is more concerned with the judicious use and re-use of plastic-waste.

**Chemical Properties—**The Table3 below provides the chemical properties of these Waste Bottle , And Small Pieces of Waste Bottles Polyethylene Terephthalate (PET)**.**

**Table.3:-**Chemical properties of Waste Bottle , And Small Pieces of Waste Bottles Polyethylene Terephthalate (PET).

| Materials | chemical Resistance |
|---|---|
| Acids- concentrated | Good |
| Acids – dilute | Good |
| Alcohols | Good |

| | |
|---|---|
| Alkalis | Poor |
| Aromatic hydrocarbons | Fair |
| Greases and Oils | Good |
| Halogens | Good |
| Ketones | Good |

**Physical Properties—**The Table4 below provides the Physical properties of these Waste Bottle, And Small Pieces of Waste Bottles Polyethylene Terephthalate (PET).

**Table.4:-**Physical properties of properties of these Waste Bottle, And Small Pieces of Waste Bottles Polyethylene Terephthalate (PET).

| Particularas | properties |
|---|---|
| Density ( $g.cm^{-3}$ ) | 1.3 - 1.4 |
| Flammability | Self Extinguishing |
| Limiting oxygen index ( % ) | 21 |
| Refractive index | 1.58 - 1.64 |
| Resistance to Ultra-violet | Good |
| Water absorption - equilibrium ( % ) | <0.7 |
| Water absorption - over 24 hours ( % ) | 0.1 |

**OBJECTIVES—**A laboratory evaluation of the mechanical performance of Dence Bituminous Macadam mixes using Granite powder and Small Pieces of Waste Bottles as a Partial replacement of filler material.

**Sub Objectives: -**Study of Marshall properties of mixes using Granite powder and Small Pieces of Waste Bottles.
o Dence Bituminous Macadam containing Granite powder.
o Dence Bituminous Macadam containing Small Pieces of Waste Bottles.
- To evaluate the optimum requirement for mineral filler as well as specified in the MORTH Dence Bituminous Macadam mixture.
- Evaluation of Dence Bituminous Macadam mixes using parameter like voids in mix (VIM), void filled by bitumen (VFB), voids in mineral aggregate (VMA).

## III. LITERATURE REVIEW

**Amir Modarres ,Hamidreza Hamedi [1]** Addition of more than 2% PET reduced the resilient modulus at both testing temperatures of 5 and 20 C. However, at all PET contents the resilient modulus quantities were in acceptable limit. At 20 C PET and SBS (styrene butadiene styrene) had similar effects on the stiffness of studied mixes. However, at 5 C, SBS reduced the mix stiffness. The later outcome is ideal because it improves the material flexibility at low temperatures. Both additives improved the fatigue response of studied mixes. Anyway, SBS modified mixes showed to some extent better fatigue behavior than PET modified mixes especially at higher strain levels of 200 microstrain.

**Baoshan Huang , Qiao Dong, Edwin G. Burdette[2]** did work on Laboratory tests were conducted to evaluate the feasibility of incorporating fired ware scrap, a waste ceramic material from automobile manufacturing, into pavement material. In this study, crushed fired ware scraps were added into Portland cement concrete (PCC) and hot-mix asphalt (HMA) to replace fine aggregates. The results of this study indicated that the fired ware scraps can be potentially used in the Portland cement concrete and HMA mixture. The compressive strength of PCC was improved by adding crushed scrap.

**Esmaeil Ahmadinia , Majid Zargar, Mohamed Rehan Karim, Mahrez Abdelaziz, Payam Shafigh[3]** did work on waste polymers. The main purpose of this research is to determine the effect of incorporating waste plastic bottles (Polyethylene Terephthalate (PET)) on the engineering properties of stone mastic asphalt (SMA) mixture. The volumetric and mechanical properties of asphalt mixes that include various percentages of PET (0%, 2%, 4%, 6%, 8% and 10%) were calculated and assessed with laboratory tests. The appropriate amount of PET was found to be 6% by weight of bitumen. The outcomes were statistically analysed and the determination of the significance at certain confidence limits was performed with the two factor variance analysis. The results show that the addition of PET has a significant positive effect on the properties of SMA and it can promote the re-use of waste material in industry in an environmentally friendly and economical way.

**H.T. Tai Nguyen, T. Nhan Tran [4]** did work on In this paper two fillers was used one is rubber powder from waste tires and another one is crumb rubber. Samples were prepared in different content and followed by Marshall stability test. minimize the hazardous effect in surrounding area by using crumb rubber.

**Hu seyin Akbulut, Cahit Gurer [5]** did work on More than 95% of asphalt pavement materials (by weight) consist of aggregates. The highway and construction industries consume a huge amount of aggregates annually causing considerable energy and environmental losses. The aggregates are usually produced from neigh borhood aggregate quarries or from natural aggregate sources. As a result of the increasing demands for new aggregate quarries, the general texture of earth's surface has been steadily deteriorating, causing environmental concerns.

**Imran M. Khan, Shahid Kabir, Majed A. Alhussain, Feras F. Almansoor [6]** did work on The seasonal change in temperature and loading nature has a significant effect on asphalt behavior because of its viscoelastic nature. Several types of flexible pavement failure/distress occur due to this behavior of asphalt binder, among which rutting and fatigue cracks are very common. In this study, Low Density and High Density Polyethylene and Crumb rubber were used as additions to base bitumen. Complex modulus (G*) and phase angle (δ) obtained from Dynamic Shear Rheometer (DSR) are the basic perimeters used to evaluate the behavior of the binder in respect to rutting and fatigue cracking.

**Kashif Ahmeda,Muhammad Irfana,Sarfraz Ahmeda, Arsalan Ahmeda[7]** did work on Rutting is a common phenomenon on pavements in Pakistan. Resilient modulus is one the important properties used in the mechanistic analysis of pavement response under dynamic traffic loads as well as used to study the rutting behavior of pavement. The analysis of experimental results revealed that both the strength and stiffness values for Polymer Modified Bitumen grade were greater than that of unmodified penetration grade bitumen.

**Lilies Widojokoa, P. Eliza Purnamasari[8]** did work on This paper is concerned with the possibility of using plastic bottle waste as an ingredient to the Asphaltic Concrete Wearing Course (AC-WC). This research is explores the effect of adding plastic and cement as ingredient to the mixture of asphalt concrete on the characteristics of Marshall. Plastics that are added are 2:4 and are 6% in weight. It was observed that the optimum bitumen content on the addition of 4% plastic and Marshall stability increases by 19% compared to the AC-WC without addition of plastic. The positive effect of plastic bottle on the characteristics of Marshall, along with its environmental advantages, make this material a feasible additive.

**Niyazi U ur Koçkala, Sevil Köftecib[9]** did work on Flexible highway pavement consists of mainly aggregate and bitumen, besides, in order to improve performance, some organic and/or inorganic additives are also utilized as additional constituents in the hot mix asphalt (HMA). By improving performance, positive characteristics can be gained to the HMA such as high strength, durability, toughness, suitable flexibility and resistance to impact. In this study, an attempt has been made to minimize deterioration due to the damage given by different aggressive environmental conditions.

**Olumide Moses Ogundipe[10]** did work on The study looks at the Marshall properties of asphalt mixtures with crushed stone dust and hydrated lime as filler. It was found that the optimum bitumen contentfor both mixtures is 6.5%. The asphalt mixture with hydrated lime had slightly greater stability than the mixture with crushed stone dust.

**Raja Mistrya , Tapas Kumar Royba[11]** presented a paper on This study investigates the effect of using fly ash (FA) in asphalt mixture as replace-ment of common filler. In this experimental work Marshall parameters, the addition of Fly Ash up to 4% in DBM mix, by replacing conventional mineral filler like hydrated lime shows a 7.5% reduction in OBC compared to the control mix, which may provides a considerable economy of bitumen in resulting mixture.

**R. Vasudevan, A. Ramalinga Chandra Sekar a,Sundarakannan a, R. Velkennedy[12]** did work on Waste plastics, littered both by domestic and industrial sectors was found to be a source of raw material for the flexible pavement. Waste plastics, mainly used for packing are made up of PE, PP and PS, their softening point varies between 110 _C and 140 _C and they do not produce any toxic gases during softening. The sample showed higher Marshall Stability value in the range of 18–20 kN and the load bearing capacity of the road is increased by 100% and there is no pothole formation.

**Sevil Kofteci Mansor Nazary[13]** did work on In this study, some properties of asphalt mixture containing Granite powder, marble and redbrick as recycled waste materials were investigated. Because of the low strength, recycled waste materials were used onlyas fine aggregate and filler. The mechanical properties were evaluated by leading Marshall Stability. The results indicated marble mixture exhibited better performance than other mixtures. In addition, from asphalt mastic test results, ceramic asphalt mastic showed the superiority of high and low-temperature properties.

**Shubham Bansal,Anil Kumar Misra , Purnima Bajpai[14]** presented a paper on Information was about various type of tests done and followed by Marshall method. waste plastic modification had positive influences on the Marshall stability.

**Suched Likitlersuang Thanakorn Chompoorat [15]** did work on The influence of filler materials on volumetric and mechanical performances of asphalt concrete was investigated in this study. The AC60/70 asphalt binder incorporating with cement and fly ash as filler materials was mixed with limestone following the Marshall mix design method. The filler contents of cement and/or fly ash were varied. The non-filler asphalt concrete mixtures of the AC60/70 and the polymer modified asphalt were prepared for the purpose of comparison.

**Sergii Kishchynskyi, Vasyl Nagaychuk, Artem Bezuglyi[16]** did work on Bitumen is a component of asphalt binder that combines gravel, sand and mineral powder in the Monolith. The conducted research showed that so-called recycled polyethylene resulting from the processing of plastic products (films designed for agricultural works, packaging material etc.) meets these requirements. Recycled polyethylene increases viscosity, cohesive strength and heat resistance of bitumen.

**Serkan Tapkın a, Abdulkadir Cevik b, Un Usar a[17]** did work on This study presents an application of neural networks (NN) for the prediction of Marshall test results for polypropylene (PP) modified asphalt mixtures. PP fibers are used to modify the bituminous binder in order to improve the physical and mechanical properties of the resulting asphaltic mixture. Marshall stability and flow tests were carried out on specimens fabricated with different type of PP fibers and also waste PP at optimum bitumen content. It has been shown that the addition of polypropylene fibers results in the improved Marshall stabilities and Marshall Quotient values, which is a kind of pseudo stiffness.

**S. Saoulaa,b, K. Ait Mokhtarb; S. Haddadib, E. Ghorbelc[18]** did work on The improvement of the characteristics of the road flexible pavements is essential in regard to the growth of the traffics and theincreasingly large performances of the vehicles. This improvement was made possible by the introduction of new methods and processes of modification of the products. In this article, the results of the influence of the modification of a bituminous concrete on its mechanical behaviour have been presented, using laboratory tests by the addition of EVA (Acetate of vinyl and ethylene) and of EVA-waste (waste of sole of shoes).

**Utibe j. Nkanga , Johnson A.joseph Feyisayo v. adams ,Obioma v.uche[19]** did work on In this fired ware scrap used instead of fine aggregate in Hot Mix Asphalt(HMA). also, as a filler material from waste plastic used and recommended to use 5%,10% and 15% as a filler in HMA surface mixture.

**Umadevi Rongali a, Gagandeep Singh b, Anita Chourasiya , Dr.P.K.Jain[20]** did work on Fly Ash (FA) and Plastic Waste (PW) are two abundantly available waste materials, with several good characteristics, making them suitable for bituminous road construction. The plastic waste will improve some properties of the bituminous mix and also solve environmental problems.

## IV. CONCLUSION

From the above research paper, we can conclude that by adding 0.25% Granite powder instead of lime powder as a filler in Dence Bituminous Macadam mixes improve the Marshall stability value and flow value. In addition of replace the Small Pieces of Waste Bottles Polyethylene Terephthalate (PET).as a 1 % as a filler can give better strength in flexible pavement condition. Also, we say that rice husk ash can efficiently be used as filler in paving mixes in place of most commonly used filler such as stone dust. rice husk as fillers in paving mixes partly solve the solid waste disposal problem of the environment..

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