AN EXPERIMENTAL STUDY OF UTILIZATION OF MARBLE DUST ON PAVEMENT ASPHALTIC CONCRETE

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Abstract: Pavement is a durable coating laid in the targeted area to support vehicles or pedestrians. In the past, widespread use of cobblestones and granite was made, but now these surfaces are mostly replaced by asphalt or concrete. Road surfaces are regularly marked to guide vehicular traffic. Fillers modify the properties, accelerate the performance, and offer greater durability to composites, polymers, rubber, adhesives, coatings and building materials (such as concrete and asphalt). Fillers are used to reduce the cost of materials, increase the stiffness and provide special features to a material (such as colour or fireproof). The effects of fillers are therefore crucial Typical fillers are fine powders having particle size less than 75µm. Fillers can be naturally occurring like calcium carbonate, manufactured or derived from industrial waste such as fly ash from power plant. Other conventional fillers include silica, kaolin, mica, and silica materials. Fillers modify the system in two ways. Firstly, the manner in which shape, particle size and the size distribution of the particles of the filler affect the system by filling the liquid with solid particles. In this study, three varying Percentages of fillers namely Marble dust and Stone Dust (3.5%, 4.5% and 5.5% by weight of total aggregates) in both types of mixes were used along with three varying contents of bitumen (4%, 4.3% and 4.6%).

Keywords: Marble Dust, Road Development, Flow value, Marshall Stability.

1.1 INTRODUCTION

Today industry's transfer of stone waste is one of the ecological issues far and wide. Stones are cut into littler squares so as to give them the ideal shape and size. Amid the way toward cutting, the first stone mass is lost by 30%. The waste is dumped in close-by pits and empty spaces. This prompts genuine ecological contamination a control of tremendous territory of land. So it represents a serious risk on the earth, eco-framework and the wellbeing of the general population. The Quarrying and Trimming waste additionally represents a genuine ecological harm. So it is important to utilize this stone waste in development industry. Reused total of Marble and Granite squander are contained squashed, evaluated inorganic particles prepared from the materials that have been considered as a waste material. Marble handling units produce a tremendous measure of Marble squander amid Marble cutting tasks. This waste is once in a while degradable and causes genuine natural issues. 70% of Marble is squandered in marble enterprises and just 30% is treated as a saleable item. This 30% recuperation causes 70% of weight on our condition. Marble enterprises dump marble squander in open fields or pits which causes water logging issues and lessens porosity of soils. Marble squander expands the alkalinity of soil and results in soil richness issues. Marble stone is utilized as dimensional stone by the marble ventures and is sold by its size as opposed to the weight. These ventures mean to get huge chunks of marble for selling reason however bigger sizes cause more wastage of marble. The conceivable answer for arrangement with issue of marble squander is it's re-use in common works particularly streets in light of the fact that different works don't utilize such enormous measure of waste. The point of this examination is to re-use marble squander as filler material in wearing course to get prudent black-top cement. Exploratory program was led to contrast Marble dust altered blends and ordinary. Blends were additionally exposed to Performance testing for deciding versatile modulus utilizing all inclusive testing Machine. Trial program demonstrated that Marble residue can be proficiently re-utilized as filler material in bituminous streets. The motivation behind this investigation is to assess the utilization of Marble dust as filler in Dense Bituminous Macadam (DBM) layers of black-top asphalt. Marble dust is delivered as squanders amid the forming and cleaning of marble squares and furthermore amid its extraction from mines. Amid extraction, molding and cleaning process almost 25-30% crude marble is changed over into residue/slurry which is a waste.

1.2 LITERATURE REVIEW ON MARBLE DUST

Shafi Ullah et al stated the Re-use S Marble Waste as Filler Substitute in Bituminous Roads. This paper describes the re-use of marble waste as filler material in wearing course of bituminous roads which is the replacement of stone dust. Stone dust is conventionally used as filler by NHA, Pakistan. Modified mixes containing Marble dust as filler were prepared and compared with conventional mixes containing stone dust as filler. Three varying Percentages of fillers namely Marble dust and Stone Dust (3.5%, 4.5% and 5.5% by weight of total aggregates) in both types of mixes were used along with three varying contents of bitumen (4%, 4.3% and 4.6%). Effect of both types of mixes was assessed in terms of Marshal stability and Indirect Tensile fatigue testing and results were discussed. Marshal mix design showed that modified mixes result higher stability as compared to conventional mixes. Increase in stability of modified mixes is due to the fact that Marble dust acts as a bitumen extender. Stone dust absorbs more asphalt content and causes disintegration of aggregate particles by bleeding when temperature exceeds 400C in summer and further compaction by heavy loaded vehicles.

Ishfaq Mohi Ud Din et al contemplated the Influence of Fillers on Paving Grade Bitumen. This examination is about the impact of fillers on clearing grade bitumen under different conditions. The premise of the theory is to discover change in the physical properties of the bitumen by altering it with various fillers. The sorts of fillers utilized in task are Cement, Fly fiery remains and Stone residue. Fillers help in filling the voids and change the physical and substance properties. Fillers change the properties, increment the presentation of, and give improved Durability to different development materials (Such as concrete and black-top). The impacts of fillers are accordingly of essential significance. At the point when bitumen is joined with filler, mastic is shaped. This mastic can be seen as the part of the black-top blend that ties the totals together and furthermore the segment of the black-top that experiences twisting when the asphalt is worried under traffic stacking. The attributes of the filler can essentially impact the properties of the mastic, and along these lines the filler properties can effectsly affect black-top blend execution. Diverse level of fillers is utilized to adjust the bitumen. Different physical tests were led on Virgin and Modified Bitumen to assess its physical properties. Marshall Test was directed on bituminous blend arranged utilizing adjusted and Virgin Bitumen and the outcomes were broke down and thought about. The investigation demonstrated that utilization of fillers improves the physical properties of Bitumen. Further it likewise demonstrated that utilization of fillers improves Marshall Stability and Flow in the bituminous blend.

M. Jovanovich et al stated the devolved samples of bituminous aggregate mixtures having fly ash, cement and lime as a filler with varying percentage of bitumen. After preparing various samples, laboratory investigation was done. The following results were observed: Fly ash as a filler can be used in asphalt mixtures successfully. With the addition of filler, optimum bitumen content was observed to be lower in mixtures for flexible pavements, lower proportion of optimum moisture content is considered better. It leads to fewer voids in sub grade. Thus with the usage of pavement, there will be less settlement.

Konstantin Sobolev et al determined the feasibility of fillers in asphalt concrete was determined. Two different binders were used. These binders were fully blended with filler materials i.e. fly ash, lime and cement .The study result demonstrated that: Rheological properties of the asphalt were greatly improved with the addition of these fillers. Fly ash also appears in improving the aging resistance of mastics With the addition of fillers, compatibility of mixtures was not affected.

A. Zulkati et al worked on influence of mineral filler on mechanical properties HMA. Experimental program was conducted to determine impact of fillers on tensile characteristics of HMA using indirect tensile strength test. Laboratory investigation indicated that performance of HMA is considerably affected by use of mineral fillers because of its affinity property for binder. Use of filler controls the compaction of mixes and moreover bitumen-filler mastic provides thick asphalt films around aggregates particles which increase resistance against weathering and moisture induced damages.

R. Muniandy et al evaluated the influence of nature and size of dust on binder and filler mastic laboratory measured properties. Use of filler with binder in asphalt concrete develops thicker asphalt films around aggregate particles that increase resistance against permanent deformations in HMA concrete. Size of filler passing sieve No.200 has greater influence on HMA properties. AASHTO suggests at least 70% passing by weight through sieve No 200. Laboratory results revealed that filler passing 100% through sieve No. 200 improves the marshal design properties of asphalt mixes.

Cabrera et al found that it is the shapeless glass portion of pounded fuel cinder which is dynamic in the pozzolanic response. Greater part of the examples, tried by him showed undefined glass, aside from mullite, hematite, magnetite, quartz and once in a while gypsum minerals. It has been accounted for that the distinction in the synthetic and mineralogical arrangements and physical properties of pounded fuel slag (PFA) does not impact the quality properties of bond cement mixed with fly cinder.

Freidin did the toughness thinks about on the above mix. Ettringite stage was all the more intently observed since its dependability under different conditions impacts folio solidness. It has been uncovered that restoring in water was more viable than in wet air. Air restored examples increased compressive quality at first amid the primary month. In this way, quality misfortune was seen amid 2-6 months relying upon the level of HCOSFA. Likewise, it is seen that higher rates of high calcium fly slag improved starting compressive quality. In any case, the misfortune in quality drags out upto a half year. It is because of nonstop rot of Aft. Further, it has been seen that the steam restored examples demonstrated less misfortune in quality. It is ascribed to crystallization of Aft at higher temperature.

Debashish Kar et al utilized concrete and stone tidies as filler material in bituminous blend. An examination has been completed in this investigation to explore the utilization of fly slag, a side-effect of a coal based warm power plant in bituminous clearing blends. For examination, regular blends with bond and stone residue have likewise been considered. Marshall Test has been received with the end goal of blend configuration just as assessment of bituminous blends. Other execution tests, for example, aberrant rigidity and held steadiness have likewise been led. It was seen that the blends with fly cinder as filler show marginally substandard properties contrasted with regular blends and full fill the ideal criteria according to details. In this manner, it has been proposed to use fly fiery debris any place open, bringing down the expense of execution, yet in addition to some degree settle the fly powder usage and dumping issues.

Weiping Ma et al examined the pore structure of the low lime fly fiery debris initiated by Ca (OH)2 and CaSO4.2H2O under aqueous treatment. It is discovered that the surface territory of fly powder treated with Ca (OH) 2 at 100° C was 33.4 m2/g, while that of untreated fly fiery debris was just 2.39 m2/g. Additionally, pores of fly fiery remains treated with Ca (OH)2 having radii of 19 Å, expanded with expanding temperature amid warm treatment. The development of calcium silicate with an enormous surface zone controls the pore structures fly fiery debris initiated with Ca (OH) 2.

Manjit Singh et al explored on mix - A (fly fiery remains 40%, lime-20% and calcined phospo-gypsum) and mix - B (fly slag, gypsum, lime and Portland concrete) to think about the impact of restoring temperature. It has been seen that ettringite is the principle hydration item in the two mixes. Higher rate of response was seen at raised temperature. The quality advancement in mix - B is higher than mix - A because of the arrangement of ettringite and tobermorite. The early quality is ascribed to the setting of calcined gypsum and the later quality is because of the arrangement of ettringite and tobermorite.

Bilodeau et.al, the test for the structural designing network soon will be to acknowledge extends in congruity with the idea of practical advancement, and this includes the utilization of j elite materials delivered at sensible expense with the most reduced conceivable natural effect. In 1985, Canada Center for Mineral and Energy Technology (CANMET) built up a solid joining huge volume of fly cinder that has every one of the qualities of elite solid, that is, one that has superb mechanical properties, low porousness, prevalent solidness, and that is naturally cordial.

1.3 EFFECT OF MARBLE DUST ON THE OPTICAL BITUMEN CONTENT

After the determination of optimum bitumen content, Marshall Stability test is performed again by using the marble dust at different percentages of 4 %, 6%, 8 %, 10 % and 12 %.

Table 1: Properties of Marshall Stability test with Marble Dust

Marble Dust (%)	Marshall Density (kg/m^3)	Stability (KN)	Flow Value (mm)	Air Void VA (%)	VMA %
0 %	2.558	15.63	3.43	4.753	14.435
4 %	2.621	16.54	3.54	4.524	13.587
6 %	2.687	18.74	3.61	4.215	13.218
8 %	2.717	19.24	3.68	3.954	12.958
10 %	2.654	20.25	3.71	3.587	12.258
12 %	2.521	17.58	3.84	3.214	11.546

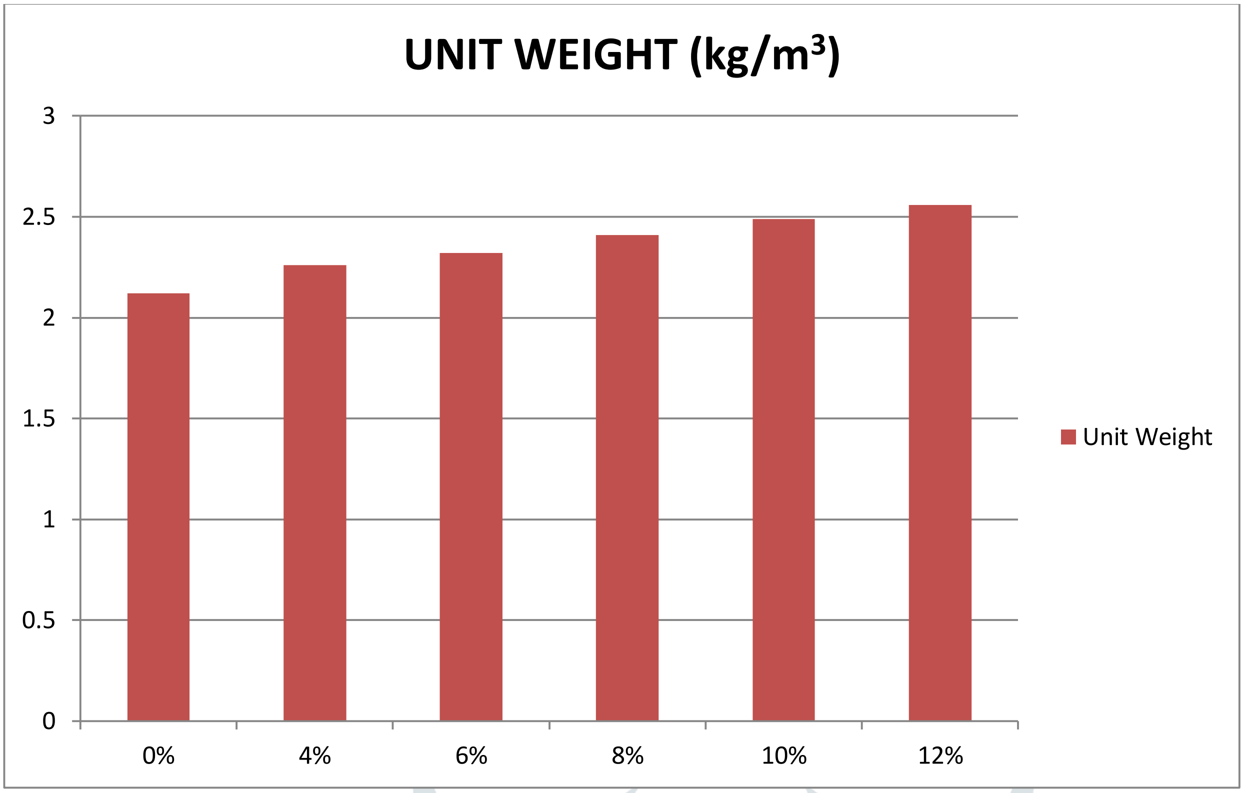

Figure 4.7: Variation of Unit Weight With %age of PET

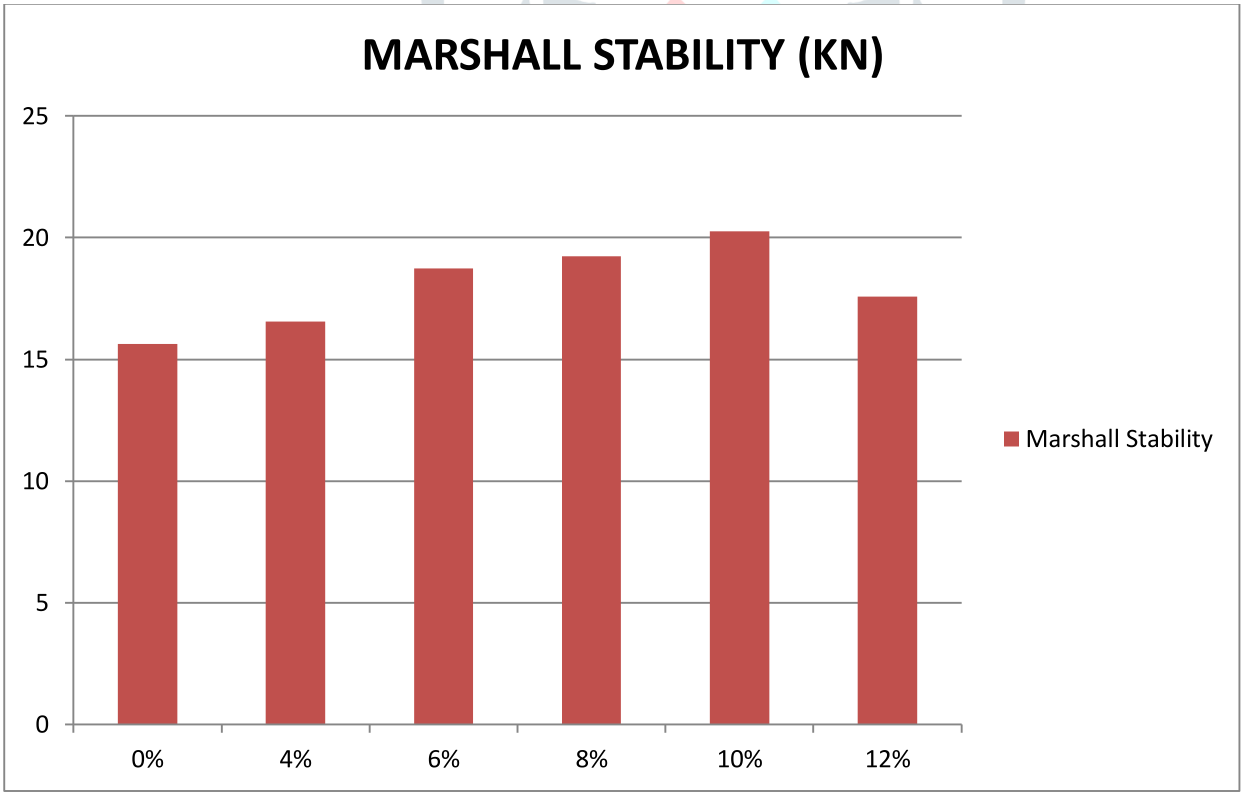

Figure 4.8: Variation of Stability With %age of Bitumen

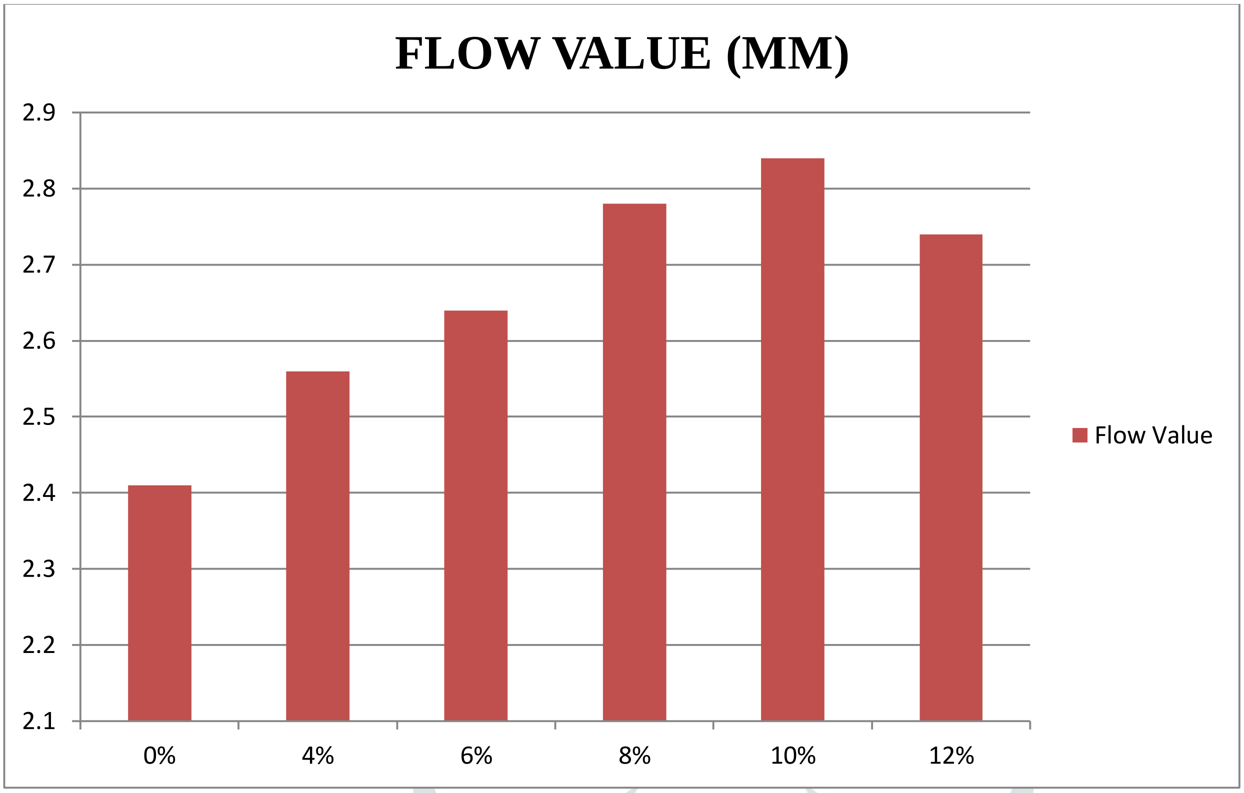

Figure 4.9: Variation of Flow Value With %age of PET

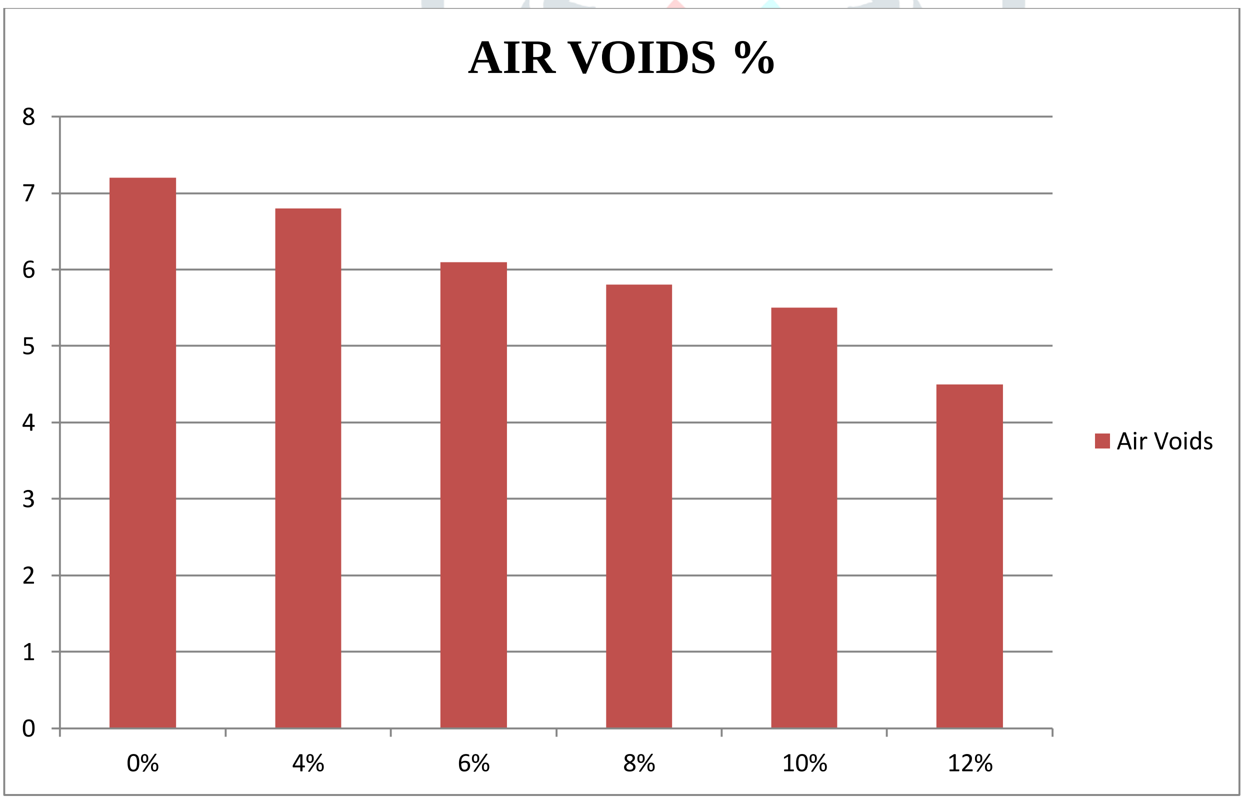

Figure 4.10: Variation of Air Voids With %age of Bitumen

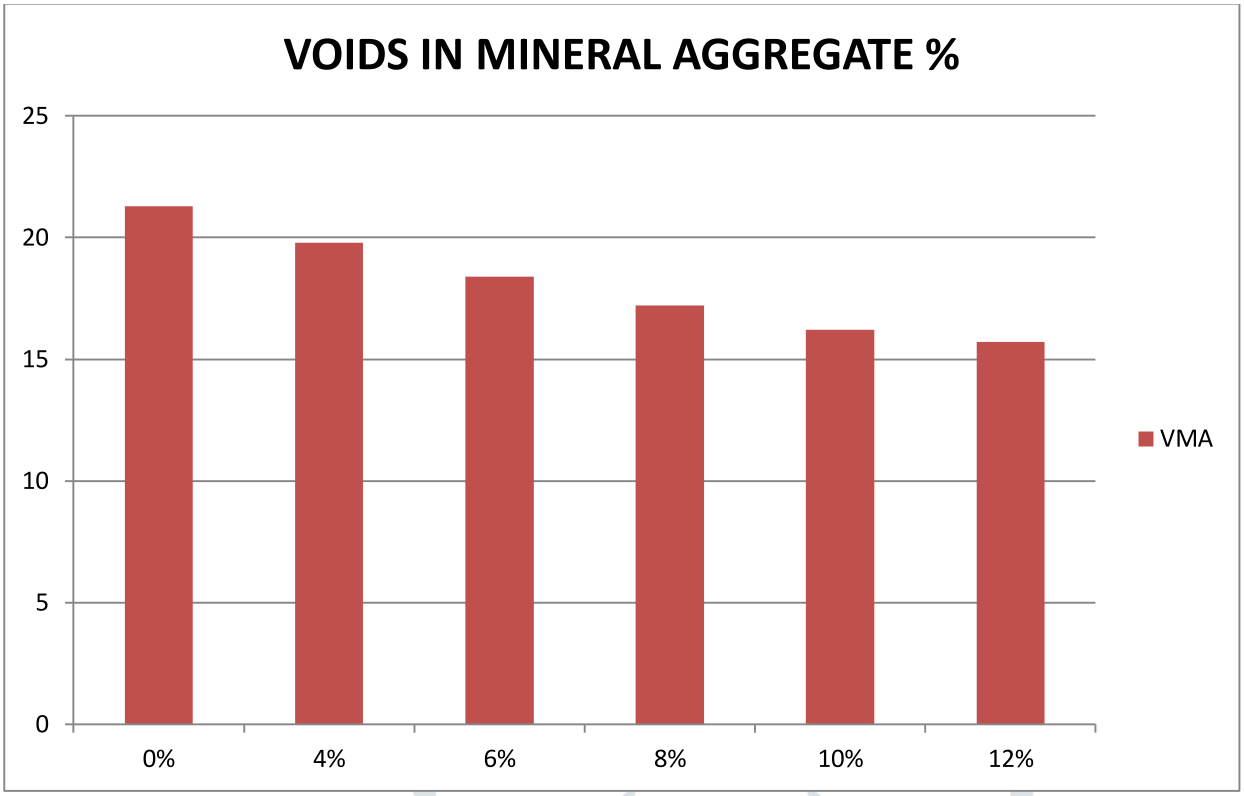

Figure 4.11: Variation of Voids in mineral aggregates with %age of Bitumen

CONCLUSION

Based on the results of the experimental investigations conducted on Virgin and modified bitumen using fillers, the following conclusions have been drawn:

1. Modified bitumen by using Marble Dust show less penetration value, thus low grade bitumen can be modified to withstand higher loads.
2. The Marshall properties of the blend demonstrates that the expansion of marble residue to the black-top cement improved properties than black-top solid blend with stone residue as filler
3. Hence the utilization of marble dust as filler in black-top solid blend is empowering and it tends to be effectively used in bitumen, will give us a progressively efficient and condition cordial asphalt.
4. Bituminous blends containing Marble dust as filler showed most extreme unit weight at 12 % substance of bitumen having an expanding pattern up to 12%.
5. Bituminous blends containing Marble dust as filler showed greatest Marshall Stability at 10 % substance of bitumen having an expanding pattern up to 12%.
6. Bituminous blends containing Marble dust as filler showed Flow Value at 10 % substance of bitumen having an expanding pattern up to 12%.
7. It is discovered that bituminous blends containing 10 % of bitumen substance gives the palatable outcomes The ductility value decreased with the use of Marble Dust as it causes the bitumen to become stiffer.
8. The optimum bitumen content is found as 4.38 % after determination of various Marshall Properties.

9. The Marshall Flow value also increases with the use of fillers and this indicates improvements in the resistance to permanent deformation of bituminous mixes with addition of these fillers.

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