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A Review Paper on partial Replacement of Cement with Waste Marble Dust and Coarse Aggregate with Reclaimed Asphalt Pavement

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ABSTRACT

Concrete is the most significant building material, and it is made up of cement, coarse aggregate, fine aggregate, and the right amount of water. Due to the unacceptably high cost of aggregates used in concrete production, Civil Engineering Researchers all across the globe are working to develop reclaimable and resource-efficient concrete for building. Several environmental issues develop as a result of waste material being deposited on landfills. Alternative waste products, such as waste marble dust, waste glass, fly ash, ceramic powder, e-waste, recovered asphalt pavement, and so on, might be considered to solve such difficulties. This study provides a brief overview of the characteristics of replacing cement with waste marble dust (WMD) and coarse aggregate with recovered asphalt pavement (RAP).

Key Words: Waste marble dust (WMD), Reclaimed asphalt pavement (RAP), Fresh and Hardened concrete properties, Environmental issues, Cement replacement, Coarse aggregate replacement.

INTRODUCTION

Concrete demand is expanding in the modern world as a result of rising human population and urbanisation. Concrete is made up of cement, fine aggregate, coarse aggregate, and a specific amount of water. However, when calcium carbonate is heated in the making of cement, greenhouse gases are released, and other waste materials can be employed to reduce depletion of natural resources. Waste marble dust is one such item (WMD). Similarly, coarse aggregate is derived from natural rocks that are not perennial, necessitating the use of a substitute material. Reclaimed asphalt pavement is one such resource (RAP).

Using RAP aggregates in cement concrete pavement might provide several demographic benefits, and this appears to be a worthwhile option. Its inclusion, however, may taint the structural and functional performance. The presence of asphalt coating and agglomerated particles are the main causes of the overall strength characteristics of RAP aggregates deteriorating. On the margin of the RAP aggregates, dust and an ageing asphalt layer are common. Because of its maturity, the asphalt coating grows harder and stiffer. In order to soften the developed asphalt, reprocessing RAP in flexible pavement construction need a greater quantity of energy. However, for the building of cement concrete pavement, this hardness effect may be preferable.

LITERATURE REVIEW

The literature is based on the replacement of cement and coarse aggregate with Waste Marble Dust (WMD) and Reclaimed Asphalt Pavement (RAP).

REPLACEMENT WITH RAP

R. J.Thomas (2018),the durability of RAP as a partial replacement of coarse aggregate by 0 %, 25%, 30%, 35%, 40 %, 45 %, and 50 % by weight is investigated in this work. This RAP, with a specific gravity of 1.05., was acquired from the Idaho Transportation Department. The findings demonstrates that the compressive strength of RAP-containing concrete dropped by 30-60% for 25-50% replacement. Up to 50% replacement, chloride permeability and coefficient of thermal expansion are unaltered. Whereas, with 25-50 percent RAP replacement, Freeze-Thaw durability was increased compared to concrete with 100 percent virgin coarse aggregate.

Alexander S. Brand (2015),ternary mix concrete is employed in their paper, which has 65 % cement, 25% slag, and 10% fly ash, with fractioned RAP (FRAP) as a partial replacement of 0 %, 20 %, 35 %, and 50 %by weight with coarse aggregate with a specific gravity of 2.59. Slump increases when FRAP content increases, unit weight falls, and air content remains same. RAP-containing concrete has lower compressive strength, split tensile strength, and flexural strength than normal concrete. They also hypothesised that the drop in concrete strength is related to the lower bonding potential between the asphalt and cementitious matrix, based on dynamic modulus tests at various temperatures.

Alexander S. Brand (2016)RAP was utilised as the coarse aggregate, and it was replaced at 0%, 20%, 35%, and 50% by weight. They compared the interfacial transition zone (ITZ) of RAP aggregate-containing mortar to virgin coarse aggregate in their research. They find that ITZ with RAP

aggregate, which is bigger and more porous, has less C-S-H gel and C-H at the asphalt interface than virgin aggregate, indicating that the asphalt layer may be impacting C-H growth to some extent. Simultaneously, the ITZ characteristics of mortar containing RAP aggregate are unaffected by silica fume. The microstructural changes generated by the RAP aggregate, as a result of bigger and more porous ITZ, have been observed, resulting in a loss in concrete strength and modulus.

Surrender Singh (2017), They used the surface treatment methods of attrition and abrasion (AB & AT) to remove the adulterant in their paper. Dirty RAP (DRAP) is RAP that has impurities, whereas ARAP is RAP that has been treated with AB and AT. The specific gravity of DRAP and ARAP is 2.49 and 2.62, respectively. By weight of coarse aggregate, replacements are done at 0 %, 100% (DRAP), 25 %, 50 %, 75 %, and 100% (ARAP). As a consequence of using the AB & AT technique to remove 50% of the asphalt component, the findings reveal robust bonding at the interface of aggregate and hydrated cement matrix. It also detaches the agglomerated particles from the DRAP aggregate to the tune of 77.36 %. In comparison to DRAP, ARAP improves the workability of new concrete. Even when 100 % ARAP is employed, only a 20% drop in mechanical qualities is seen (after 28 days) when compared to normal concrete.ARAP aggregate can be utilised in concrete mixes with a compressive strength of 40 MPa, influencing the durability attributes of hardened concrete

Nabil Hossiney (2016),two separate RAP materials were taken from RAP stock piles at a Gainesville, Florida asphalt facility. 0%, 10%, 20%, and 40% coarse and fine aggregate replacement is done. RAP-1 has a specific gravity of 2.231 and 2.185, whereas RAP-2 has a specific gravity of 2.309 and 2.325 for coarse and fine RAP, respectively. When can be observed, as the RAP content increases, the compressive strength, flexural strength, split tensile strength, and elastic modulus of concrete drop, but the coefficient of thermal expansion and drying shrinkage remain same. When he used fine element analysis to determine the maximum stress in concrete at critical temperature and load conditions, he discovered that when RAP content increases, the maximum stress reduces owing to a decrease in the elastic modulus of concrete.

REPLACEMENT WTH WASTE MARBLE DUST

Shreyas.K (2017), WMD was utilised as a partial substitute at 0 %, 5%, 10%, 15%, and 20% by weight of cement, respectively. The M25 mix has been produced. The results demonstrate that the compressive strength of concrete rises up to a 10% replacement of cement by WMD, then begins to decrease (as compared to normal concrete), leading him to the conclusion that waste marble dust may be utilised as a filler material. It also aids in the improvement of durability qualities and guarantees that mortar and concrete are more cohesive.

OM Ofuyatan (2019), with a constant water cement ratio of 0.5 and a specific gravity of 2.71, waste marble dust was employed as a partial replacement at 0 %, 15%, 25%, and 35% by weight of sand. In comparison to normal concrete mix, the experiment demonstrates that as the amount of marble dust powder increases (up to 25%), the slump value increases (real slump) and then reduces at 35%. Furthermore, at 56 days, the compressive strength of concrete with 25% replacement is larger than standard concrete. As a result, the best percentage replacement of sand by WMD is 25%. Toughness improves when WMD is incorporated into sand, allowing concrete to withstand higher amounts of stress and, as a result, buildings produced with WMD have increased load bearing capability.

G V Vigneshpandian (2017), as a partial replacement for fine aggregate, leftover marble dust was employed. The sand replacement is done at 25%, 50%, and 100% by weight; M30 mix was made with a water-cement ratio of 0.42 and a specific gravity of 2.67 for WMD. The results reveal that the compressive and flexural strength of concrete rises up to 50% sand replacement and then starts to decline in 28 days when compared to ordinary concrete, whereas the tensile strength steadily falls with the addition of WMD. As a result, he thinks that the best proportion of sand for WMD is 50%.

Zahiruddin Siddique (2019), M25 mix was made using discarded marble dust as a partial replacement at 0%, 5 %, 10 %, 15 %, and 20 % by volume of cement. The results demonstrate that as the amount of WMD grows, strength improves, but only up to 10%. Workability likewise reduces as WMD increases. As a result, he finds that the ideal percentage replacement of cement is 10%, and that using WMD reduces cement use.

Gopi R (2017),M30 mix was created as a partial substitute for 0 %, 5 %, 10 %, 15 %, 20 %, and 25 %by weight of cement. The results demonstrate that when concrete is replaced at 15%, compressive strength, tensile strength, and modulus of elasticity improve by 14.53 %, 14.25%, and 7.1% respectively, as compared to ordinary concrete in 7,14, and 28 days. Additionally, the compaction factor increases with an increase in the replacement level up to 15%, then drops.

CONCLUSIONS

From the above papers the following conclusions are made:

•RAP can be utilised to replace coarse aggregate in some cases.

• The best percentage proportionate replacement for RAP is 35%.

•In comparison to concrete manufactured with natural aggregates, the compressive strength of RAP-containing concrete diminishes as the percentage substitution of RAP increases. This is due to a decrease in aggregate and hydrated cement paste bonding.

• The water absorption of RAP-based concrete is lower than that of virgin aggregate-based concrete.

•As the proportion of RAP replacement increases, the concrete slump reduces.

• Up to 50% replacement of RAP aggregate, the coefficient of thermal expansion does not change.

• Furthermore, the split tensile strength and flexural strength of RAP aggregate concrete are lower than those of natural aggregate concrete.

RAP aggregate can be utilised in concrete with medium and low strength.

• In a concrete mix, waste marble dust (WMD) can be utilised to partially replace cement.

• The best percentage proportionate replacement for WMD is 15%.

• Compressive strength rises up to 10% as the proportion of WMD replaced increases, while split tensile and flexural strength increases up to 15%.

• The slump value of WMD-containing concrete increases up to 15%, 25% replacement, and subsequently falls at 35% replacement.

•The presence of WMD improves the longevity of the mortar and guarantees optimal mortar-concrete cohesion.

• In RAP-containing concrete, WMD can be employed as a supplemental cementitious ingredient. Also, because RAP and WMD are waste materials, they lower building costs.

REFRENCES

[1] Alexander S. Brand, J. R. (2015). Ternary Concrete with Fractionated Reclaimed Asphalt. *ACI MATERIALS JOURNAL*.

[2] Alexander S. Brand a, ⇑. (2016). Bonding in cementitious materials with asphalt-coated particles:. *A.S. Brand, J.R. Roesler / Construction and Building Materials* .

[3] K, S. (2017). Impact of Marble Dust on Cement Concrete. *IJSTE - International Journal of Science Technology & Engineering*.

[4] Gopi R, M. K. (2017). Study on Marble Powder as Partial Replacement. *GRD Journals- Global Research and Development Journal for Engineering*.

[5] O M Ofuyatan (2019),1st International Conference on Sustainable Infrastructural Development IOP Conf. Series.

[6] G V Vigneshpandian (2017),IOP Conf. Series: Earth and Environmental Science.

[7] Zahiruddin Siddique (2019),Conference: Proceedings Of The International Conference On Sustainable Materials And Structures For Civil Infrastructures (Smsci2019)

[8] Nabil Hossiney (2016), International Journal of Pavement Research and Technology.

[9] Surender Singh, G.D.R.N. Ransinchung& Praveen Kumar(2017),Feasibility study of RAP aggregates in cement concrete pavements, Road Materials and Pavement Design