# Comparison of Solid Waste Concrete with Conventional Concrete- A Review

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**Abstract-** Concrete industry is largely depends on the natural resources and due to this growing industry the natural resources gradually vanishes, also the sustainability of concrete is under threat. How to balance the economic and environment? Is the biggest challenge for concrete industry. The reduction in the sources of natural sand and the requirement for reduction in the cost of concrete production has arises the increased need to identify substitute material to sand as fine aggregates in the production of concrete. Now it is time to enhance the properties of concrete by replacing basic units of concrete by various wastes such recycled aggregate, waste slag, quarry dust but this material are not suitable for balancing the economic and environment.

In this paper we are trying to increase the compressive strength of concrete by the use Glass powder, Marble Powder & Crumb Rubber powder as partial replacement of fine aggregate in concrete. Fine aggregate are replaced by Glass powder, marble Powder & Crumb Rubber powder as 5%,10%,15% & 20% by weight for M20 Concrete.

Keywordss- Mateials1, Conventional Concrete 2, Glass, Marble& Crumb Rubber Concrete3, Properties4

#### 1. INTRODUCTION

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Concrete is premier construction material across the world and the most widely used in all types of civil engineering works, including infrastructures, low and high-rise buildings, environment protection and local/domestic developments. Modern times require introduction of new construction materials and procedures. One of the ways to create a new material is to reinforce the existing one. For instance, the cost effectiveness and strength properties of reinforced concrete are better than those of plain concrete. These requirements cannot be fulfilled by conventional concrete, as it possesses very low tensile strength, limiting ductility and little resistance to cracking. Internal micro cracks are inherently present in concrete and its poor tensile strength is due to propagation of such micro cracks, eventually leading to brittle micro cracks of concrete. One of the most advanced types of concrete reinforcement is by using crumb rubber particles, marble waste and glass waste as fine aggregates in concrete. The waste from industries is reused and recycled for the specific purpose except the waste from rubber and glass industry and marble from crusher unit.. The glass has properties like elasticity, light weight, vibration absorption capacity, adhesive and impermeable; we can use this waste material in concrete to replace natural aggregates. Also, waste glass and waste marble have property of toughness, strength and durability, we have chosen it to use in concrete mix with some environmental benefits and for the purpose of management of this solid waste too.

# 2. MATERIALS

#### 2.1. Waste Glass Powder

Glass is a transparent material produced by melting a mixture of materials such as silica, soda ash, and CaCO3 at high temperature followed by cooling where solidification occurs without crystallization. Glass is widely used in our lives through manufactured products such as sheet glass, bottles, glassware, and vacuum tubing. Glass is an ideal material for recycling. The use of recycled glass saves lot of energy and the increasing awareness of glass recycling speeds up focus on the use of waste glass with different forms in various fields. One of its significant contributions is the construction field where the waste glass was reused for concrete production. The application of glass in architectural concrete still needs improvement. Several study have shown that waste glass that is crushed and screened is a strong, safe and economical alternative to sand used in concrete. During the last decade, it has been recognized that sheet glass waste is of large volume and is increasing year by year in the shops, construction areas and factories. Using waste glass in the concrete construction sector is advantageous, as the production cost of concrete will go down

Crushed glass, if properly sized and processed, can exhibit characteristics similar to that of gravel or sand. The application of glass reinforced concrete includes precast elements, slabs and pavements on ground, spillways, seismic resistant structures, highway and road, shotcrete in mining etc



Fig:-Glass Powder

#### 2.2 Waste Marble Powder

Waste marble dust is one such material which can be used to replace sand as fine aggregate. The present study is aimed at utilizing Waste marble powder as fine aggregate in concrete, replacing natural sand. Marble is one of the most important materials used in buildings since ancient times, especially for decorative purposes. Marble powder is produced from processing plants during the sawing and polishing of marble blocks and about 25% of the processed marble is turn into powder form. Disposal of the marble powder material from the marble industry is one of the environmental problems worldwide today.

One of the logical means for reduction of the waste marble powder is utilizing them in building industry itself. Some attempts have been made to find and assess the possibilities of using waste marble powder in mortars and concretes and results about strength and workability were compared with control samples of conventional mortar/concrete. The present study investigate the effects of using waste marble dust (WMD) as a fine material on the mechanical properties of the concrete. For this purpose four different series of concrete-mixtures will be prepared by replacing the fine sand with WMD at proportions of 0, 5, 10 and 15% by weight. In order to determine the effect of the WMD with respect to the curing age, standard mechanical properties of concrete are to be analyzed at the curing ages of 7, 14, 28 days.



Fig:- Marble Powder 2.3 Crumb Rubber Powder

Crumb rubber is generated at the time of shredding process of used waste automobile tyres and also in tyre remoulding plants. Use of waste tyre rubber particles in concrete can gives an efficient way of utilizing rubber and by using it in concrete gives better environmental benefits. The waste tyre rubber provides a concrete with good engineering properties by partial replacement of waste tyre crumb rubber particle to the fine aggregate in concrete.

The basic material required in construction of buildings by using concrete are aggregate and cement. In this study, the performance of waste materials crumb rubber as partial replacement for fine aggregates in M20 grade of concrete mix at different 4 percentages and its effect on concrete properties like compressive strength, flexural strength and tensile strength can be investigated. The waste tyre crumb rubber particles can be use to replace fine aggregate in concrete of size passing through 4.75 mm IS sieve and retaining on 600µ IS sieve. The addition of crumbrubber fine aggregate has a significant effect on concrete mix apparent porosity which affects both the plastic state workability and hardened state mechanical properties



Fig:- Crumb Rubber Powder

#### 2.4 Cement

Cement in concrete acts as a binding material that harden after the addition of water. It plays an important role in construction sector. Cement used in the experimental work is Ordinary Portland Cement (OPC 43 GRADE) conforming to IS: 1489 (Part1)-1991 from a single batch will be use for the entire work



Fig:- Cement

# 2.4 Fine Aggregate (Sand)

The material which passed through I.S. Sieve No. 480 (4.75mm)is termed as fine aggregates



Fig:- Fine Aggregate(Sand)

### 2.5 Coarse Aggregate (10 & 20 mm)

Aggregates are the important constituents in concrete. They give body to the concrete, reduce shrinkage and effect economy. One of the most important factors for producing workable concrete is good gradation of aggregates. Good grading implies that a sample fractions of aggregates in required proportion such that the sample contains minimum voids. Samples of the well graded aggregate containing minimum voids require minimum paste to fill up the voids in the aggregates. Minimum paste is mean less quantity of cement and less water, which are further mean increased economy, higher strength, lower shrinkage and greater durability. Thus, For well grading, both 10mm and 20mm Aggregates will be use in the proportion 40% and 60% resp.



Fig:- Coarse Aggregate(10&20mm)

# **3.** Procedure to be adopt

In this paper, we are going to adopt following procedure

- Collecting all ingredients of concrete
- Determining the laboratory properties of ingredients used in concrete.
- Calculation for design mix.
- Casting of conventional concrete cubes as per design mix.
- Casting of marble, glass and rubber concrete cubes as per design mix
- Determining the Compressive strength of concrete.
- Observe the effect of waste marble, waste glass and crumb rubber over con. Concrete.
- Comparison of waste marble, waste glass and crumb rubber concrete with conventional concrete.

# 3.1 Casting of cubes

3.1.1 Casting of Conventional Cubes The cubes having dimensions 150\*150\*150mm will be cast as per design mix for M20 grade of concrete

3.1.2 Casting of Glass, Marble & Crumb Rubber Cubes

The cubes having dimension 150\*150\*150mm with 5%,10%,155 & 20% replacement of Glass powder, marble powder & Crumb rubber powder will be cast as per mix design for M20 grade concrete.

# 4. Properties of Concrete

# 4.1 Workability of Concrete

The Workability of Concrete is determine by using slump cone test. Thus, for each mix the slump cone test done.



# Fig:- Slump Cone apparatus 4.2 Compressive Strength Test

The Compressive strength is the key factor of concrete and In this we are trying to enhance the compressive strength of concrete.

The Compressive strength of concrete can be work out by compressive strength test which is done on compression testing machine.



Fig:- Compression Testing Machine

# 4.3 Moisture Determination Test

In this, the average dry weight of cube specimens after removing from moulds was measured and the average weight of cube specimens after submerging in water for curing was measured at 28 days of age. The percentage of water absorption was measured for each concrete specimen and it gave indirect measure of durability.



Fig:- Weighing Machine

# 5. Literature Review

# 5.1Bouziani Tayeb, Benmounah Abdelbaki, Bederina Madani and Lamara Mohamed

They found that the increase of Marble Powder (MP) content in Self Compacting Sand Concrete, from 150 kg/m3 to 350 kg/m3, improves the properties at fresh state by decreasing v-funnel flow time (from 5s to 1.5s) and increasing the mini-cone slump (from 28cm to 34cm). In other hand, the 28 days compressive strength decreases with an increase of MP content [4]. Marble waste powder from The Ethiopian Marble Processing Enterprise used gives the replacement of Ordinary Portland cement by marble waste powder at 5% replacement range comparable compressive strength with that of 100% ordinary Portland cement. Replacement at 10%, 15% and 20% replacement ranges resulted in compressive strength reduction than that of 100% Ordinary Portland cement. However blended cements with 5 to 15% replacement ranges satisfied the standard of high early strength of class 42.5MPa and blended cements at 20% replacement range satisfied the standard of high early strength of class 32.5MPa as per the EN 197-1 standard. Other properties of marble waste blended cements such as consistency, setting times, insoluble residue, sulphate residue and soundness remained within the acceptable limits of different standards

Generally, in literature waste marble dust has been replaced with either all of the fine aggregate (0 - 4 mm) or passing 1 mm sieve. However, not a single study on the performance of the concrete prepared by replacing very fine sand (passing 0.25 mm sieve) with WMD.[6]Use of marble dust as a fine aggregate in concrete draws serious attention of researchers and investigators. The maximum compressive and flexural strengths were observed for specimens containing a 6% waste sludge when compared with control and it

was also found that waste sludge up to 9% could effectively be used as an additive material in cement. When marble powder is partially replaced in cement by weight, there is a marked reduction in compressive strength values of mortar mix with increasing marble powder content when compared with control sample at each curing age. On increasing marble waste fine aggregate ratio i.e. when marble waste / granules are partially replaced in fine aggregate by weight then there is increase in compressive strength values of marble waste mortar at each curing age. Degree of workability is medium conforming to IS: 456 - 2000. The mean strength of all concrete mixes with marble granules was 510% higher than the references concrete conforming to IS: 456 2000. The flexural strength of waste marble mix concrete increases with the increase of the waste marble ratio in these mixtures. They concluded that the marble dust can be used as a replacement for cement. Test results indicate that the 10% of marble dust in the cement concrete gives the best results. And also increase in curing days will increase the strength of marble dust concrete when compared from 14 days to 28 days

# 5.2 T.Subramani, S.B.Sankar Ram

Glass is used in many forms in day-to-day life. It has limited life span and after use it is either stock piled or sent to landfills. Since glass is non-biodegradable, landfills do not provide an environment friendly solution. Hence, there is strong need to utilize waste glasses. Many efforts have been made to use waste glass in concrete industry as a replacement of coarse aggregate, fine aggregate and cement. Its performance as a coarse aggregate replacement has been found to be non-satisfactory because of strength regression and expansion due to alkali-silica reaction. The research shows that there is strength loss due to fine aggregate substitution also. Efforts have been made in the concrete industry to use waste glass as partial replacement of coarse or fine aggregates and cement. In this study, finely powdered waste glasses are used as a partial replacement of cement in concrete and compared it with conventional concrete. This work examines the possibility of using Glass powder as a partial replacement of cement for new concrete. Glass powder was partially replaced as 10%, 20%, 30% and 40% and tested for its compressive, Tensile and flexural strength up to 28 days of age and were compared with those of conventional concrete; from the results obtained, it is found that glass powder can be used as cement replacement material up to particle size less than 75µm to prevent alkali silica reaction

#### 5.3M. Iqbal Malik, Muzafar Bashir, Sajad Ahmad, Tabish Tariq, Umar Chowdhary

The using of waste glass as fine aggregate in concrete creates a problem in concrete due to ASR (Alkali Silica Reaction). The reaction between alkalis in

Portland cement and silica in aggregates forms silica gel. This gel is prone to swelling. It absorbs water and the volume of the gel increases. Under confinement by cement matrix and aggregate, the swelling of the ASR gel generates hydrostatic pressure. If the reaction continues and internal pressure exceeds the tensile strength of the matrix, cracks will form around the reactive aggregate particles. Ground waste glass was used as fine aggregate in concrete and no reaction was detected with fine particle size, thus indicating the feasibility of the waste glass reuse as fine aggregate in concrete. In addition, waste glass seemed to positively contribute to the mortar micro-structural properties resulting in an evident improvement of its mechanical performance.Larger the particle size of waste glass more is the chance of ASR occurrence. Shayan and Xu reported fine glass powder for incorporation into concrete up to 30% as a pozzolanic material suppressed the ASR .Hence the size of waste glass used was in the range 0-1.18mm.

# 6. Conclusions

From our study and this above literature reviews following conclusions can be drawn

- The 28 days compressive strength for concrete with Glass and Marble is increased
- The 28 days compressive strength for concrete with crumb rubber powder is decreased
- The Marble powder is more suitable than glass powder
- Only 10-15% Glass powder can be replaced
- The Crumb Rubber is not suitable for replacing

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