

# Review Paper on Partial Replacement of Cement with Various industrial Waste Materials

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**ABSTRACT-** The main concept of this paper is to make use of industrial waste into wealth. By adding the by-products like fly ash, metakaolin, lime powder, glass powder, aluminium powder to get eco-friendly cement. The tests were conducted on compressive strength and tensile strength of the concrete has to be done compare with the conventional concrete. If the strengths are high while comparing with the conventional concrete, then the newly made eco-friendly cement is suitable for further construction purposes.

**Keywords:** Industrial waste, concrete, mortar, Compressive strength-flexure strength

## 1. INTRODUCTION

The progress in industrial technology had prompted a significant increment in the amount and types of waste. The issue of waste amassing each year is everywhere throughout the world. The problem of waste accumulation is everywhere throughout the world. By products used are fly ash, slag, glass powder, tires, brick dust, cement, rice husk, silica fume, mineral waste, fiber waste, inorganic solid waste etc. The construction material industry is an area of enthusiasm for utilizing the waste and research has building up different speculations in concordance with feasible condition. The construction materials in the nearness for getting materials or items, for the development of extensions or expressways, soil adjustment, in water powered development, and so forth. Extensive waste stabilization in development is suggested, while particular waste may be too risky to use. The development in the building materials must be sustainable and in the same time they ensure ratio cast energy that satisfy the modern requirements.

## 2. LITERATURE REVIEW

**Development of concrete using industrial waste materials as partial Replacements:** (Lam Tang Van, Dien Vu Kim)[1] developed and studied the strength of concrete using industrial waste like aluminium powder and flyash in addition of cement upto 0.25 % to 1% inclusion of aluminium powder decrease the density of aerated concrete to be less by 32.2% than conventional specimens. They observed that the strength of specimen for flyash 30% accomplished a compressive strength for 28 days 52.7 Mpa

Rana Shabbar, Paul Nedwell and Zhangjian Wu) [2] Investigated that an increase in aluminium content caused a decrease in the compressive strength, tensile strengths and also decrease the modulus of elasticity. At the point aluminium content increased the density of concrete decreased and the porosity increased. They observed that the strength of concrete by using aluminium powder decrease the strength. Guglielmi et al.[3] reported that Al content increased from 0.2 to 0.4% the compressive strength decreased.

Dr. K. Chandra sekharreddy [4] Suggested that combination of aluminium powder & fly ash replacement is fixed as 5%, 10%, and 15% of the cement in the mixture. It is noted that after adding up of aluminium powder there is a gradual decrease in compressive strength and split tensile strength. Combination of flyash (15%) and aluminium powder (0.25%) gives higher compressive strength and split tensile strength.

Wendimu Gudissa and Abebe Dinku [5] studied on the use of limestone powder as an alternative cement replacement material an experimental study. In this paper investigate the limestone powder addition of physical and chemical properties of the cement paste and hardened concrete. The of OPC by fine limestone powder from 5% to 10% with blain fineness value of 4000 to 4500 cm<sup>2</sup>/gm satisfies the standard compressive strength requirement of excessive early strength of 32.5 Mpa as per EN 197-1 standard requirement.

P.Anusuya, K.Sai Ramya [6] based on the experimental investigation the compressive strength of concrete increase as percentage of copper slag increase with 60% and limestone powder increase with 15% and then decreases. The flexural strength of concrete increase as percentage of copper slag increase with 80% and limestone powder increase 15% and then decreases.

P.Meenaksh (2017) studied on partial replacement of cement by barites and lime powder in concrete in this paper design mix is M30 grade of concrete is used. The cement is partial replacement of barites and lime powder as the proportion are 0%, 10%, 20% and 30% have been used the experimental work. The replaced ingredients are increase the compressive strength in early period at 7 days and 14 days also same result obtained. The replacement for concrete not show increase the compressive strength in 28 days.

S.Sudha (2016) studied on durability and strength character of concrete using lime sludge and flyash as partial replacement of fine aggregate in this paper design the concrete mix. The construction use the waste materials like flyash, lime sludge etc.. These materials is very low cost. The cement is replaced by lime sludge and the first-class mixture is replacement by flyash. The percentage of lime sludge are 0%, 5% 10% and 15%. Fly ash are 0% and 5%. To determine the compressive strength, flexural strength and split tensile strength at 7 days and 28 days.

(M. Narmatha and Dr. T. Felixkala)[7] Suggested that the Metakaolin [MK] is a pozzolanic admixture which provides many unique characteristics. Metakaolin is a significant admixture for concrete and cement applications. Generally 8%-20% [by weight] of Portland cement is supplanted by metakaolin. Such a concrete exhibits great engineering properties. The specimen was casted with M60 grade of concrete with 5%, 10%, 15% and 20% substitution levels of metakaolin. The seven day compressive strength varied between 45 and 55MPa. The 28 days compressive strength varied between 61 and 73MPa.

The split tensile strength for MK 10%, 15% and 20% increases in 14.70%, 20.56% and 11.76% respectively. The flexural strength for MK 10%, 15% and 20% increases by 11.11%, 14.28% and 7.94% respectively. The outcome shows that 15% cement substitution by metakaolin is better than all other mixes and are useful in producing high performance. The increase in metakaolin content improves the compressive strength and split tensile strength up to 15% of cement replacement. (Dr. K. Srinivasu, M. L. N Krishna Sai, N. Venkata Kumar)[8] Noted that the concrete is the most broadly used construction material which devours natural materials leading to ecological worries in terms of utilization of raw material and also emissions of CO<sub>2</sub> while producing cement. Replacing cement by pozzolana leads to lower heat of hydration.

Commonly used industrial waste materials are fly ash, base ash and blast furnace slag. Elective cementation materials such as metakaolin, silica fume, steel fibers, quarry dust, wood debris, limestone, calcined clays are of interest in concrete. Kaolinitic clay, widely available in the earth crust treated with heat of 600°C to 800°C prompts to de hydroxylation of the crystalline structure of kaolinite to form metakaolin. High tensile strength was observed at 10% condensate silica fume, 5% MK and 1.5% steel fiber content. Concrete with 8% MK and 1.5% steel fiber are observed with increase of compressive strength by 8.9% and tensile strength by 26.94% and flexural strength by 58.28% in contrast with control concrete mix.

The outcome of using metakaolin in concrete with 25% replacement of cement gave excellent strength results and durability improvement. Water permeability, absorption has upgraded with the use of metakaolin which prompts to increase in density of concrete. Using metakaolin in preparation of acid resistance concrete such as chloride permeability, sulphate resistance exhibited good results.

PragadaRambabu[4] Investigated that the lime concrete, produced by this mix, makes a good base for load bearing walls, columns, or laying under floors since it has a suitable degree of flexibility than regular concrete. In addition it has a specific waterproof property in order to prevent subsoil dampness in floors and walls. Additionally, lime concrete can be made easy and cheap by still providing durable material that opposes weathering, wear and tear. The substitution of cement by lime powder is done from replacements of 0% to 30% in steps of 10% for M20 grade of concrete for keeping constant slump of 60mm. The compressive strength of concrete cubes at age of 7 and 28 days is noted at room temperature. Split tensile strength of concrete are observed at the age of 28 days. From the test results, it is found that the maximum compressive strength and tensile strength are gained only at 30% replacement. These mixtures as a decent replacement for Natural River sand at 30% substitution shows additional strength than control concrete.

(Tarun R Naik and F.ASCE)[23] Concluded that the replacement of Portland cement clinker by limestone filler from 15% - 20% with Blainfiness value of 4000 to 4500 cm<sup>2</sup>/gm satisfies compressive strength of ordinary early strength of 32.5 Mpa.

Hongjian Du and Kiang HweeTan)[9] Shows that at 60% substitution leads to the reduction of water penetration depth by 80% while the compressive strength was maintained at 85%. Using the glass powder as fine aggregates provides higher resistance to chloride penetration in concrete unmistakably the maximum heat evolution rate and the total heat generated decreases continuously with higher OPC substitution level due to the dilution of cement and the slower rate of pozzolanic reaction of GP. In the presence of GP, the time to reach the peak hydration rate is shortened, conceivably on the grounds that the fine glass powders can accelerate the cement hydration by means of adsorption of calcium ions from the liquid phase and play as nucleation and growth sites for C-S-H and other hydrates.

When used as additional cementitious material at 15% , glass powder can obviously reduce the porosity and the pore size distribution. Thus, large increases in compressive strength, resistance to water and chloride penetration were observed. (R. Vandhiyan, K. Ramkumar and R. Ramya)[10] Noted that the cost of concrete and also the consumption of cement; there by directly reduce the CO<sub>2</sub>emission which is related to the production of surface area of finer glass particles; there was increase in the water demand.

When comparing the strength gained and the cement mortar strength gain, it can be inferred that there is an increment of strength even at 15% glass powder substitution. The advantages of this project are that the substitution of glass powder is cement. Also this reduces the cost of making concrete. It shows a small increase in the water demand when the substitution percentage was increased to 10 % and above. This must be due to the fact that it is economically cheap as well as a superior concrete with The usage of waste glass to replace cement could reduce.

### 3. CONCLUSION

Today, we are living in a well developed society having lots of sophisticated facilities. It creates lots of pollution to our daily life using large amount of cement in construction leads to increased CO<sub>2</sub> emission and it causes diseases in people. Therefore, by using the various eco-friendly materials in industries, we can safe guard our environment from disasters. Making use of industrial waste can reduce the generation of wastes by reusing it as a useful material. This creates the pollution free environment.

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