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# REPLACEMENT OF FINE AGGREGATE WITH WASTE STEEL TO IMPROVE THE SLAG STRENGTH OF GEOPOLYMER CONCRETE

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***Abstract***
*The expanded creation of Portland concrete makes incredible concern climate in view of its high carbon impression. Geopolymer concrete is another creation in the realm of cement where concrete is completely supplanted by modern waste and results like fly debris. Geopolymer concrete is climate cordial material for development in view of its decreased carbon impression and furthermore it is observed to be solid. In this review, strength and toughness qualities of geopolymer concrete are contemplated with incomplete substitution of waste steel slag acquired from steel plants. Steel slag is impregnated in fluctuating rates of 5–15% rather than fine total in geopolymer concrete ready with sodium silicate and sodium hydroxide utilized in a proportion of 1.8:2.5, and different properties acquired were investigated.*
***Keywords:*** *Geopolymer, fly ash, steel slag, fine aggregate*

## INTRODUCTION

In environmental aspect, waste from steel industries causes bountiful hazards to the environment and to human health. Geopolymer concrete is a new material that does not need the presence of Portland cement as a binder. Instead, the material such as fly ash (FA) is activated by alkaline liquids to produce the geopolymeric binder. The contribution of cement industry to the $CO_2$ emissions is about 5% of the global $CO_2$ emissions and one ton of $CO_2$ is released in the atmosphere from one ton production of Portland cement [1].

The geopolymer technology is proposed by Davidovits and gives considerable promise for application in concrete industry as an alternative binder to Portland cement. In terms of reducing global warming, geopolymer technology could reduce $CO_2$ emission in to the atmosphere, caused by cement and aggregate industries about 80% [2–5]. The main benefit of geopolymeric cement is reduction in environmental impacts to move toward sustainable development which is defined as the optimum usage with correct and efficient operation of basic and natural resources for providing the requirements of the

future generation. In India, about 2,069,738 thousands of metric ton of $CO_2$ was emitted in the year 2010 [6–8]. Several studies have been carried out to reduce the use of Portland cement in concrete to address global warming issues. These include utilization of supplementary cementing materials such as FA, silica fume, granulated blast furnace slag, rice-husk ash and metakaolin, and the development of alternative binders to Portland cement [9]. The survey shows that total production of FA in the world is about 780 million ton per year after 2010. In India, more than 100 million ton of FA is produced annually, out of which 17–20% FA is utilized either in concrete as a part replacement for cement or workability improving admixture or in stabilization of soil [10].

Geopolymer-based materials are attractive because of their excellent mechanical properties, high early strength, high durability, freeze-thaw resistance, low chloride diffusion rate, abrasion resistance, thermal stability and fire resistance that can be achieved. Due to their lower Ca content, they are more resistant to acid attack than Portland cement-based materials. A further advantage of geopolymers compared to epoxy adhesives is related to their

inorganic silico-aluminate nature, which makes these materials more similar to the concrete support from a chemical and physical point of view. In fact, so far, good mechanical and physical properties of geopolymer composite systems have been obtained by controlling the curing conditions in terms of high temperature and/or controlled pressure [11]. The curing temperature or the temperature at which the initial reaction takes place plays a vital role in the development of strength and can be achieved by curing it above ambient temperature [12]. The utilization of fly ash, especially in concrete production, has significant environmental benefits, viz, improved concrete durability, reduced use of energy, diminished greenhouse gas production, reduced amount of fly ash that has to be disposed in landfills, and saving of the other natural resources and materials.[13] In recent years, the Iron and Steel industry has played a vital role in the development of the country's economy as India has turned out to be the 5th largest producer of crude steel in the world with the total finished steel (alloy + non-alloy) production for sale of 47.30 million tonne (MT) during April – December 2010. India is expected to be the 2nd largest producer by the year 2015-16 .With such pace of development, the industry is also adding up to the industrial solid waste (ferrous + non-ferrous)every year [14] Concrete exposed to marine environment is subjected to several types of aggressive agents: mechanical agents, such as waves and tides, and erosion due to the effects of the waves; chemical attacks due to the action of chlorides present in seawater and sulfates, and climatic agents due to the variations of temperature.[15]

## CONCLUSIONS

- ✓ When compared with conventional geopolymer concrete, the addition of 10% steel slag replacement with fine aggregate increases the compressive strength at 28 days curing.
- ✓ 16 M NaOH and 2.5 silicates to sodium hydroxide ratio gives good result.
- ✓ This is economical than conventional geopolymer concrete.

- ✓ The compressive strength for steel slag geopolymer concrete after doing ambient curing is 85% higher than conventional concrete.
- ✓ The binding property is more efficient in steel slag geopolymer concrete.

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