

Utilisation of Copper Slag as A Partially Replacement of Fine Aggregate in Concrete

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Abstract- Sustainability and resource efficiency are becoming increasing important issues within today's construction industry. Granulated copper slag (or) copper slag which is a by-product of metallurgical operations in Sterlite industries (India) Ltd. For every tone of metal production, about 2.2 ton of waste slag is generated. Dumping or disposal of such large quantities of slag cause environmental and space problems. This study reports the potential use of granulated copper slag from Sterlite Industries as a replacement for sand in concrete mixes. In this project work, the concrete grade M25 was selected and IS method was used for mix design. The properties of the material for cement, fine aggregate, coarse aggregate and copper slag were studied for mix design. The effect of replacing fine aggregate by copper slag on the compressive strength and split tensile strength are attempted in this work. The percentage replacement of sand by granulated copper slag was 0%, 15%, 30%, 40% and 45%. The compressive strength was observed to increase by about 35-40% and split flexure strength by 30-40% and split tensile strength by 30-35%. The experimental investigation showed that percentage replacement of sand by copper slag should be up to 40%.

I. INTRODUCTION

Concrete is a composite material composed of water, coarse granular material (the fine and coarse aggregate or filler) embedded in a hard matrix of material (the cement or binder) that fills the space among the aggregate particles and glues them together. Concrete is widely used for making architectural structures, foundations, brick or block walls, pavements, bridges or overpasses, highways, runways, parking structures, dams, pools/reservoirs, pipes, footings for gates, fences and poles and even boats.

Concrete is used in large quantities almost everywhere mankind needs infrastructure. The amount of concrete used worldwide, ton for ton, is twice that of steel, wood, plastics, and aluminum combined. Concrete's use in the modern world is

exceeded only by that of naturally occurring water. Concrete is also the basis of a large commercial industry. Globally, the ready-mix concrete industry is projected to exceed \$100 billion in revenue by 2015.

In the United States alone, concrete production is a \$30-billion-per-year industry, considering only the value of the ready-mixed concrete sold each year. Given the size of the concrete industry, and the fundamental way concrete is used to shape the infrastructure of the modern world, it is difficult to overstate the role this material plays today. Copper slag is used in the concrete as one of the alternative materials. It is the waste product of copper from Sterilize Industries India Ltd. The safe disposal of this waste is a lack, costly and causes environmental pollution.

The construction industry is the only area where the safe use of waste material (copper slag) is possible. When it is introduced in concrete as a replacement material, it reduces the environmental pollution, space problem and also reduces the cost of concrete. However, further additions of copper slag caused the reduction in the strength due to an increase of the free water content in the mix. Mixes with 80% and 100% copper slag replacement gave the lowest compressive strength value of approximately 80 MPa, which is almost 16% lower than the strength of the control mix.

The results also demonstrated that the surface water absorption decreased as copper slag quantity increases up to 40% replacement; beyond that level of replacement, the absorption rate increases rapidly. Therefore, it is recommended that 40 wt% of copper slag can use as a replacement of sand to obtain HPC with better strength and durability properties.

II. LITERATURE REVIEW

Shanmuganathan et al., 2007 reviewed and mentioned that large amounts of copper slags are

generated as waste worldwide during the copper smelting process. Copper slag can be used in many applications such as concrete, landfills, Ballasts, bituminous pavements, tiles, etc. The characteristics and utilization of copper slag have been reviewed (Gorai et al., 2003). The apprehensions of environmental hazard from the viewpoint of leaching of heavy metals from the slag and its long-term stability in extreme environmental conditions are studied by Shanmuganathan et al., and reported from their sulphuric acid leaching results that the heavy metals present in the slag are very stable and have poor leach ability. They suggested that the slag is safe to be considered for use in a wide variety of applications such as for Portland cement, building materials such as tiles and bituminous pavement constructions. The slag samples are non-toxic and pose no environmental hazard.

R R Chavan & D B Kulkarni (2013) conducted experimental investigations to study the effect of using copper slag as a replacement of fine aggregate on the strength properties and concluded that Maximum Compressive strength of concrete increased by 55% at 40% replacement of fine aggregate by copper slag and flexural strength increased by 14 % for 40 % replacement. Many researchers have investigated worldwide on the possible use of copper slag as a concrete aggregate. Some of the important and published works are reviewed and presented briefly below.

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