Reuse of Steel Slag for Building Products

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Abstract— The exploitation of natural resources is also another environmental issue. Construction industry is the very fast growing industry in developing countries like India. It is obvious that construction industry demands huge amount of sand. Sand mining is another environmental concern. The present demand of sand in the field of construction is not being met. Hence an alternative is required. Steel slag generated as a waste bears the same physical properties as that of the sand and work is carried out to check the scope of it being used as an alternative for sand. As for now even ventures for the use of slag in incorporating in building blocks manufacture are being established. These are mainly near the iron and steel industries. Once studies are conducted, the possibility of its use in all major construction industry products would increase considerably. With this view the investigation has been carried out. It focuses on examining the scope of slag as an alternative to river sand by comparing the physical properties and chemical composition of both, thereby substantiate by some applications of both in construction industry. Products like mortar cubes, bricks, pavers were casted using both sand and slag and the strength of the products are compared. It also shows the benefits from environmental concerns highlighting the importance of reuse of waste slag. And hence it acts as a promoter to waste management as well as resource conservation principles.

Keywords-- Reuse, steel slag, building products

I. INTRODUCTION

The steel slag which was generated in huge quantities from the iron and steel industries in Bellary, Karnataka was the study specimen of the project. This issue of slag is a hot topic as per the environmental concerns. Being dumped in huge quantities, the generators found it difficult handling. Several studies were then conducted on topic of waste steel slag utilization. This slag was to be checked for possibility to include in some useful product, generally in the construction industry. Hence the main objective was to include it in concrete or mortar as replacement to river sand. In addition to solving the issue of dumped waste as well as landfills, due to the replacement of river sand the investigation also helps in reducing natural resource exploitation of river sand.

II. STUDY AREA

The industry identified was a leading manufacturer of cement additives, concrete admixtures and water proofing materials, located in Bangalore rural district.

Some of the main products were concrete admixtures, water proofing agents, high precision grouts, precision engineered mortars, joint sealants, non-shrink, epoxy, anchoring grouts, etc. Thus the studies for incorporating this waste steel slag in one of their products is considered. In view of this, steel slag which was causing a major problem is transformed into useful building products by the concept of reuse.

III. MATERIALS AND METHODS

Mortar cubes were casted by replacing sand with steel slag. The replacements were done in 100 %. For comparison, one set of mortar cubes were made using river sand and the other set of slag. Details of mortar cubes casted: Dimensions: 7 cm x 7 cm x 7 cm Mix proportion: 1:3 FM of sand: 3.24 Sp. Gravity of sand: 2.66 Sp. Gravity of slag: 2.78 Strength test days: 1, 7, and 28 No. of mortar cubes casted using sand: 5 No. of mortar cubes casted using slag: 5 w/c ratio: 0.5. The other product is the non-fired clay bricks. These bricks are made from sand and soil. They are a substitution to the locally available fired bricks which have been in use through generations. Bricks were casted using the Magdhini Press. This consists of a frame where the steel mold is held, several metal plates for transferring the load while pressing, a lever for pressing the mechanism and a counterweight setup. Dimensions of a brick: 230 mm x 110 mm x 72 mm No. of bricks created: 5 Percentage replacements for sand with slag were done of the order of 0 %, 10 %, 20 %, 30 %, 40 % and 100 %. Soil requirement according to ASTM C62-89 a, and IS 1077-1992. Sand content: (70 +/- 5) % Clay content: (10 – 14) % Silt content: 13 % Accordingly the soil used here was sieved through 4.75 mm and removed all organic matter and impurities and already tested with silt content in the laboratory. Sand content: 45 % Silt content: 25 % Clay content: 26 % So in order to meet the specification of the prescribed soil, these quantities were adopted for one brick. Wt. of sand used: 1623 g Wt. of red soil used: 1514 g Wt. of cement used: 273 g Wt. of water used: 410 g Both these sand and soil was free from impurities and sieved through 4.75 mm. Then they were mixed manually and thoroughly in the quantities mentioned above. The mixture was then transferred to the Magdhini Press mold after assembling its units and oiling the mold. Then by pressing the lever with some force for two times the mold comes up. Then once the plates are removed, the unburnt bricks are ready.
The other type of useful product transformed from the waste steel slag was the paver block. This is because it involved the use of fine aggregate as natural river sand. The experimental results on slag also showed good results. Type of mold : rubber Shape of mold : I
Dimensions : 250 mm x 180 mm x 65 mm No. of paver blocks : 6 Mix detail for 1 block Wt. of 6 mm granite aggregate : 3300 g Wt. of river sand : 1150 g Wt. of cement : 500 g Water used : 250 ml Mix detail for color Wt. of 6 mm granite aggregate : 150 g Wt. of river sand : 100 g Wt. of cement : 60 g Wt. of white cement : 36 g Wt. of color : 36 g Percentage replacements of the order 0 %, 25 %, 50 %, 75 % and 100 % of sand by slag were done. All the blocks which were casted were detached from their molds after 24 hours. Then they were cured for 28 days. This was followed by test for compressive strength. Figure 1 shows the compressive strength of mortar cubes using steel slag.

![Compressive stress vs peak load](image)

**Fig.1 Compressive strength of mortar cubes with steel slag**

**IV. CONCLUSIONS**

The steel slag, which is a by-product in iron and steel industries, which is considered as a waste can be considered as a useful raw material in the construction industry. This would bring about a noticeable change in waste management in these industries and hence in the steel scenario around the globe.

Steel slag which was presently considered as a waste product was identified as useful in construction industry. It was proved that it shows similarities with natural river sand after comparing the physical properties and studying the chemical composition. Then some basic building products were identified which used sand as fine aggregate. Those products were created out of this waste slag. Mortar, non-fired clay bricks and paver blocks were casted out of it accordingly strictly based on IS specifications. Then these products were analyzed for their strength requirements as per the standards. Satisfactory results were obtained for slag use in mortar. Excellent results were obtained in slag use in non-fired bricks and paver blocks.

**REFERENCES**


