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To Study the Properties of Concrete with Partial Replacement of Fine Aggregates through Copper Slag and Coarse Aggregates by Recycled Aggregates

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ABSTRACT

Natural resources are depleting worldwide while at the same time the generated wastes from the industry are increasing substantially. The sustainable development for construction involves the use of nonconventional and innovative materials, and recycling of waste materials in order to compensate the lack of natural resources and to find alternative ways conserving the environment. So, this paper presents the results of an experimental investigation carried out to evaluate the mechanical properties of concrete mixtures in which fine aggregate (sand) was replaced with Copper Slag. The fine aggregates (sand) was replaced with percentages 0% (for the control mixture), 10%, 20%, 30%, 40%, 50%, 60%, 80%, and 100% of Copper Slag by weight. Tests were performed for properties of fresh concrete and Hardened Concrete. Compressive strength and Flexural strength were determined at 7, 28 and 56days. The results indicate that workability increases with increase in Copper Slag percentage. Test results indicate significant improvement in the strength properties of plain concrete by the inclusion of up to 80% Copper slag as replacement of fine aggregate (sand), and can be effectively used in structural concrete. Also as percentage of Copper Slag increased the density of concrete increased. The workability of concrete increased with increase in percentage of copper slag. Toughness of copper slag is found to be more, which increases the compressive and flexural strength of concrete.

KEYWORDS: *Copper Slag, Concrete, Compressive strength, Fine Aggregate, Flexural strength, Replacement etc*

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INTRODUCTION

One of the main development elementis concrete comprising of cementitious substances, fine aggregate, coarse aggregate also, water. Presently days the cost of these materials are expanded in this way, we have to analyze an approach to diminish the building materials cost particularly concrete. One of the ongoing headway in development industry is substitution of materials in concrete. The substitution of materials offers cost decrease, vitality funds and security of condition [1].Concrete is one of the real upsets ever of. Many surprising landmarks were manufactured utilizing concrete. Be that as it may, now daily in the present situation the regular assets are being depleted to manufacture the concrete wilderness. Prior to common assets are totally exhausted, it is smarter to pick other elective assets for binder, fine aggregate and coarse aggregate [4].

Green or natural concrete is an idea to utilize ecological accommodating elements in concrete, to form a framework more supportable. The natural concrete is all the time and furthermore shabby to create, on the grounds that for instance, waster items are utilized as a fractional substitute for aggregates and cement, charges for the transfer of waste are maintained a strategic distance from, vitality utilization underway is lower, and toughness is more

noteworthy. This solid ought not to be mistaken for its shading. Waste could be used to deliver new products or could also be used as admixtures with the goal that regular assets are constrained and use more efficiently also the nature is shielded from squander stores. Inorganic remaining items like stone residue, smashed marble squander are utilized as green totals in concrete. This task outlines the different endeavors' in progress to enhance the ecological invitingness of cement to make it appropriate as a "Green Building" material[5].

The Portland Pozzolona cement (PPC) is one of the significant fixings utilized for the arrangement of concrete. Shockingly, generation of cements prompts discharge of a lot of CO_2 gas into the air, a noteworthy benefactor for greenhouse impact and the worldwide warming. Hence it is required either to mission for another material or somewhat supplant it by some other material. Conveying concrete in huge aggregate in assembling plants particularly impacts the greenhouse gasses release [2].

There are numerous elective assets like fly ash, marble powder, GGBS, reused aggregates and so on. In this setting it's smarter to pick the locally accessible materials for substitution [4].

On the other sides, the utilization of sand in development results in exorbitant sand mining which is frightful. Because of quick development in development action, the accessible wellsprings of natural sand are getting depleted. Likewise, great quality sand may must be transported from long separation, which adds to the cost of development. Along these lines, it is important to supplant normal sand in concrete by a substitute material either somewhat or totally without bargaining the quality of concrete [3].

RESEARCH OBJECTIVES

1. To calculate the Optimum content of copper slag in concrete.
2. To find out the values of strength properties like flexural strength, Split tensile strength, and compressive strength of the concrete having recycled aggregates and Copper slag
3. To find out some fresh characteristics of the concrete.

FUTURE SCOPE OF THE STUDY

For further research and further study, copper slag could be used in a form of cement replacing element, and the scope for the same could be analysed extensively in the future. Other wasted resources can also be utilized in concrete.

EXPERIMENTAL WORK

GENERAL

Here in this section, the analysis of outcomes of the different tests discussed in the previous chapter on the concrete sample is done. This analysis depends on the different values of the Split tensile strength and compressive strength test, of the concrete sample consisting of recycled coarse aggregates and Copper slag.

WORKABILITY OF CONCRETE

The workability of the concrete mix was measured by slump test. The slump test was used to measure the workability of concrete. The slump va1ues are provided in table 4.l.

Table: Workability of Concrete

Designation	Mix	Slump in mm
M-0	Control	62
M-1	10 % CS	59
M-2	20 % CS	58
M-3	30 % CS	54
M-4	10 % RCA	60
M-5	20 % RCA	59
M-6	30 % RCA	57
M-7	10 % CS + 10 % RCA	58
M-8	10 % CS + 20 % RCA	54
M-9	10 % CS + 30 % RCA	49
M-10	20 % CS + 10 % RCA	54
M-11	20 % CS + 20 % RCA	52
M-12	20 % CS + 30 % RCA	46
M-13	30 % CS + 10 % RCA	51
M-14	30 % CS + 20 % RCA	48
M-15	30 % CS + 30 % RCA	42

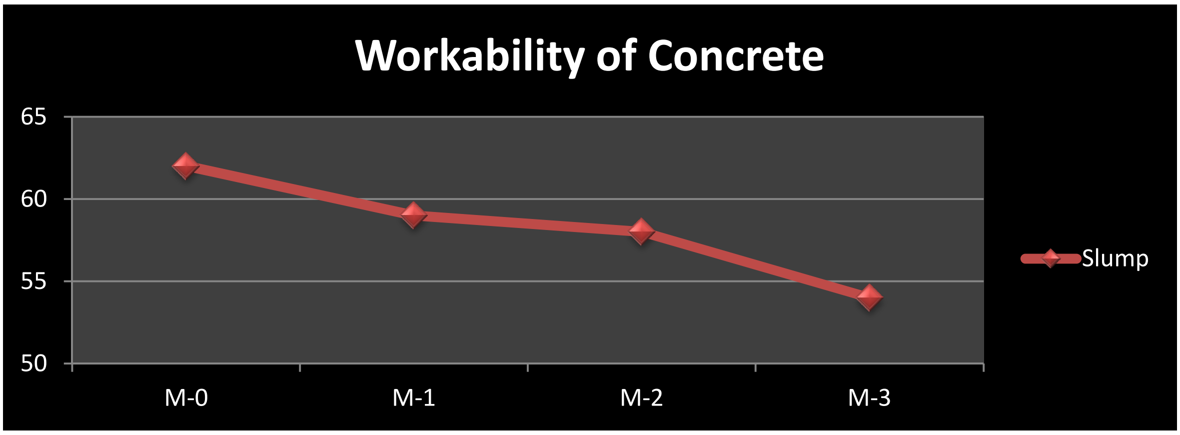

Figure: Workability of Concrete by using Copper Slag only

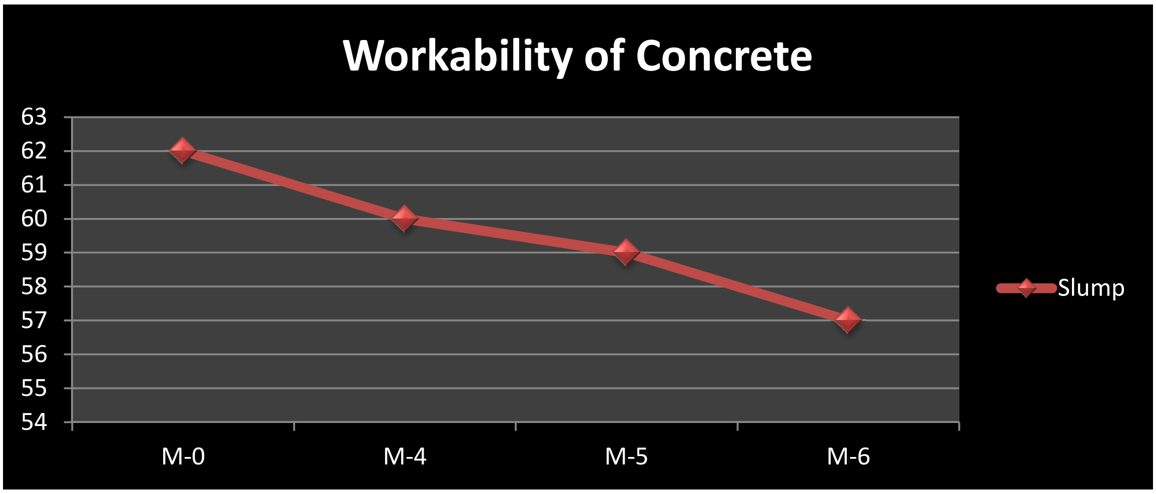

Figure: Workability of Concrete by using recycled aggregates only

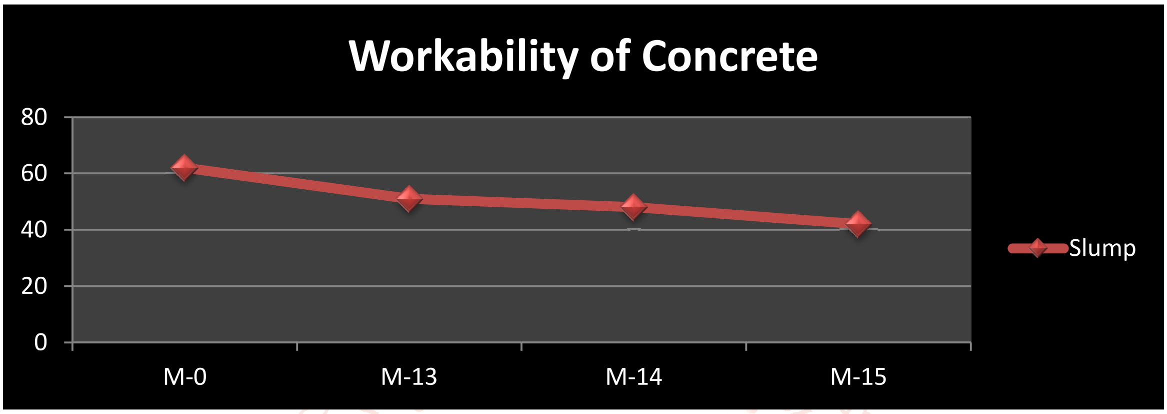

Figure: Workability of Concrete by using 20 % Copper Slag and 10 to 30 % Recycled aggregates

COMPRESSIVE STRENGTH TEST

The concrete strength depends on various aspects like the cement type, quality or proportion of copper slag, recycled aggregates and curing temperature. The compressive strength results are given in Table 4.2. Compressive strength test was performed confirming to IS 516-1959 to achieve the test results for concrete at the age of 7 and 28 days.

Table: Compressive strength of Concrete cubes

Designation	Mix	Compressive1strength	
		7 Days	28 Days
M-0	Control	17.78	28.2
M-1	10 % CS	18.55	30.52
M-2	20 % CS	19.85	32.6
M-3	30 % CS	22	35.2
M-4	10 % RCA	17.40	27.57
M-5	20 % RCA	16.75	26.52
M-6	30 % RCA	15.68	24.67
M-7	10 % CS 10 % RCA	18.18	29.8
M-8	10 % CS 20 % RCA	17.48	28.30
M-9	10 % CS 30 % RCA	16.57	27.35
M-10	20 % CS 10 % RCA	19.18	32.1
M-11	20 % CS 20 % RCA	18.56	30.2
M-12	20 % CS 30 % RCA	17.51	29.05
M-13	30 % CS 10 % RCA	21.3	33.95
M-14	30 % CS 20 % RCA	20.42	32.6
M-15	30 % CS 30 % RCA	19.12	31.45

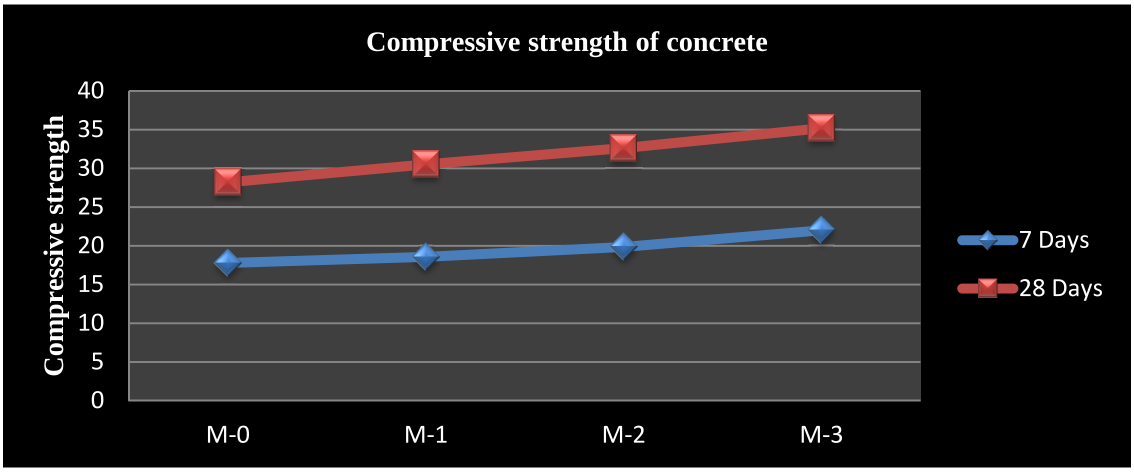

Figure: Compressive strength of Concrete by using Copper Slag only

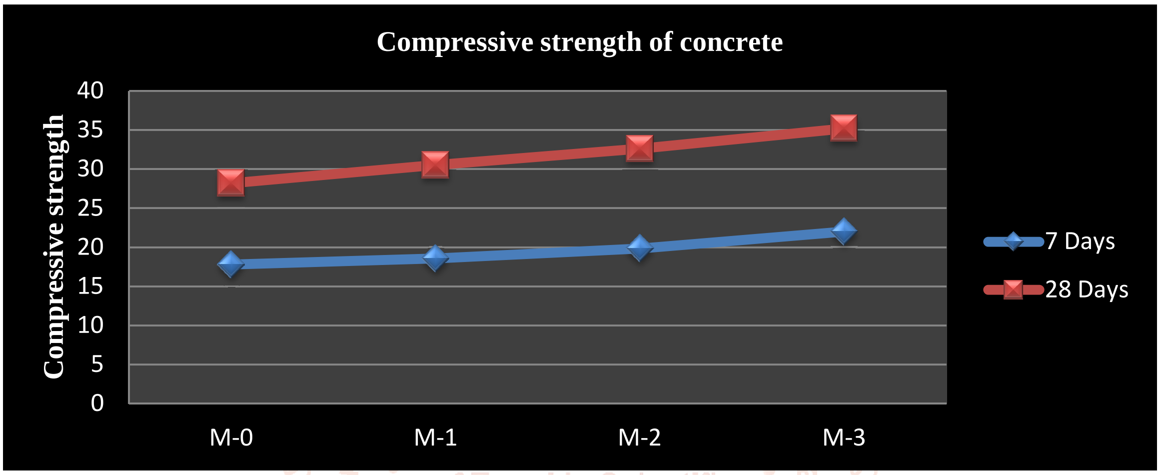

Figure: Compressive strength of Concrete by using recycled aggregates only

SPLIT TENSILE STRENGTH TEST

The split tensile strength examination was performed to confirm to IS 516-1959 so as to achieve the value of concrete aged 7 days and 28 days. A Compression Testing Machine (CTM), of 1000Kn capacity was used to test the cylinders. The outcomes are displayed in table 4.3.

Table: Split tensile strength of Concrete cubes

Designation	Mix	Split tensile strength	
		7 Days	28 Days
M-0	Control	1.564	2.538
M-1	10 % CS	1.635	2.687
M-2	20 % CS	1.782	2.983
M-3	30 % CS	1.859	3.395
M-4	10 % RCA	1.392	2.237
M-5	20 % RCA	1.340	2.135
M-6	30 % RCA	1.254	2.098
M-7	10 % CS 10 % RCA	1.549	2.415
M-8	10 % CS 20 % RCA	1.487	2.343
M-9	10 % CS 30 % RCA	1.356	2.233
M-10	20 % CS 10 % RCA	1.583	2.767
M-11	20 % CS 20 % RCA	1.509	2.652
M-12	20 % CS 30 % RCA	1.407	2.525
M-13	30 % CS 10 % RCA	1.848	3.218
M-14	30 % CS 20 % RCA	1.781	3.132

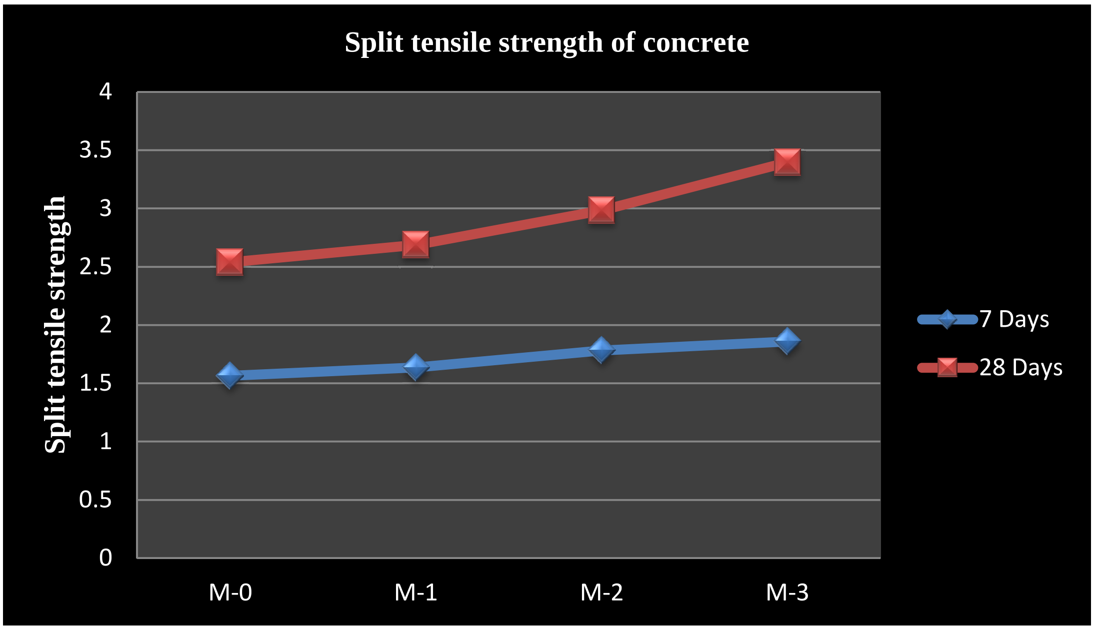

Figure: Split tensile strength of Concrete by using Copper Slag only

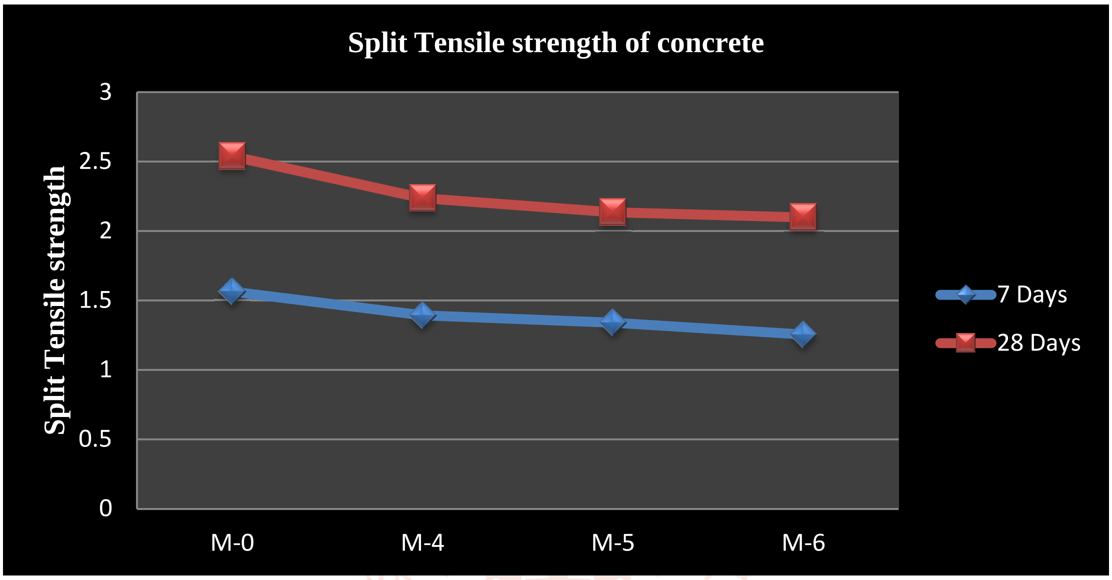

Figure: Split tensile strength of Concrete by using recycled aggregates only

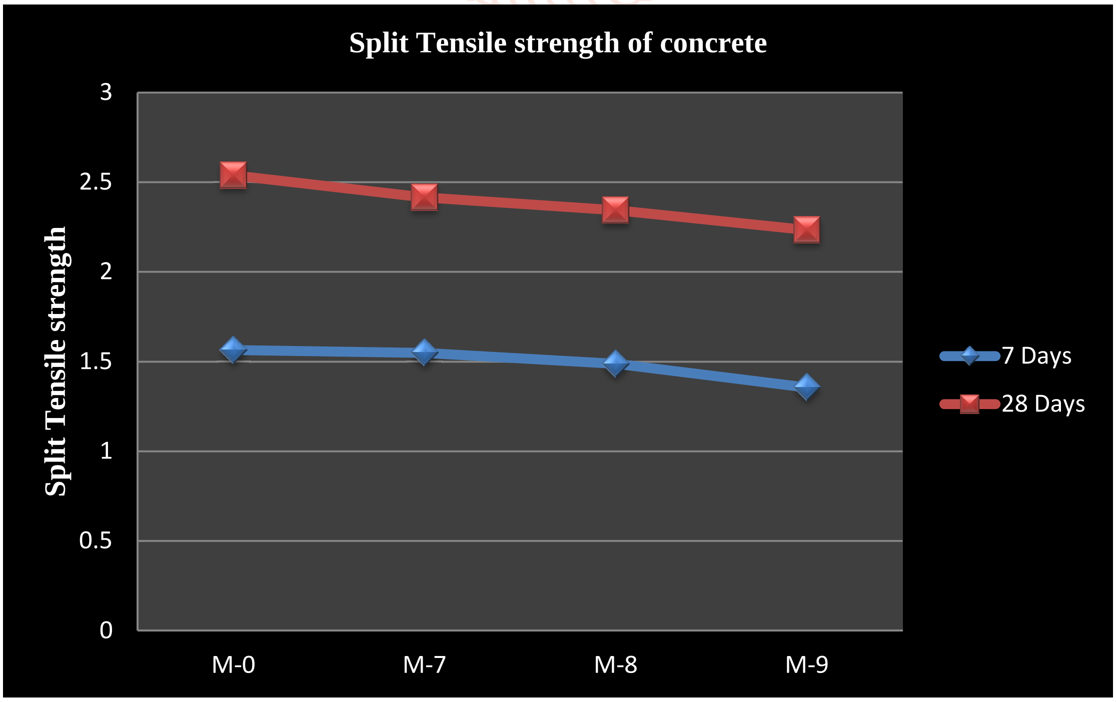

Figure: Split tensile strength of Concrete by using 10 % Copper Slag and 10 to 30 % Recycled aggregates

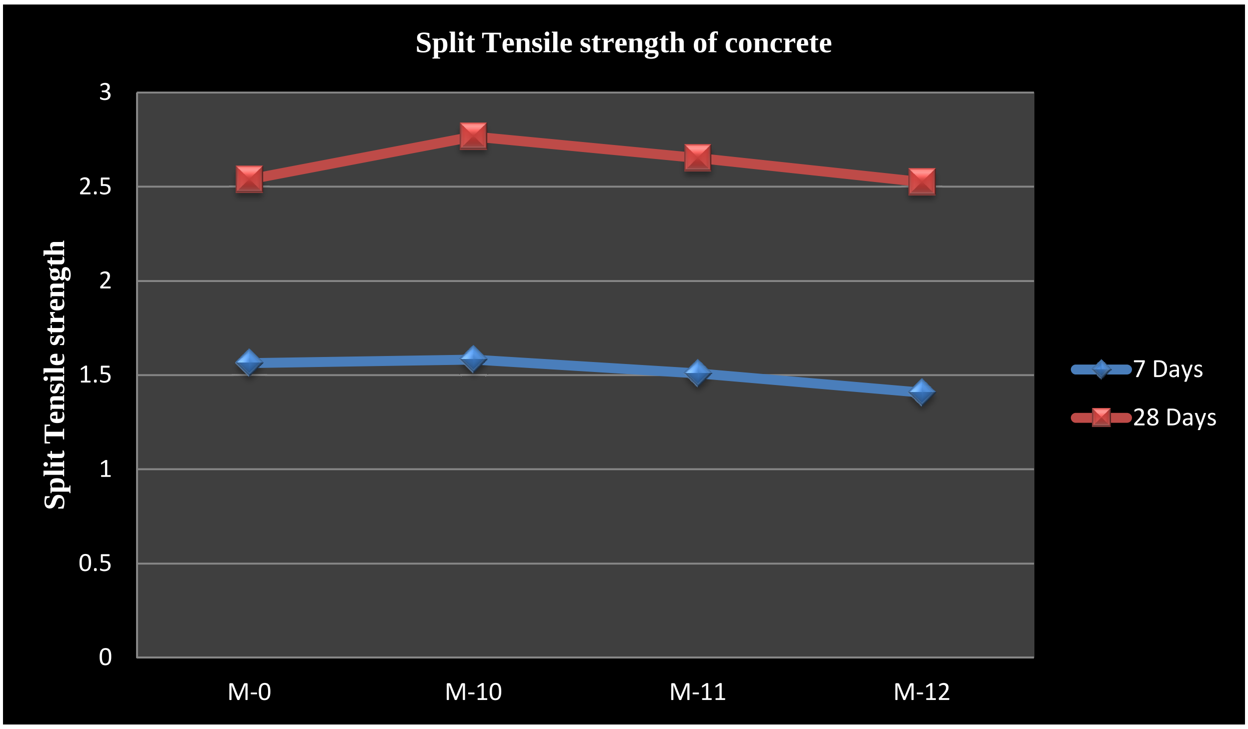

Figure: Split tensile strength of Concrete by using 20 % Copper Slag and 10 to 30 % Recycled aggregates

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