EFFECT ON THE STRENGTH PROPERTIES OF CONCRETE BY USING COPPER SLAG AND RECYCLED AGGREGATES WITH PARTIALLY REPLACEMENT OF FINE AGGREGATES AND COARSE AGGREGATE

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Abstract: In this study**,** the level of Copper slag was replaced by 12 %, 24 %, 36 % and Recycled aggregates replaced by 12 %, 24 % and 36 % with coarse aggregates. The solid cubes of 150 X 150 X 150 mm blocks were tried. The compressive quality of 28 days strength was resolved. This paper presents results from an experimental investigation carried out to study the potential use of copper slag as fine aggregate and recycled aggregates as coarse aggregates on the strength of both normal and high strength concrete. Also results showed that the compressive strength of concrete is generally improved, compared with the control mix, with the increase of copper slag up to a certain copper slag content beyond which the strength generally reduces. Mixes with large copper slag percentage showed signs of bleeding and segregation due to the significant increase of workability.

Keywords: Copper slag, Concrete, recycled aggregates, Compressive strength

1.1 INTRODUCTION

The use of industrial waste or auxiliary materials has supported the creation of cement and concrete in industry field. New results and waste materials are being produced by different enterprises. Dumping or transfer of waste materials causes natural and medical issues. In this manner, reusing of waste materials is an incredible potential in solid industry. For a long time, side-effects, for example, fly fiery debris; silica smoke and slag were considered as waste materials. Concrete arranged with such materials demonstrated enhancement in functionality and toughness contrasted with ordinary cement and has been utilized in the development of intensity, synthetic plants and submerged structures [7].

Copper slag is a mechanical side-effect material created from the way toward assembling copper. For each ton of copper creation, about 2.2 huge amounts of copper slag is produced. It has been

evaluated that around 24.6 million tons of slag are produced from the world copper industry. Despite the fact that copper slag is generally utilized in the sand impacting industry and in the assembling of grating apparatuses, the rest of discarded with no further reuse or recovery [7].

At present about 33 million tonnes of copper slag is generating annually worldwide among that India contributing 6 to 6.5 million tonnes. 50 % copper slag can be used as replacement of natural sand in to obtain mortar and concrete with required performance, strength and durability. In India a study has been carried out by the Central Road Research Institute (CRRI) shown that copper slag may be used as a partial replacement for river sand as fine aggregate in concrete up to 50 % in pavement concrete without any loss of compressive and flexural strength and such concretes shown about 20 % higher strength than that of conventional cement concrete of the same grade.

1.2 LITERATURE REVIEW ON COPPER SLAG AND RCA

Muqtar Ahmed et al (2017) studied on the strength properties of concrete by using copper slag and Rice husk ash. In this study, fine aggregates are replaced with Copper slag ranging 0%, 10%, 20%, 30% & 40% and cement with rice husk ash as 15 % of its weight. The effect of Rice Husk Ash and Copper Slag on mechanical properties of concrete were analyzed and compared with normal concrete. The maximum compressive, spilt tensile and flexural strength got 30% replacement of Copper slag as fine aggregate and it is found that As percentage of copper slag is increasing in the mix, the percentage of voids decreases & also it absorbs less water that found with sorptivity.

Md. Arshad Hussain et al (2017) studied on the effects on the properties of concrete by using copper slag and micro silica. In this study M 30 mix was designed by using copper slag at 0%, 25%, 50% and 75% with fine aggregates and Cement is replaced by Silica Fume for 5%, 10% and 15%. The test results shows that there was more improvement in the flexural strength of concrete at 25% replacement of copper slag with 10% Silica Fume when compared to control mixes.

K.Bhanu Prakash Reddy et al **(2016)** studied on the use of copper slag in concrete and cement mortar as replacement of sand. This investigation work predominantly comprises of 2 primary components. Concrete was wont to check various mechanical properties. First a piece of the theory comprises of work sand by copper filth in cement for determinant quality properties. For sand substitution, seven check groups (counting the executives blend) were authentic with substitution of third (control example), 20%, 40%, half, 60%, eightieth and 100% copper filth with sand in each arrangement.

Zine Kiran Sambhaji et al (2016) studied on the Effect of Copper Slag as A Fine Aggregate on Properties of Concrete. The principle objective is to empower the utilization of these apparently squander items as a development material. In this paper , the impact of utilizing copper slag as a fine total on properties of bond mortars and cement different mortars and solid blends were set up with various extents of copper slag going from (0CS+100S)%,(10CS+90S)%,(20CS+80S)%, (30CS+70S)%, (40CS+60S)%, (50CS+50S)%, (60CS+40S)%, (70CS+30S)%, (80CS+20S)%, (90CS+10S)%,(100CS+0S)% The plan M25 grade concrete for half substitution of CS demonstrates the HPC attributes. The plan M25 grade concrete for 30% substitution of CS demonstrates the HPC attributes.

S. Muneera et al (2016) studied on the Use of Recycled Aggregate in Concrete. In this study the natural concrete is replaced by recycled coarse aggregates at different percentages of 10%, 20%, 30%, 40%, 60%, 75%, 100%. Various tests such as slump test, compaction factor test, split tensile strength, compression test have been conducted in this study. The average reduction in compressive strength is nearly 5- 10%. This reduction in compressive strength is attributed to the decrease in adhesive strength between the RCA aggregates and the cement binder.

DEEPIKA K P et al (2016) did the experiment study on the utilization of copper slag as a partial replacement of fine aggregate in concrete. The present examination for the most part centers around researching the impact of utilizing copper slag as a substitution of fine total on the quality properties. In this report, M25 grade concrete was utilized and tests were led for different extents of copper slag supplanting with sand of 40%, 80% and 100% in concrete.

M. V. PATIL et al (2015) studied on the properties and effects of copper slag in concrete. For this research work, M30 grade concrete was used and the tests were conducted for various proportions of copper slag replacement with sand of 0%, to100 % in concrete. The obtained results were compared with those of control concrete made with ordinary Portland cement and sand. Cube of size 150 mm × 150 mm × 150 mm were used and tested at 7,28 and 56 days of curing in water under controlled laboratory conditions. From the test results, it can be seen that compressive strength of copper slag concrete mixes with 10%, 20%, 30%, 40%, 50%, 60%, and 80 % fine aggregate replacement with copper slag, were higher than the control mix at all ages.

1.3 PREPARATION OF MIX SAMPLES

The M 20 concrete grade is utilized in this study for mix proportioning. It's composed according to IS 10262-1982 principles. The level of Copper slag was shifted by 12 %, 24 %, 36 % and Recycled aggregates replaced by 12 %, 24 % and 36 % with coarse aggregates. The solid cubes of 150 X 150 X 150 mm blocks were tried. The compressive quality of 28 days strength was resolved.

Table 1.1: Mix Proportion of Concrete cubes

Designation	Mix	Water (kg/m^3)	Cement (kg/m^3)	Fine Agg. (Sand) (kg/m^3)	Copper slag	Coarse Agg (kg/m^3)	Recycled Aggregates
M-0	**Normal**	207.244	460.54	690.8168	--	1191.916	--
M-1	**12 % CS**	207.244	460.54	607.9188	82.898	1191.916	--
M-2	**24 % CS**	207.244	460.54	525.0208	165.796	1191.916	--
M-3	**36 % CS**	207.244	460.54	442.1228	248.694	1191.916	--
M-4	**12 % RCA**	207.244	460.54	690.8168	--	1048.89	143.02
M-5	**24 % RCA**	207.244	460.54	690.8168	--	905.866	286.05
M-6	**36 % RCA**	207.244	460.54	690.8168	--	762.836	429.08
M-7	**12 % CS 12 % RCA**	207.244	460.54	607.9188	82.898	1048.89	143.02
M-8	**12 % CS 24 % RCA**	207.244	460.54	607.9188	82.898	905.866	286.05
M-9	**12 % CS 36 % RCA**	207.244	460.54	607.9188	82.898	762.836	429.08
M-10	**24 % CS 12 % RCA**	207.244	460.54	525.0208	165.796	1048.89	143.02
M-11	**24 % CS 24 % RCA**	207.244	460.54	525.0208	165.796	905.866	286.05
M-12	**24 % CS 36 % RCA**	207.244	460.54	525.0208	165.796	762.836	429.08

M-13	**36 % CS 12 % RCA**	207.244	460.54	442.1228	248.694	1048.89	143.02
M-14	**36 % CS 24 % RCA**	207.244	460.54	442.1228	248.694	905.866	286.05
M-15	**36 % CS 36 % RCA**	207.244	460.54	442.1228	248.694	762.836	429.08

1.4 COMPRESSIVE STRENGTH TEST

Strength of concrete is affected by several factors viz. type of cement, quality and proportion of copper slag, recycled aggregates and curing temperature. The results of compressive strength are presented in below figures. The test was carried out conforming to IS 516-1959 to obtain compressive strength of concrete at the age of 7 and 28 days

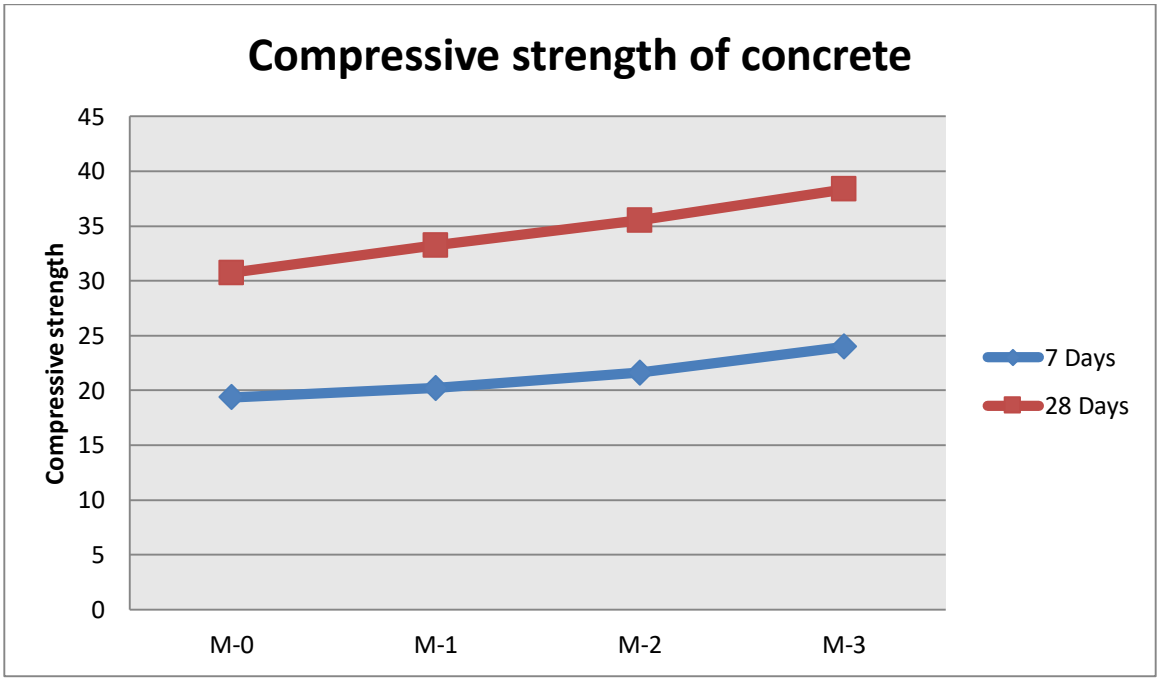

Figure 1.1: Compressive strength of Concrete by using Copper Slag only

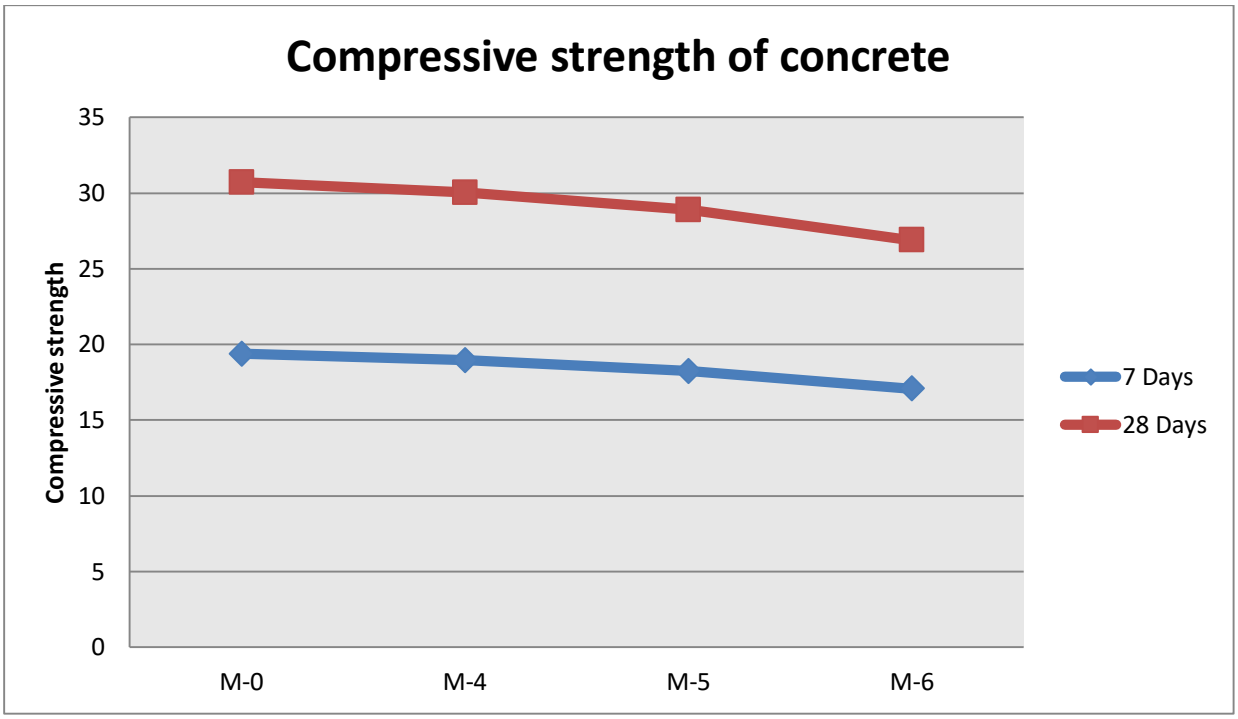

Figure 1.2: Compressive strength of Concrete by using recycled aggregates only

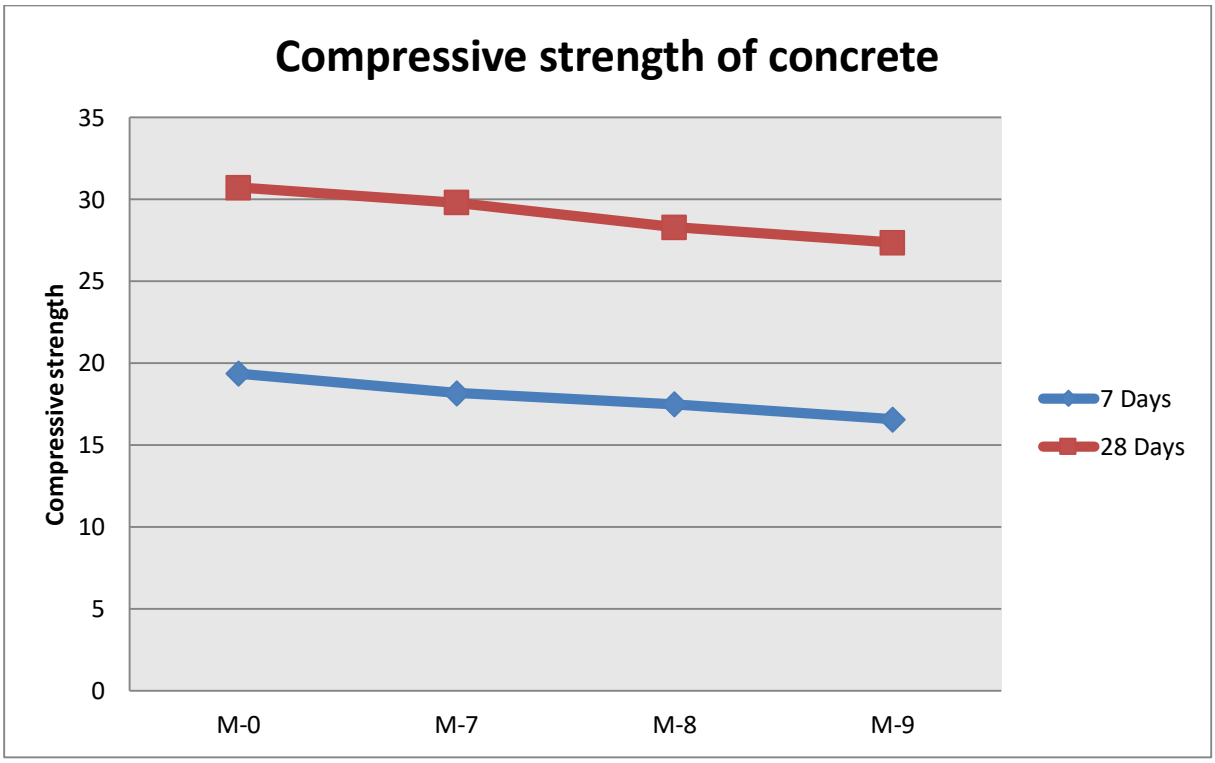

Figure 1.3: Compressive strength of Concrete by using 12 % Copper Slag and 12 to 36 % Recycled aggregates

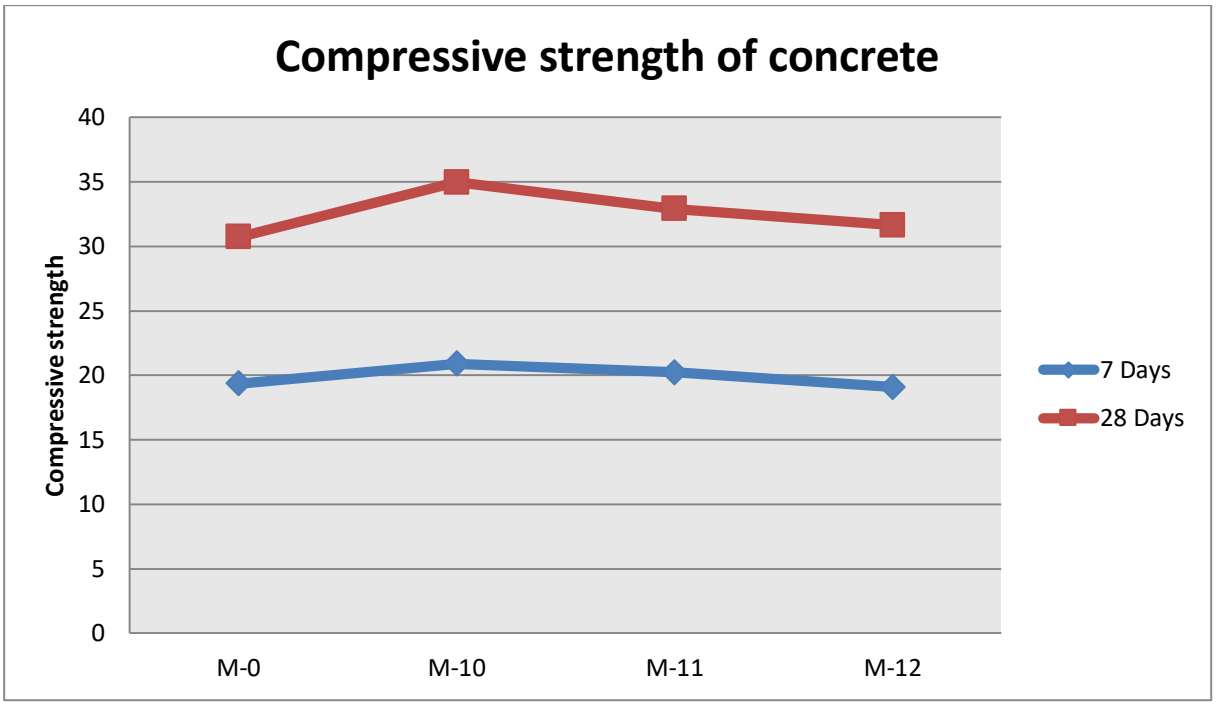

Figure 1.4: Compressive strength of Concrete by using 24 % Copper Slag and 12 to 36 % Recycled aggregates

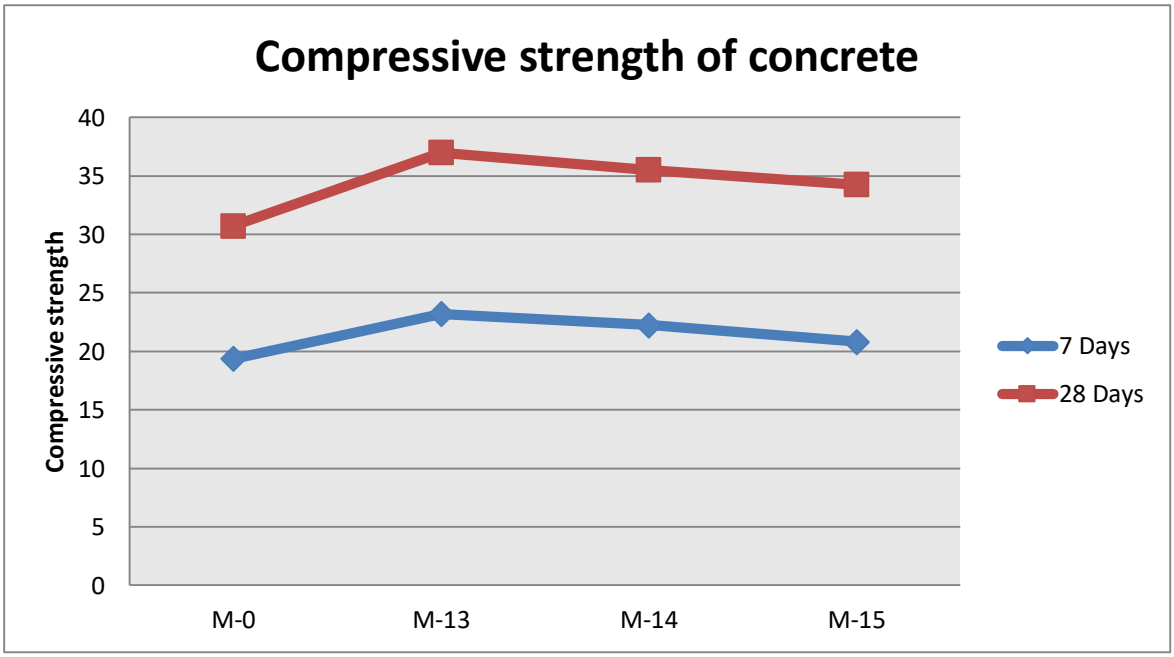

Figure 1.5: Compressive strength of Concrete by using 36 % Copper Slag and 12 to 36 % Recycled aggregates

1.5 SPLIT TENSILE STRENGTH TEST

The test was carried out conforming to IS 516-1959 to obtain Split Tensile Strength of Concrete strength at the age of 7 and 28 days. The cylinders were tested using Compression testing machine (CTM) of capacity 1000 Kn.

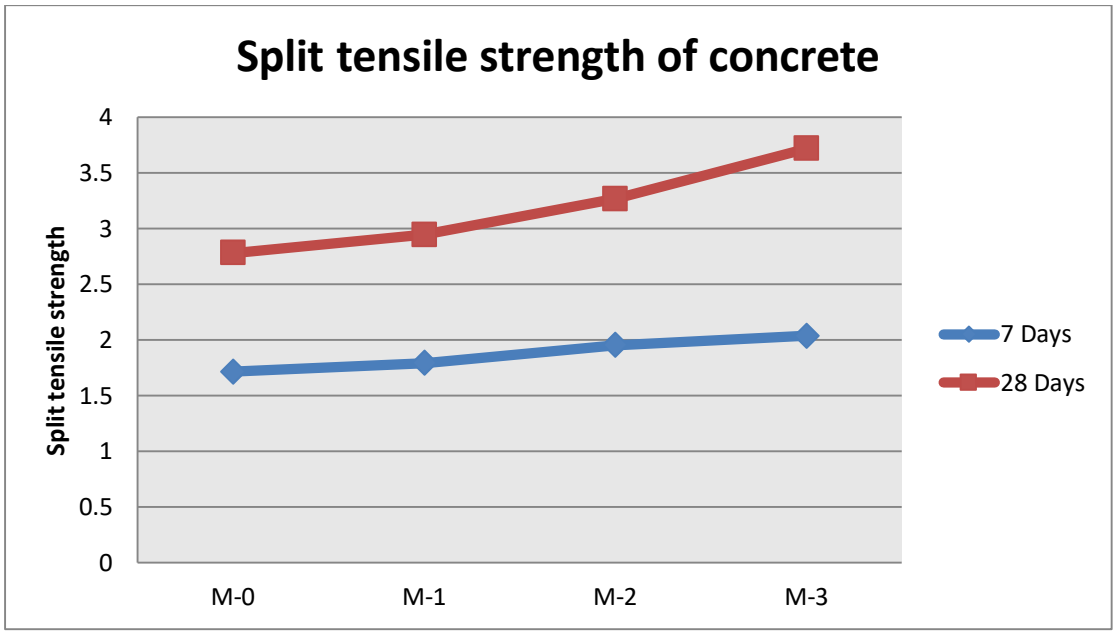

Figure 1.6: Split tensile strength of Concrete by using Copper Slag only

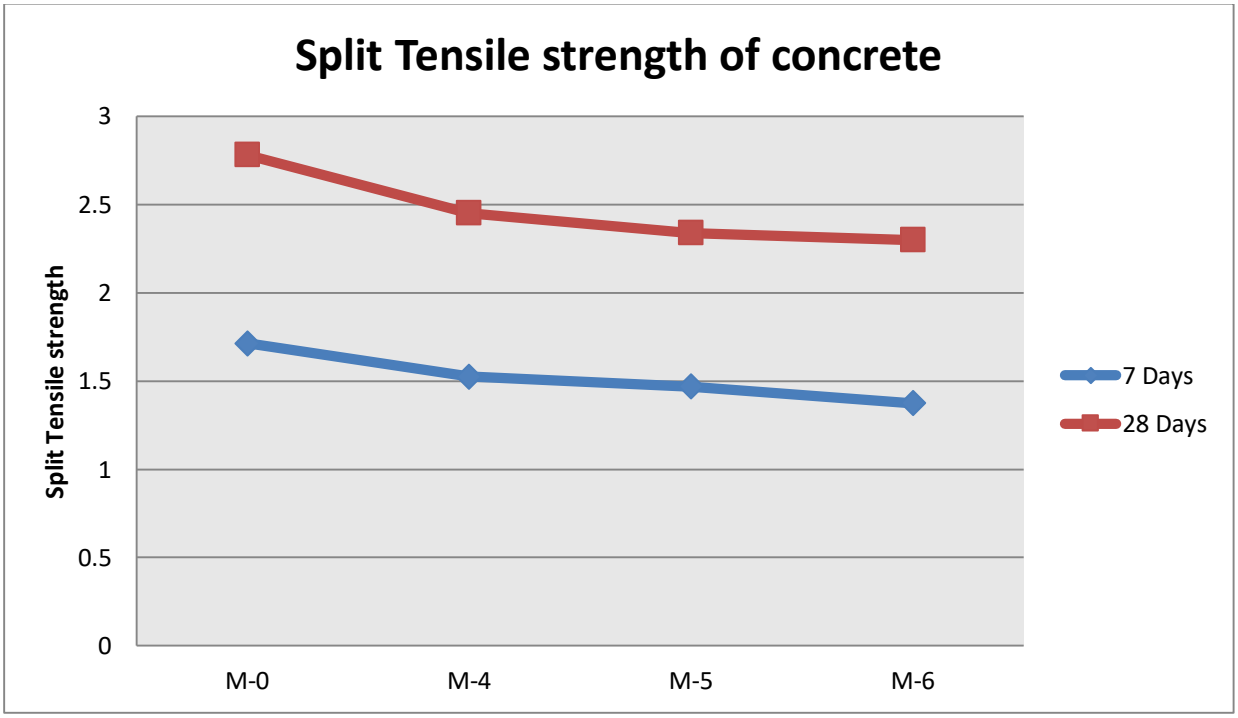

Figure 1.7: Split tensile strength of Concrete by using recycled aggregates only

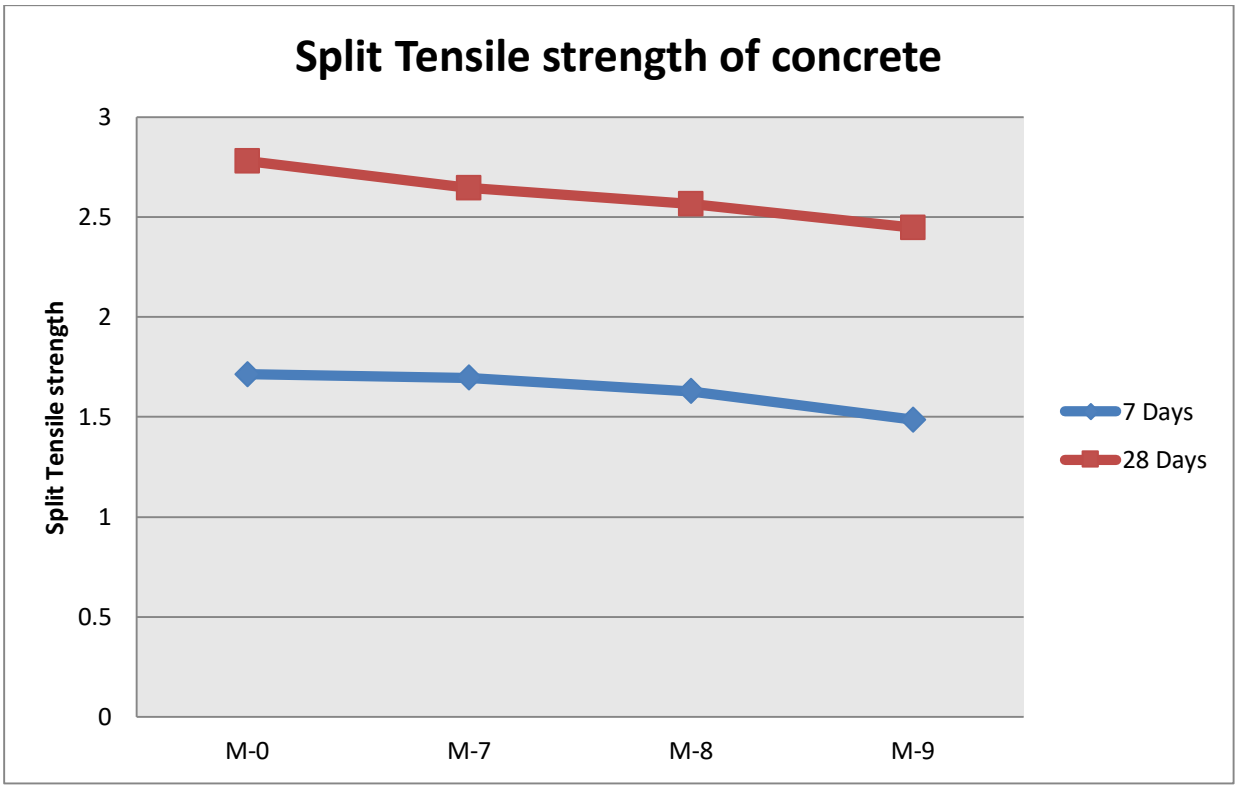

Figure 1.8: Split tensile strength of Concrete by using 10 % Copper Slag and 10 to 30 % Recycled aggregates

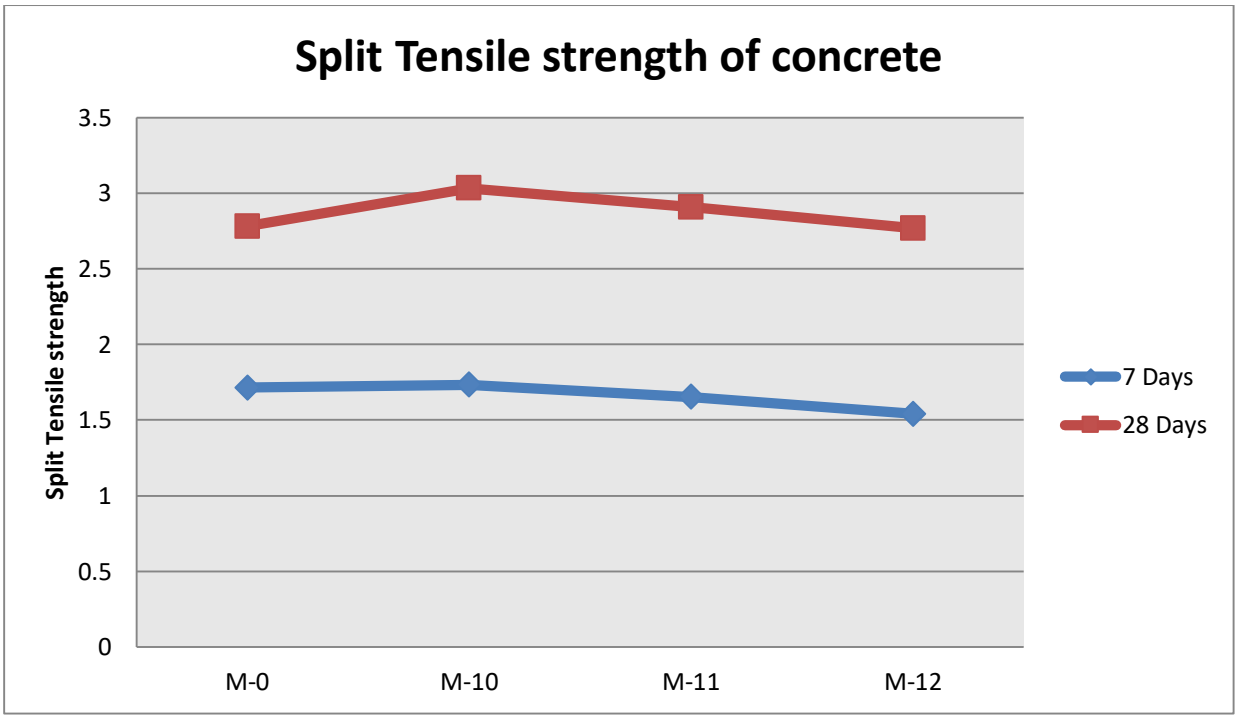

Figure 1.9: Split tensile strength of Concrete by using 20 % Copper Slag and 10 to 30 % Recycled aggregates

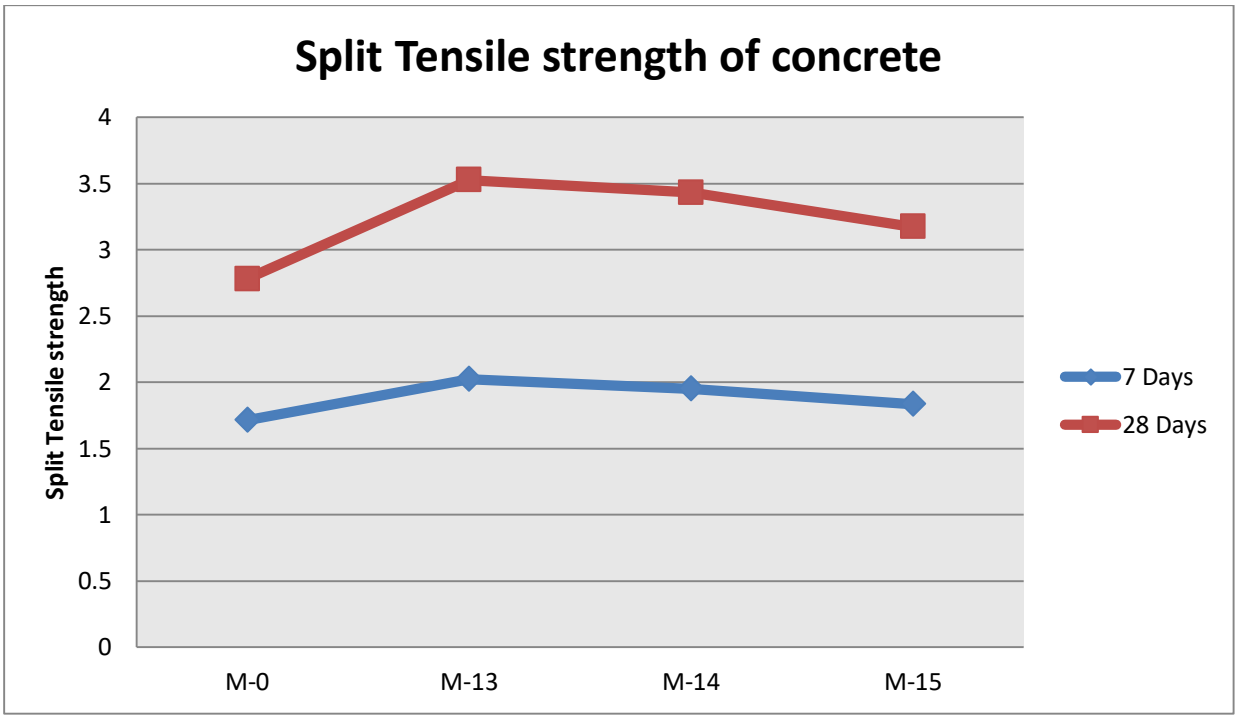

Figure 1.10: Split tensile strength of Concrete by using 20 % Copper Slag and 10 to 30 % Recycled aggregates

CONCLUSION

1. The compressive strength of concrete decreases by the addition of recycled coarse aggregates.
2. The optimum percentage of Copper slag is 36 % and 12 % for recycled coarse aggregates.
3. The maximum compressive strength is achieved after the addition of 36 % copper slag and 12 % recycled coarse aggregates for compressive strength.
4. The split tensile strength of concrete increases by the addition of copper slag.
5. The Split tensile strength of concrete decreases by the addition of recycled coarse aggregates.
6. The optimum percentage of Copper slag is 36 % and 12 % for recycled coarse aggregates.
7. The maximum compressive strength is achieved after the addition of 36 % copper slag and 12 % recycled coarse aggregates for split tensile strength
8. The maximum split tensile strength is achieved on M- 4 containing 36 % Copper slag only as a cement replacing material.

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