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E-mail :
editor.ijpast@gmail.com
editor.ijpast@.in

www.ijpast.in

Tests of M30 and M40 concrete were conducted, with copper slag replacing part of the fine aggregate and eggshell powder taking the place of the cement.

J. GANESH KUMAR, A. MOUNIKA, D. MADHUKAR, B ANAND

Abstract:

In the past, concrete was thought to be weaker and less durable than it is now. Furthermore, concrete's primary benefits over other building materials must be preserved. Ability to fabricate almost anywhere, ability to build the shape dictated by a mould, and minimal component and production costs are all advantages. Concrete performance advancements have been spurred by these variables for years and will continue to do so. The increasing demand for concrete, coupled with concerns about environmental effect, has led to the increased usage of alternative material components. Copper slag will be used as a partial substitute for fine aggregates in the concrete mix design for an experimental examination. Copper slag (CS) and Egg shell powder (ESP) will be used in varying proportions to determine the compressive strength and split tensile strength of concrete of M30 and M40 grades. Various durability tests will be conducted to determine the compressive strength and split tensile strength of these concretes. Thereafter, the findings will be compared with ordinary concrete, in order to learn about the qualities of copper slag-based concrete. Compressive strength, split tensile strength, eggshell powder, copper slag are some of the key terms.

INTRODUCTION

In the construction industry, industrial waste or secondary resources may be used to produce cement and concrete. Byproducts and waste materials are generated by a variety of businesses. Processing or disposing of waste materials leads to problems with the environment and public safety. Reusing and recycling construction and demolition debris is consequently an excellent business opportunity. These byproducts have been considered waste items for many years now. Fuel, chemical, and submarine constructions all employed concrete built with these components because it worked better and lasted longer than ordinary concrete. Recent decades have seen an increase in study into all feasible methods of recycling. It has been established that many locations have approved the use of construction waste, explosive furnace ash, slag of steel, coal fly ash and low ash as raw materials for the creation of conventional Portland cement (Teikthyluin et al 2006). Copper slag is a byproduct of the copper manufacturing process. Each tonne of copper

produced generates around 2.2 tonnes of copper slag. Slag from the world's copper industry is predicted to total 24.6 million tonnes (Gorai et al 2003). Since abrasive tool production and sand blasting employ copper layer, the remainder of it is discarded without any further recycling or usage. As a component replacement for Portland cement or an aggregate substitute for the material to be used in concrete, the copper layer is mechanically and chemically defined. Slag is an excellent choice for combined usage because of its outstanding soundness and abrasion resistance. It also has a long history of being stable (Gorai et al 2003). In addition to its pozzolanic properties, copper slag also has low CaO content. NaOH may activate the cement to reveal its cemented qualities, which can be utilised to partly or totally replace Portland cement. Because it may be used to replace Portland cement or serve as a main ingredient, copper slag has the added advantage of lowering the cost of concrete while also decreasing waste disposal expenses.

ASSISTANT PROFESSOR^{1,2,3}, STUDENT⁴
Department of Civil
Arjun College Of Technology & Sciences

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Literature review

The experimental studies of Gowsika et al. (2014) on powdered eggshell (ESP) as partial replacement for cemented concrete. At 28 days of curing time ESP was substituted in 5, 10, 15, 20, 25, 30 percent by weight of cement and a mixing proportion of 1:3 by a chemical composition and strength properties of ESP in cement mortar. For compression, over and above 5 percent of ESP replacement, admixtures such as saw dust ash, fly ash and microsilica have been utilized to pump up the power. In contrast with traditional concrete, it was found that replacement of 5 percent ESP with 10 percent micro silica leads to the high strength of hard concrete. The properties of eggshell concrete powder as cement substitute were investigated by Amaranth Yerramala et al., (2014). During 7th and 28th day curing times 5, 10, 15% of ESP for cement and tests were determined for specific characteristics of hardened concrete. The findings suggest that adding flyash along with ESP is positive up to 15 percent over the control of concrete. The absorption property has decrease with the reduction in permeable vacuum. The absorption has decreased with force and increased with water absorption. This paper substitutes partial volume of cement with powder from the fused cement, as at the end of 28 days it is noted that a 5 percent rise in weight and strength of up to 30%. In order to obtain the force which decreased by over 5%, some mineral admixtures, such as fly ash, silica and saw dust must be strengthened by replacement. This scenario shows that the strength properties of concrete are improved by 5% ESP with 10% micro silica, ash fly, replacing dust. The ESP has been replaced by 10%, 20% and 30% of the ESP has been replaced by 5%, 10% and 15% by the ESP, and studies on seventy-four days and twenty-eight days have been carried out for well-healed specimens. [3] Praveene Kumar et al., (2015) experimentally tested on partial cement replacement with eggshells. The strength also increases by up to 15 per cent without the application of silica fume, but economically speaking, ESP is necessary to achieve a stronger strength. The comparative research on Eggshell cement with partial cement replacement with Fly Ash was submitted by Dhanalakshmi and others (2015). Two wastes are used as a partial replacement for cement here and different materials have been obtained. The application of fly ash to maximum ESP concrete has demonstrated improved density and workability. [5] [5] [5]

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characteristics were substituted by 10, 15 and 20 percent ESP replacement in cement for concrete. Results show that ESP replacement is successful at about 10 to 15% and further intensity is reduced. [6] Monisha et al. (2016) have experimentally researched eggshell powder and polypropylene fiber concrete. The following paper offers the substitution of fine aggregates of ESP 20% and polypropylene fiber in the range of 0, 0.2 and 0.4%. Similar to standard concrete 7, 14 and 28 days of curing time, the strength properties are obtained. The test results indicate that 20% of fine aggregates substituted by ESP have adequate resistance and 0.2% of polypropylene fiber by concrete weight have been reached by grade M20. The mechanical features of concrete with the use of eggshell ash and rice ash as a partial substitute for cement have been studied by the

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Since copper slag and egg shell powder is seen as a waste product and the land that can be dumped every day has a major effect on the environment, therefore, we use copper slag in building. Copper slag has many applications in relation to its use in building but is just a little percentage point.

The principal aim is to research how copper slag can be used in concrete as a fine aggregate. It includes the knowledge of the strength parameters of concrete including compressive strength, division of tensile strength, flexural strength in which fine adds copper slag and egg shell powder are substituted by 0% (5% +5%), (15% +10%), (15% +15%), +20% (25% +20%) and (30% +30%)

Methodology

One of the main aims of examining the various properties of concrete and hardened concrete materials is the development of a concrete technologist for a specific strength and durability of a concrete mix. Because of the wide varying material properties, the conditions at the site, particularly the exposure condition, and the condition required for a particular task for which mix is designed, the design of the concrete mix is not a simple task. Concrete mixing design requires a full understanding of different characteristics of the various component materials, their effect on the site, their effect on hardened concrete and the dynamic inter-relationships between the variables in cases of alteration of these conditions. All these complicate and complicated the task of mix design. In addition to knowledge of material

properties and properties of plastic concrete, the design of the concrete mix also requires broader expertise and concreting experience. Even then, the proportion of concrete materials found in the lab requires changes and adjustments according to the field conditions.

Mix design can be defined as the process of selecting the correct concrete ingredients and of determining their relative proportions as economically as possible with a concrete producing object of some minimum strength and durability. Secondly, the minimum strength and reliability listed are to be archived. The second goal is to make concrete the most cost-effective method. The cost depends primarily on two factors: material costs and material costs. As cement costs much more than other materials, we primarily concentrate on the use of cement as small as possible, which is compatible with strength and durability.

4.1 Mix Design of Conventional Concrete (M30)

The next step is the design of the concrete
Step 1 :Target Mean Strength

$$f'_{ck} = f_{ck} + 1.65 \times \sigma = 30 + 8.25 = 38.25$$

Table 1 Assumed Standard Deviation
(Clauses 3.2.1.2, A-3 and B-3)

Sl No. (1)	Grade of Concrete (2)	Assumed Standard Deviation N/mm ² (3)
i)	M 10	3.5
ii)	M 15	
iii)	M 20	4.0
iv)	M 25	
v)	M 30	5.0
vi)	M 35	
vii)	M 40	
viii)	M 45	
ix)	M 50	
x)	M 55	

NOTE — The above values correspond to the site control having proper storage of cement; weigh batching of all materials; controlled addition of water; regular checking of all materials; aggregate grading and moisture content; and periodical checking of workability and strength. Where there is deviation from the above, values given in the above table shall be increased by 1 N/mm².

Phase 2: Ratio of W / C

- For 25 N / mm² concrete compressive strength the graph defined in IS10262, w / c shall be taken as 0.46.
- For mild condition, the w / c ratio from Table 5 of Is 456 is 0.45
- Hence the ratio is 0,45 as w / c, at least of two values. •

Stage 3: Value for Water

From Table 2 of IS10262, conclude that the 20 mm of the total volume is used. Accordingly, the maximum water content is 186 kg.

$$\text{Water content} = 186 \times 1.06 = 197.16$$

Table 4.2: Water Content

Table 2 Maximum Water Content per Cubic Metre of Concrete for Nominal Maximum Size of Aggregate
(Clauses 4.2, A-5 and B-5)

Sl No.	Nominal Maximum Size of Aggregate mm	Maximum Water Content ¹⁾ kg
(1)	(2)	(3)
i)	10	208
ii)	20	186
iii)	40	165

NOTE — These quantities of mixing water are for use in computing cementitious material contents for trial batches.

¹⁾ Water content corresponding to saturated surface dry aggregate.

4.2 Calculation Of Coarse Aggregate And Fine Aggregate

The region of the fine aggregate has been assigned Zone 1 of IS10262 and the corresponding coarse aggregate volume of 20 mm is 0,62 if the w / c is 0,5; our w / c is 0,46 and the effective coarse aggregate volume is 0,6, with the coarse aggregate volume 0,608 for w / c 0,42.

and hence volume of fine aggregate is 1 - 0.608 = 0.392

Table 4.2: Zone classification

Table 3 Volume of Coarse Aggregate per Unit Volume of Total Aggregate for Different Zones of Fine Aggregate
(Clauses 4.4, A-7 and B-7)

Sl No.	Nominal Maximum Size of Aggregate mm	Volume of Coarse Aggregate ¹⁾ per Unit Volume of Total Aggregate for Different Zones of Fine Aggregate			
		Zone IV	Zone III	Zone II	Zone I
(1)	(2)	(3)	(4)	(5)	(6)
i)	10	0.50	0.48	0.46	0.44
ii)	20	0.66	0.64	0.62	0.60
iii)	40	0.75	0.73	0.71	0.69

¹⁾ Volumes are based on aggregates in saturated surface dry condition.

Step 6 : Mix Proportion

$\text{volume of concrete} = 1\text{m}^3$
 $\text{volume of cement} = \frac{438.13}{(3.2 \times 1000)}$
 $= 0.136\text{m}^3$
 $\text{volume of water} = 197.16$
 $= 0.197\text{m}^3$
 $\text{Absolute weight of all materials except total aggregates} = 1 - (0.136 + 0.197)$
 $= 0.667$
 $\text{volume of coarse aggregate} = 0.667 \times 0.61 \times 2.68 \times 1000$
 $= 1090.41\text{m}^3$
 $\text{volume of fine aggregate} = 0.667 \times 0.39 \times 2.52 \times 1000$
 $= 655.52\text{m}^3$

Data analysis Materials used

5.1 Cement:

Cement is the important required material for the construction of concrete. Cement is a well-known construction material and has engaged a vital place in construction work. There is a change of cement obtainable in market and each type is used under convinced illness due to its singular properties such as colour and arrangement of cement.

The physical properties of cement, chemical composition of cement are shown in Table-1 and Table-2 respectively.



Figure 5.1- Ordinary Portland cement 53 grade

Table 5.1 Physical Properties of cement

Sl.no	Properties	Test value
1	Standard Consistency	34%
2	Initial Setting Time	35min
3	Specific Gravity	3.14
4	Fineness	3%

Table 5.2 Chemical Properties of Cement

Sl.no	Oxide Contents	Percentage (%)
1	CaO	60.67
2	SiO ₂	17.25
3	Al ₂ O ₃	3.8
4	Fe ₂ O ₃	0.5-6.0
5	MgO	0.1-4.0
6	K ₂ O, Na ₂ O	0.4-1.3
7	SO ₃	1.3-3.0

5.3 Coarse Aggregate:

The coarse mixture is that the largest part of concrete. It's with chemical stable material. It reduces the drying shrinkage and different dimensional changes occurring on account of movement of moisture. The Rigid broken granite stones were used as coarse aggregate in concrete. The nearby quarry is brought with crushed stone aggregate 20 mm in size. Sizes of more than 20 mm are divided by sieves. Tests are performed to test the properties of aggregate



Figure 5.3- Coarse aggregate

Table 5.3 Physical properties of Coarse aggregate

Slno	Properties	Test Value
1	Specific gravity	2.67
2	Fineness modulus	4.75
3	Aggregate impact value	24.48%
4	Flakiness Index	12.56%
5	Elongation Index	42.24%

5.4 Fine aggregate

The most significant function of the aggregate is to assist in manufacturing workability and regularity in mixture. The fine mixture additionally assists the cement paste to carry the coarse aggregate particle in suspension. This action helps plasticity in the mixture and avoids the possible segregation of paste and coarse aggregate.



Figure 5.4-Fine aggregates

Table 5.4 Physical Properties of Fine aggregate

Sl.no	Properties	Test value
1	Specific gravity	2.7
2	Fineness Modulus	4.72
3	Bulking of fine aggregate	52%

5.5 Copper slag

Copper slag is by result of the production of copper. Huge measure of copper slag is created as waste overall amid the copper refining process. River Sand is regular type of fine aggregate utilized in the cement production. Be that as it may, as a result of expanded expense and enormous scale exhaustion of sources choices for river sand are being considered. There have been numerous elective materials with comparable physical and synthetic properties of Sand discovered (Marble powder, lime stone waste, heater slag and welding slag, stone residue and so forth.) and research have been completed to check the reasonableness of its utilization as incomplete substitution of sand.



Figure5.5-Copper slag

5.6 Egg shell powder

The egg shell wastelands in the poultry manufacturing have been highlighted because of its recovery potential. Egg shell waste is available in huge amounts from the food processing, egg breaking, and shading industries. The food indulgence industry is in need of investigation to find another methods for processing and using egg shells

waste in an ecological friendly way. There is a need to find a low cost solution. Removal of egg shell waste are usually not income centers but cost centers. Therefore, the least cost of removal is most necessary.



Figure 5.6- Egg shell powder

Table 5.6 Physical Properties of Egg shell powder

Sl.no	Properties	Test value
1	Specific gravity	2.44
2	Standard Consistency	39%
3	Initial setting time	38 min

Results and Discussion

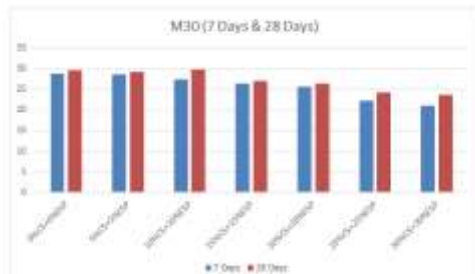
6.1 Introduction

The following chapter describes the compressive test results, preparing cubes from various blends that were previously mentioned, creating six cubes per blend, allowing compression testing on two cubes to be conducted on 7 days, 14 days and 28 days, while the average compression value is used as a compressive power.

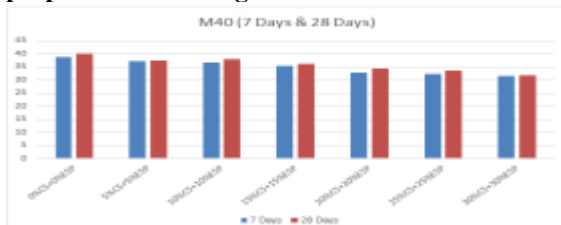
Test results

Table 6.1 Compressive strength results

Sl.No	Type of concrete	M30(7 Days)	M30(28 Days)	M40(7 Days)	M40(28 Days)
1	0%CS+0%ESP	28.84	29.60	38.60	39.86
2	5%CS+5%ESP	28.66	29.20	37.24	37.44
3	10%CS+10%ESP	27.40	29.80	36.80	37.90
4	15%CS+15%ESP	26.40	27.60	35.40	36.20
5	20%CS+20%ESP	25.60	26.40	32.80	34.22
6	25%CS+25%ESP	22.20	24.20	32.20	33.45
7	30%CS+30%ESP	21.00	23.60	31.60	31.62



Graph 6.2 – 7 & 28 Days strength of different proportions of M30 grade concrete

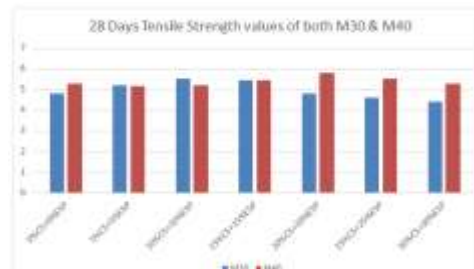


Graph 6.3 – 7&28 Days strength of different proportions of M40 grade concrete

6.3 Tensile Strength

Table 6.2 Tensile Strengths

Sl.No	Type of concrete	28 Days Tensile strength of M30	28 Days Tensile strength of M40
1	0%CS+0%ESP	4.82	5.28
2	5%CS+5%ESP	5.21	5.16
3	10%CS+10%ESP	5.53	5.20
4	15%CS+15%ESP	5.45	5.46
5	20%CS+20%ESP	4.80	5.80
6	25%CS+25%ESP	4.60	5.53
7	30%CS+30%ESP	4.40	5.30

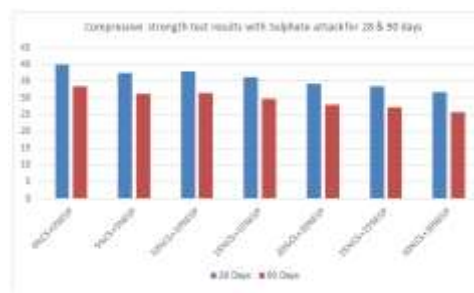


Graph 6.4-28 Days Tensile strength of different proportions of M30 & M40 grade concrete

6.4 Compressive strength test with Sulphate attack

Table 6.3 Compressive strength test with Sulphate attack

Sl.No	% replacement	Compressive strength of cube after 28 Days	Compressive strength of cube after 90 Days	%loss of compressive strength due to sulphate attack
1	0%CS+0%ESP	39.86	33.40	16.22
2	5%CS+5%ESP	37.44	31.13	16.84
3	10%CS+10%ESP	37.90	31.37	17.22
4	15%CS+15%ESP	36.20	29.82	17.60
5	20%CS+20%ESP	34.22	28	18.20
6	25%CS+25%ESP	33.45	27.30	18.40
7	30%CS+30%ESP	31.62	25.73	18.60



Graph 6.5- Compressive strength test results with Sulphate attack for 28 & 90 days

Conclusion

It is possible to utilise the materials for testing since the cement, fine aggregates, and gross aggregates meet IS code specifications within tolerable limitations. As the proportion of copper slag in copper slag concrete declines, the concrete fails to perform properly. The compaction factor of copper slag concrete decreases as the degree of copper slag increases. The best benefit of 7 days of treatment and 28 days of treatment is a copper layer replacement of 20% overall in the concrete compressive force.

Clamping strength for cylindrical specimens is best achieved after 28 days of 20% copper slag replenishment. Increased carbonation and reduced permeability may be achieved by using egg coating powder on the mixture's surface. The carbonation cycle in the mixture must thus be thoroughly studied. Concrete workability was found to be reduced when the ESP and Copper Slag between 14% ESP and 20% Copper Slag. Maximum bending strength is achieved at a maximum of 28 days at 14% ESP and 20% Copper Slag. Maximum split tensile reached with a duration of 28 days and a duration of 40% coffee slag.

For better strength values in concrete grade M30 the substitution of 20 percent copper slack is usually useful.

Concrete of the M30 strength grade may benefit from copper slag replacement in amounts ranging from 20% to 40%..

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The principal aim is to research how copper slag can be used in concrete as a fine aggregate. It includes the knowledge of the strength parameters of concrete including compressive strength, division of tensile strength, flexural strength in which fine adds copper slag and egg shell powder are substituted by 0% (5% +5%), (15% +10%), (15% +15%), +20% (25% +20%) and (30% +30%)

Methodology

One of the main aims of examining the various properties of concrete and hardened concrete materials is the development of a concrete technologist for a specific strength and durability of a concrete mix. Because of the wide varying material properties, the conditions at the site, particularly the exposure condition, and the condition required for a particular task for which mix is designed, the design of the concrete mix is not a simple task. Concrete mixing design requires a full understanding of different characteristics of the various component materials, their effect on the site, their effect on hardened concrete and the dynamic inter-relationships between the variables in cases of alteration of these conditions. All these complicate and complicated the task of mix design. In addition to knowledge of material

properties and properties of plastic concrete, the design of the concrete mix also requires broader expertise and concreting experience. Even then, the proportion of concrete materials found in the lab requires changes and adjustments according to the field conditions.

Mix design can be defined as the process of selecting the correct concrete ingredients and of determining their relative proportions as economically as possible with a concrete producing object of some minimum strength and durability. Secondly, the minimum strength and reliability listed are to be archived. The second goal is to make concrete the most cost-effective method. The cost depends primarily on two factors: material costs and material costs. As cement costs much more than other materials, we primarily concentrate on the use of cement as small as possible, which is compatible with strength and durability.

4.1 Mix Design of Conventional Concrete (M30)

The next step is the design of the concrete
Step 1 :Target Mean Strength

$$f'_{ck} = f_{ck} + 1.65 \times \sigma = 30 + 8.25 = 38.25$$

Table 1 Assumed Standard Deviation
(Clauses 3.2.1.2, A-3 and B-3)

Sl No. (1)	Grade of Concrete (2)	Assumed Standard Deviation N/mm ² (3)
i)	M 10	3.5
ii)	M 15	
iii)	M 20	4.0
iv)	M 25	
v)	M 30	5.0
vi)	M 35	
vii)	M 40	
viii)	M 45	
ix)	M 50	
x)	M 55	

NOTE — The above values correspond to the site control having proper storage of cement; weigh batching of all materials; controlled addition of water; regular checking of all materials; aggregate grading and moisture content; and periodical checking of workability and strength. Where there is deviation from the above, values given in the above table shall be increased by 1 N/mm².

Phase 2: Ratio of W / C

- For 25 N / mm² concrete compressive strength the graph defined in IS10262, w / c shall be taken as 0.46.
- For mild condition, the w / c ratio from Table 5 of Is 456 is 0.45
- Hence the ratio is 0,45 as w / c, at least of two values. •

Stage 3: Value for Water

From Table 2 of IS10262, conclude that the 20 mm of the total volume is used. Accordingly, the maximum water content is 186 kg.

$$\text{Water content} = 186 \times 1.06 = 197.16$$

Table 4.2: Water Content

Table 2 Maximum Water Content per Cubic Metre of Concrete for Nominal Maximum Size of Aggregate
(Clauses 4.2, A-5 and B-5)

Sl No. (1)	Nominal Maximum Size of Aggregate mm (2)	Maximum Water Content ¹⁾ kg (3)
i)	10	208
ii)	20	186
iii)	40	165

NOTE — These quantities of mixing water are for use in computing cementitious material contents for trial batches.

¹⁾ Water content corresponding to saturated surface dry aggregate.

4.2 Calculation Of Coarse Aggregate And Fine Aggregate

The region of the fine aggregate has been assigned Zone 1 of IS10262 and the corresponding coarse aggregate volume of 20 mm is 0,62 if the w / c is 0,5; our w / c is 0,46 and the effective coarse aggregate volume is 0,6, with the coarse aggregate volume 0,608 for w / c 0,42.

and hence volume of fine aggregate is 1 - 0.608 = 0.392

Table 4.2: Zone classification

Table 3 Volume of Coarse Aggregate per Unit Volume of Total Aggregate for Different Zones of Fine Aggregate
(Clauses 4.4, A-7 and B-7)

Sl No. (1)	Nominal Maximum Size of Aggregate mm (2)	Volume of Coarse Aggregate ¹⁾ per Unit Volume of Total Aggregate for Different Zones of Fine Aggregate			
		Zone IV (3)	Zone III (4)	Zone II (5)	Zone I (6)
i)	10	0.50	0.48	0.46	0.44
ii)	20	0.66	0.64	0.62	0.60
iii)	40	0.75	0.73	0.71	0.69

¹⁾ Volumes are based on aggregates in saturated surface dry condition.

Step 6 : Mix Proportion

$\text{volume of concrete} = 1\text{m}^3$
 $\text{volume of cement} = \frac{438.13}{(3.2 \times 1000)}$
 $= 0.136\text{m}^3$
 $\text{volume of water} = 197.16$
 $= 0.197\text{m}^3$
 $\text{Absolute weight of all materials except total aggregates} = 1 - (0.136 + 0.197)$
 $= 0.667$
 $\text{volume of coarse aggregate} = 0.667 \times 0.61 \times 2.68 \times 1000$
 $= 1090.41\text{m}^3$
 $\text{volume of fine aggregate} = 0.667 \times 0.39 \times 2.52 \times 1000$
 $= 655.52\text{m}^3$

Data analysis Materials used

5.1 Cement:

Cement is the important required material for the construction of concrete. Cement is a well-known construction material and has engaged a vital place in construction work. There is a change of cement obtainable in market and each type is used under convinced illness due to its singular properties such as colour and arrangement of cement. The physical properties of cement, chemical composition of cement are shown in Table-1 and Table-2 respectively.



Figure 5.1- Ordinary Portland cement 53 grade

Table 5.1 Physical Properties of cement

Sl.no	Properties	Test value
1	Standard Consistency	34%
2	Initial Setting Time	35min
3	Specific Gravity	3.14
4	Fineness	3%

Table 5.2 Chemical Properties of Cement

Sl.no	Oxide Contents	Percentage (%)
1	CaO	60.67
2	SiO ₂	17.25
3	Al ₂ O ₃	3.8
4	Fe ₂ O ₃	0.5-6.0
5	MgO	0.1-4.0
6	K ₂ O, Na ₂ O	0.4-1.3
7	SO ₃	1.3-3.0

5.3 Coarse Aggregate:

The coarse mixture is that the largest part of concrete. It's with chemical stable material. It reduces the drying shrinkage and different dimensional changes occurring on account of movement of moisture. The Rigid broken granite stones were used as coarse aggregate in concrete. The nearby quarry is brought with crushed stone aggregate 20 mm in size. Sizes of more than 20 mm are divided by sieves. Tests are performed to test the properties of aggregate



Figure 5.3- Coarse aggregate

Table 5.3 Physical properties of Coarse aggregate

Slno	Properties	Test Value
1	Specific gravity	2.67
2	Fineness modulus	4.75
3	Aggregate impact value	24.48%
4	Flakiness Index	12.56%
5	Elongation Index	42.24%

5.4 Fine aggregate

The most significant function of the aggregate is to assist in manufacturing workability and regularity in mixture. The fine mixture additionally assists the cement paste to carry the coarse aggregate particle in suspension. This action helps plasticity in the mixture and avoids the possible segregation of paste and coarse aggregate.



Figure 5.4-Fine aggregates

Table 5.4 Physical Properties of Fine aggregate

Sl.no	Properties	Test value
1	Specific gravity	2.7
2	Fineness Modulus	4.72
3	Bulking of fine aggregate	52%

5.5 Copper slag

Copper slag is by result of the production of copper. Huge measure of copper slag is created as waste overall amid the copper refining process. River Sand is regular type of fine aggregate utilized in the cement production. Be that as it may, as a result of expanded expense and enormous scale exhaustion of sources choices for river sand are being considered. There have been numerous elective materials with comparable physical and synthetic properties of Sand discovered (Marble powder, lime stone waste, heater slag and welding slag, stone residue and so forth.) and research have been completed to check the reasonableness of its utilization as incomplete substitution of sand.



Figure5.5-Copper slag

5.6 Egg shell powder

The egg shell wastelands in the poultry manufacturing have been highlighted because of its recovery potential. Egg shell waste is available in huge amounts from the food processing, egg breaking, and shading industries. The food indulgence industry is in need of investigation to find another methods for processing and using egg shells

waste in an ecological friendly way. There is a need to find a low cost solution. Removal of egg shell waste are usually not income centers but cost centers. Therefore, the least cost of removal is most necessary.



Figure 5.6- Egg shell powder

Table 5.6 Physical Properties of Egg shell powder

Sl.no	Properties	Test value
1	Specific gravity	2.44
2	Standard Consistency	39%
3	Initial setting time	38 min

Results and Discussion

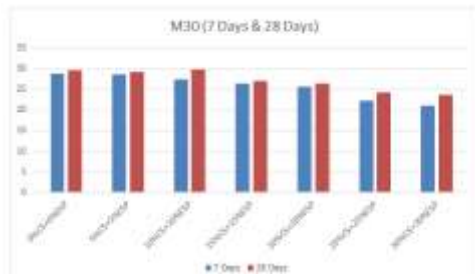
6.1 Introduction

The following chapter describes the compressive test results, preparing cubes from various blends that were previously mentioned, creating six cubes per blend, allowing compression testing on two cubes to be conducted on 7 days, 14 days and 28 days, while the average compression value is used as a compressive power.

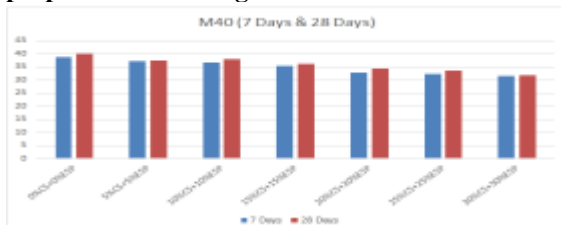
Test results

Table 6.1 Compressive strength results

Sl.No	Type of concrete	M30(7 Days)	M30(28 Days)	M40(7 Days)	M40(28 Days)
1	0%CS+0%ESP	28.84	29.60	38.60	39.86
2	5%CS+5%ESP	28.66	29.20	37.24	37.44
3	10%CS+10%ESP	27.40	29.80	36.80	37.90
4	15%CS+15%ESP	26.40	27.60	35.40	36.20
5	20%CS+20%ESP	25.60	26.40	32.80	34.22
6	25%CS+25%ESP	22.20	24.20	32.20	33.45
7	30%CS+30%ESP	21.00	23.60	31.60	31.62



Graph 6.2 – 7 & 28 Days strength of different proportions of M30 grade concrete

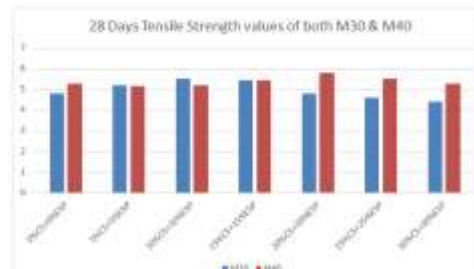


Graph 6.3 – 7&28 Days strength of different proportions of M40 grade concrete

6.3 Tensile Strength

Table 6.2 Tensile Strengths

Sl.No	Type of concrete	28 Days Tensile strength of M30	28 Days Tensile strength of M40
1	0%CS+0%ESP	4.82	5.28
2	5%CS+5%ESP	5.21	5.16
3	10%CS+10%ESP	5.53	5.20
4	15%CS+15%ESP	5.45	5.46
5	20%CS+20%ESP	4.80	5.80
6	25%CS+25%ESP	4.60	5.53
7	30%CS+30%ESP	4.40	5.30

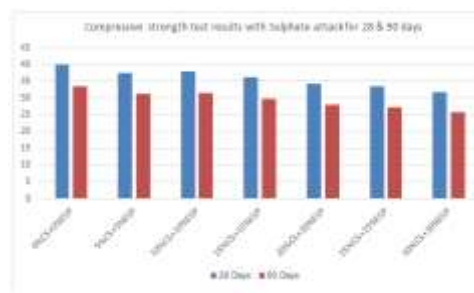


Graph 6.4-28 Days Tensile strength of different proportions of M30 & M40 grade concrete

6.4 Compressive strength test with Sulphate attack

Table 6.3 Compressive strength test with Sulphate attack

Sl.No	% replacement	Compressive strength of cube after 28 Days	Compressive strength of cube after 90 Days	%loss of compressive strength due to sulphate attack
1	0%CS+0%ESP	39.86	33.40	16.22
2	5%CS+5%ESP	37.44	31.13	16.84
3	10%CS+10%ESP	37.90	31.37	17.22
4	15%CS+15%ESP	36.20	29.82	17.60
5	20%CS+20%ESP	34.22	28	18.20
6	25%CS+25%ESP	33.45	27.30	18.40
7	30%CS+30%ESP	31.62	25.73	18.60



Graph 6.5- Compressive strength test results with Sulphate attack for 28 & 90 days

Conclusion

It is possible to utilise the materials for testing since the cement, fine aggregates, and gross aggregates meet IS code specifications within tolerable limitations. As the proportion of copper slag in copper slag concrete declines, the concrete fails to perform properly. The compaction factor of copper slag concrete decreases as the degree of copper slag increases. The best benefit of 7 days of treatment and 28 days of treatment is a copper layer replacement of 20% overall in the concrete compressive force.

Clamping strength for cylindrical specimens is best achieved after 28 days of 20% copper slag replenishment. Increased carbonation and reduced permeability may be achieved by using egg coating powder on the mixture's surface. The carbonation cycle in the mixture must thus be thoroughly studied. Concrete workability was found to be reduced when the ESP and Copper Slag between 14% ESP and 20% Copper Slag. Maximum bending strength is achieved at a maximum of 28 days at 14% ESP and 20% Copper Slag. Maximum split tensile reached with a duration of 28 days and a duration of 40% coffee slag.

For better strength values in concrete grade M30 the substitution of 20 percent copper slack is usually useful.

Concrete of the M30 strength grade may benefit from copper slag replacement in amounts ranging from 20% to 40%..

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