A Critical Review on Limited Substitution with Copper Slag and Quarry Dust on M-25 Grade for Light Weight Concrete

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Abstract— **Concrete is a most prevalent development material on the planet. It is made by blending fine and coarse aggregates, water, cement added substances in a specific endorsed extent. Indeed, even where another material is the main segment of a structure, concrete is normally utilized with it for specific parts of the work. More individuals need to find out about concrete than about other specific materials. Slump shows that the workability increase with the increase in the percentages of copper slag & quarry dust. All investigated containing copper slag & quarry dust mixtures had height slump values and acceptable workability.**

Index Terms— **Copper Slag, Quarry Dust, Aggregates, Compressive Strength, Tensile Strength, Flexural Strength, Split Tensile Strength.**

I. INTRODUCTION

Cement is a integrate material which is used for development as part of exercises. It is found that 10-12 million tons squander materials are create and consume which is determined by the review. We are replaced the fine aggregates such as cement by quarry dust, copper slag. while replaced the cement (in certain rate) with copper slag powder and copper slag, quarry dust, properties of cement determine. they need to rival other growth materials by considering of economy, profitability, condition and quality, for example cement, sand and aggregates. However, this matter can be comprehended by replacement of aggregates and cement with some bonding material or by replacement of aggregate with squander materials.

Plastic State

Once the concrete is firstly mixed it's like 'Tough'. It's soft and will be processed or moulded into numerous shapes. In this stage, concrete is termed plastic. Concrete is plastic for the duration of placing and compaction. The foremost valuable characteristics of plastic concrete are workability and cohesiveness. A worker can sink concrete into plastic concrete.

Setting State

Concrete then initiates hardening. The hardening of concrete once it's not soft is called setting. The setting takes place after compaction & during finishing. Concrete that is messy or wet is additionally simple to place but will be harder to complete. A worker leaves impression in setting concrete.

Hardened State

Hardened state when the concrete has set it begins to realize strength and harden. The characteristics of hardened concrete are strength and durability.

Hardened concrete will have any impression on it if walked on. Concrete exhibits completely different properties in every state. The 4 main characteristics of concrete are:

- Workability
- Durability
- Cohesiveness
- Strength

Alternative Material

Quarry dust has an attractive purpose for the option material as a substitute for sand requiring little to no effort. It even makes trouble dump the crusher dust at one place which causes natural contamination. Basically, within the territories wherever lots of copper slag is created. The conceivable utilization of copper slag as fine and coarse mixture in concrete and its impact on numerous mechanical and long -term properties of mortar and concrete. Copper slag is a potential wellspring of vitality and earth amiable amicable material. There will be expanded use or copper slag in vitality generation later on. So, use as the concrete supplement.

II. OBJECTIVES

The general objectives of this dissertation work is to search out the properties of fresh and hardened concrete for M-25 grade of concrete for cement replacement at various percentages of 0%, 5%, 15% & 20% by quarry dust, copper slag. In this experimental study compressive strength, flexural strength, split tensile strength and workability of concrete has been found out.

The aims of the study are:

- To research the impact of Copper Slag, quarry dust and waste materials in concrete on its strength.
- Replacing the conventional material such as cement by using the different squander materials such as quarry dust, copper slag
- To determine optimum dose of alternative materials such as quarry dust, copper slag and as partial substitute of cement respectively for target strength.
- The investigation concentrates on to determine the relative performance of concrete by using various waste products like quarry dust, copper slag.

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III. Mix design

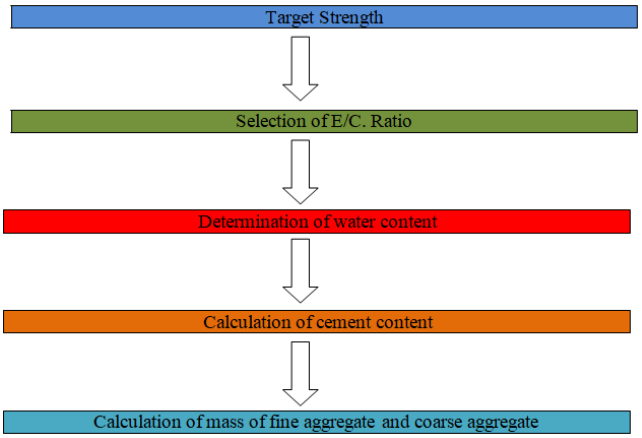
CONCRETE MIX DESIGN METHOD

The way toward choosing reasonable elements of concrete and deciding their relative sums with the goal of producing a concrete of the required, quality, solidness, and workability as financially as could be normal under the circumstances, is named the concrete blend outline.

Indian standard recommended process for concrete mix configuration(IS 10262:1982) was first displayed in the midst of the year 1982. In the revision of IS 456:2000, different changes were displayed in IS-456 where necessities the refresh of IS 10262 of 1982. Indian standard prescribed strategy IS 10262:2009.

- Arbitrary degree
- Fineness modulus method
- Maximum thickness method
- Surface domain methodology
- Indian road congress procedure
- High quality concrete mix
- ACI Committee 211 procedure
- DOE procedure
- Mix outline of pump able concrete

IS Method (Indian standard prescribed strategy IS 10262:2009)



Step 1. Target Strength for Mix Design Proportion
F'ck = fck+ (ts)
F'ck = Target mean strength of 28 days F ck = characteristics strength
Tolerance factor = (IS-10262)
S= Standard Deviation given in table 3.1 Table: Standard Deviation

S.No.	Grade of Concrete	Assume Standard Deviation (N/mm2)
1	M-10	
2	M-15	3.5
3	M-20	
4	M-25	4.0
5	M-30	
6	M-35	
7	M-40	
8	M-45	5.0
9	M-50	
10	M-55	

Step 2. Selection of water cement ratio
Table : Water Cement Ratio (IS-456-2000, Table-5)

S. No.	Exposure	Maximum W/C Ratio
1	Mild	0.55
2	Moderate	0.50
3	Severe	0.45
4	Very Severe	0.45
5	Extreme	0.40

STEP - 3 WATER CONTENT
TABLE : APPROXIMATE WATER CONTENT

S.NO.	NOMINAL MAXIMUM SIXE OF AGGREGATE (MM)	MAXIMUM WATER CONTENT
1	10	208
2	20	168
3	40	165

TABLE : COARSE AGGREGATE PROPORTION

S.NO.	NOMINAL MAXIMUM SIZE O AGGREGATE (MM)	VOLUME OF COARSE AGGREGATE PER UNIT VOLUME OF TOTAL AGGREGATE FOR DIFFERENT ZONE OF FINE AGGREGATE			
1	10	0.50	0.48	0.46	0.44
2	20	0.66	0.64	0.62	0.60
3	30	0.75	0.73	0.71	0.69

Content of Fine Aggregate -= (1-content of coarse aggregate)

Mass of coarse aggregate

= Va x Volume of C.A x Specific gravity of C.A x 1000
Mass of fine aggregate

= Va x Volume of F.A x Specific gravity of F.A x 1000
Where,

Va = Volume of Admixture
CA = Coarse Aggregate
FA = Fine Aggregate
Material and METHOD
Material

1) Cement

2) Copper Slag

3) Quarry Dust

Cement

OPC cement is most simple type cement is in all over the world. It decelerates the faster setting time of cement. In this experimental work 43 grades OPC cement is used to validate as per Indian Standard IS 8112-1989.

- General civil construction
- R.C.C. Works
- Pre-cast items like Blocks, Tiles & Pipe lines Etc.
- Asbestos sheets & pipes
- Plastering& Flooring in Non-structural work.

Table 3.5 Properties of Cement

Properties	Value	Standard Value
Fitness of cement	8.8%	Less than 10%
Grade of Cement	OPC (43 grade)	OPC (33,43,53)
Specific gravity of cement	3.10 g/cc	3.15 g/cc
Initial setting time	55	Min 30 minutes
Final setting time	520	Max 600 minutes
Normal Consistency	31%	26 to 33%

Aggregates

Aggregates can be classified as normal weight, light weight, heavy weight aggregate. Aggregate usually exist o natural sand and gravel, crushed rock or mixture of those materials. Natural sand and gravels are most generally used and can be acquired economically in sufficient quality. Crushed rock is widely used for coarse aggregate the state of the particles of crushing rock depends to a great extent on the kind of rock and technique for crushing.

Table 3.6 Properties of Coarse Aggregate

A. Properties	B. Values	C. Standard Value
D. Specific Gravity	E. 2.76	F. 2.8-2.9
G. Size of aggregates	H. 20mm	I. 20-22 mm
J. Fineness Modulus	K. 5.96	L. -
M. Water absorption	N. 1.0%	O. 0.1 to 2 %
P. Impact Test	Q. 18.2%	R. < 30%
S. Crushing Test	T. 25.5%	U. < 25% for wearing surfaces

Sand

Aggregate which go from 4.75 mm sifter and contains just so considerably coarser material as allowed, fine aggregate is regular sand which is coming about because of the characteristic crumbling of shake and which has been stored by streams or frosty offices, it is likewise pounded stone sand which is created by pulverizing hard stone, it is additionally smashed rock sand which delivered by squashing common rock. Sand, Rock, residue and mud are for the most part results of all characteristic and simulated deterioration of shake sand minerals.

Table 3.7 Properties of Fire Aggregate

A. Properties	B. Value	C. Standard Value
D. Specific Gravity	E. 2.54	F. 26-2.9
G. Fineness Modulus	H. 2.4	I. 2.2-2.6 (fine sand)
J. Water absorption	K. 2.0%	L. More than 1-1.5% by mass

Mixing Water

The blending water needs to be clear and apparently clean free of substances that discolor it, makes it taste or smell in uncommon manner. Alternative sources like ocean water will increase the chance of corrosion in reinforced and pre-stresses concrete, however it doesn't have any effects on the strength of plain concrete. Since, the pH scale is between 7.0 and 9.0. It must be in observation that this also relevant to water existing on the surface and pores of aggregates utilized for concrete preparation.

ALTERNATIVE MATERIAL

Copper slag is a by-result of copper purifying and cleansing process. Copper slag which is a mechanical waste acquired from purifying and refining procedure of copper from Bharat Industry Ltd, Govindpura, Bhopal. Almost 4 tonnes of copper are acquired as waste is arranged to grounds bring about natural effects. So, it can be reused as cementing materials. In refinery plants when copper metal delivered by extraction prepare then copper slag is created in an expansive sum in the generation of copper metal.

Quarry Dust

A quarry is a part from which measuring stone, Shake, development total riprap, sand, rock or slate has been excavated starting from the earliest stage. A quarry is an indistinguishable thing from an open-pit mine from those minerals is removed. The most unimportant variation among the 2 is that open-pit mines

that deliver building materials & measuring stone are generally alluded to as quarries. It's one among the most necessary characteristic of concrete and effects several alternative expressible characteristics of the hardened.

METHODOLOGY USED

First Trial (Replacement of Cement by)

 Normal mix (control) i.e., cement + coarse aggregate + sand + water.

 Special mix 1 i.e., cement (5% of WA replaced by weight of the cement) + coarse aggregate + sand + water.

 Special mix 2 i.e., cement (10% of WA replaced by weight of the cement) + coarse aggregate + sand + water.

 Special mix 3 i.e., cement (15% of WA replaced by weight of the cement) + coarse aggregate + sand + water.

 Special mix 4 i.e., cement (20% of WA replaced by weight of the
cement) + coarse aggregate + sand + water.

Second Trial (replacement of Cement by Quarry Dust)

 Normal mix (control) i.e., cement + coarse aggregate + sand + water.

 Special mix 1 i.e., cement (5% quarry dust replaced by weight of the cement) + coarse aggregate + sand + water.

 Special mix 2 i.e., cement (10% quarry dust replaced by weight of the
cement) + coarse aggregate + sand + water.

 Special mix 3 i.e., cement (15% quarry dust replaced by weight of the
cement) + coarse aggregate + sand + water.

 Special mix 4 i.e., cement (20% quarry dust replaced by weight of the cement) + coarse aggregate + sand + water.

Third Trial (Replacement of Cement by Copper Slag)

 Normal mix (control) i.e., cement + coarse aggregate + sand + water.

 Special mix 1 i.e., cement (5% copper slag replaced by weight of the

cement) + coarse aggregate + sand + water.

 Special mix 3 i.e., cement (15% copper slag replaced by weight of the

cement) + coarse aggregate + sand + water.

 Special mix 4 i.e., cement (20% copper slag replaced by weight of the

cement) + coarse aggregate + sand + water + Concrete.

I. EXPERIMENTAL STUDY

The sieve investigation is directed to decide the molecule measure dispersion in test of aggregate, which we call degree. An advantageous framework for communicating the degree of aggregate is one which the sequential sieve opening are always multiplied, for example 10 mm, 20 mm, 40 mm and so forth the aggregate utilized for making concrete are typically o the most extreme size 80 mm, 40 mm, 20 mm, 10 mm, 4.75 mm, 2.36 mm, 600 micron, 300 micron and 150 micron.

 The aggregate portions from 80 mm to 4.75 mm are termed as coarse aggregate and those divisions from 4.75 mm to 150 microns are termed as fine aggregate. Evaluating example of specimen of coarse aggregate and fine aggregate is surveyed by sieving an example effectively over all the sieve attach one over and other arranged by estimate, with bigger size on the best.

Specific Gravity

Specific gravity of aggregate is ranging from 2.6 to 2.8 as per IS-2720-3.1 (Part-III).

Workability Test

Workability of concrete is a term that contains of the related to four incomplete characteristic of concrete i.e., mix capacity, Transportability, mould capacity and similarity. As a rule, terms workability speaks to the measure of work that is to be done to conserve the concrete in a given shape.

A feasible mix shouldn't segregate. Here the workability is tested by the slump test. The slump test shows the performance of a compacted cone under the reaction of gravitational forces. This examination is performing with a mould known as slump cone.

Compressive Strength Test

The compressive strength is the maximum external load per unit area endured by a concrete sample before failure under compression. Concrete characteristics like the modulus of elasticity, resistance to shrinkage, and creep and durability is directly proportional to compressive strength.

Flexure Strength Test

Modulus of rupture known as flexural strength, bending strength or fracture strength which is a mechanical parameter for hard material, is clear as materials perform to prevent deformation below load. It's defined the normal tensile stress in concrete, when cracking happens in a flexure test. This tensile stress is the flexural property of concrete and is calculated by the utilization of formulas which is considered that the section is uniform.

$F = (M/I)y$

Where,

F = Stress in the extreme fibre.

M = Bending moment at the failure section.

Y = extreme fibre - distance from the neutral axis.

Split Tensile Test

The splitting tests are notable backhanded tests utilized for deciding the rigidity of cement once in a while alluded to as split elasticity of cement. The elasticity of cement can be acquired indirectly by subjecting a solid barrel to the activity of compressive drive along to inverse closures of a generator.

Due to the compressive load the cylinder is dominate to a large magnitude of compressive stress closed to the loading area.

The broad portion is dominated to the same tensile stress placing horizontally. This tensile stress is captured as an index of the tensile strength of concrete and is given by the formula:

$St = 2P/\pi DL$

Where,

St= the indirect tensile strength of concrete

P = load Causing rupture.

D = diameter of cylinder. L = length of cylinder. In this work the cylinder of diameter 15 cm and length 30 cm (IS: 5816-1999) is threw in the is determined shape.

Mixing Concrete

The concrete may be mixed by hand, or preferably, in a examination facility clump blender, so as to side tap loss of water or diverse materials. OPC cement (43 grade) are used as a part of blend and sand are utilized on 2.36 passing sifter on utilized. Normal aggregate is utilized the extent of 40% of 10 mm coarse aggregate and 60% of 20 mm coarse aggregate. There are three waste materials mixed in concrete with incomplete substitute of 5%, 10% and 20%. Water is utilized 50% ml/Kg concrete on base of cement consistency value.

V. RESULT AND DISCUSSION

DISCUSSION

There are three waste materials (Copper Slag and Quarry Dust) to be used as a fractional substitute of cement. We can consider about cost are insignificant by contrast with typical ordinary concrete. Accordingly, this proposal manages checking the plausibility of the ranch, quarry stone, copper result quarry dust &copper slag which is delivered as a loss in production lines for utilizing it as cement replacement material.

Today we are having diverse waste materials, which isn't used other reason. So,we are chipping away at some level of supplanting material like cement, sand and aggregate. That waste material is used in development industry. There are various beneficial like practical, better condition and quality successful. So, we are used waste material like quarry dust, and copper slag with some rate and we are deciding quality by UTM.

CONCLUSION

From the above experiments, the study concentrates on the relative performance of concrete by utilization the copper slag, & quarry dust as partial substitute of cement. In the current work the strength analysis is execute which is analyzed in the following points: All of the concrete containing copper slag & quarry dust showed normal consistency equal and more than the control concrete. Up to 5%, 10%, and 15% of replacement the normal consistency was mostly constant minor differences, at 20% replacement the normal consistency had shown a slight increment to 35%. Slump shows that the workability increases with the increase in the percentages of copper slag & quarry dust. All investigated containing copper slag & quarry dust mixtures had height slump values and acceptable workability. The compressive strength outcome represents that concrete casted with M25 grade at 7^{th}, 14^{th}, & 28^{th} days are decrease with replacements of 5% to 10%, and increments, when the level of the copper slag increment from 15% to 20% at 7^{th}, 14^{th}, and 28^{th} days. The compressive strength outcome represents that concrete casted with M25 grade at7^{th} days are decreases with replacement of 5%, 15%, 20% & 10% have increments, and 14^{th}, 28^{th} days have decrease with replacement of 5%, 15% to 20% and increments when the percentage of the quarry dust increase from 0% to 15% and slightly decreased with 20% replacement at 28^{th} days. Flexural strength is increments when the 5% of the level of the increment and decreasing from 10%, 15% & 20% with the age of 28^{th} days. Flexural strength is increments when the 5%, 10% and 20% of level of the quarry dust increment and reduction from 15% with the age of 28^{th} days. Flexural strength is increments when the 10% and 15% of level of the copper slag increment and decline from 5^{th} and 20% with the age of 28^{th} days. Tensile strength is expanded with the replacement of copper slag and quarry dust increments with the age of 28^{th} days.

A. FUTURE SCOPE

B. Study on M-25 Grade in limited substituted by Copper Slag &Quarry Dust for Concrete which is Light Weight in Future.

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