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# Impact of Various Materials on the Physical Properties of Concrete, Along with Curing Methods

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**ABSTRACT:** Due to increase of modernity in the structural development, we need more acceleration in construction works for accomplishing the demand of modern civilization. As a result to make the construction more effective and less time consuming, testing the impact of various materials on the concrete, with relative decrease of curing period and comparing the different curing methods, to identify the influence of various materials on physical characteristics such as mechanical toughness and resilience that correspond to increased heat of hydration, so that we can compare the respective concrete that eventually gets cured by different curing techniques to accelerate its setting time in order to make it more durable concrete. The replacement will be done by simultaneously increasing the percentages of the materials like fly ash, quarry dust, steel slag, paper fibres, brick powder, coconut shell by 5% 10% 20% 30% 40% and then comparing them with each other to recognize which would be more effective and cost worthy in order of respective replacement.

**KEYWORDS:** Curing methods, fly ash, quarry dust, steel slag, paper fibres, brick powder, coconut shell, physical characteristics, replacement

## I. INTRODUCTION

In last 2 to 4 decades, concrete technology has been grasping more attention in the different modified affordable in construction with introduction of rapid hardening properties. With the help of IS 10262 which is mainly used in mix design of concrete. The amount of most of the products utilized for the simultaneous partial or fully replacement by different materials will go in increasing manner of testing purpose. Here we are considering the impacts of different materials on the concrete to enhance the physical characteristics of the concrete with the allowable replacement. For the intended performances and durability requirements it is essential to concrete structures get properly cured, and to ensure the physical characteristics of the involved materials the respective testing of the materials getting ready with means of curing techniques. Internal curing impacts of physical characteristics on the concrete, as it is more impactful in order to make the concrete less time consuming, as the constructions day by day increasing to its peak due to which it is more reliable and is the very much admiring process which can produce additional moisture content in concrete in order to reach that satisfying heat of hydration. Curing provides the curing agents which will be acting as a source of water in the concrete structure which can ultimately lead to proper curing testing. Here we are not only testing the concrete but also comparing the different curing methods to introduce more effective as well as productive product of quicker setting concrete. Concrete plays the key role in the construction practices likewise it has the property of self-curing. At low cement concentration due to comparatively higher water to cement ratio good workability and finish-ability in the normal strength concrete can be easily obtained. Hence performance of concrete which ultimately depends upon the number of criteria for the increase of life span of the structure it is crucial to mark the corrected curing methods.

### 1.1 NEED

The main need of determination of the impacts of various materials physical characteristics of the materials on the concrete is much important to ensure or to produce the cost worthy and effective product for the alternative measure over less availability of the materials as the sources are depleting slowly but the construction of modern



infrastructure and development of the places needs construction materials, for this to find out the alternative over the current product it is necessary to identify and recognize the materials impact with the curing. As the world is on its changing phase and more construction needs to make it more effective within a month and for that we are comparing the different curing methods in order to justify the property of quicker setting into the newly produced product after simultaneous partial and fully replacement of the current aerials with the waste products of industries. To develop the modern civilization within a month we need this project to make sure the curing methods would be instantaneous over the mote time consuming construction.

## 1.2 OBJECTIVES

1. To compare the physical characteristics of concrete by partially replacing the cement and sand.
2. To perform different curing methods on the concrete cubes to determine its compressive strength.
3. To increase heat of hydration by adding quarry dust so that it can be used in Water retaining structure.
4. To study for the purpose of making cost efficient high strength performance concrete.
5. To increase the use of waste material by considering environmental factor.
6. To give high strength and high workability of concrete by replacing cement and sand.

## II. LITRATURE REVIEW

### 2.1 Strength characteristics by partial replacement of cement by brick powder.

**Sanjay Raj, Preeti D B, Anil kumar, Akshay Mangraj**

The research paper shows that the author has used brick powder as partial substituent of cement with varying percentage of 0%, 5%, 10%, 15%, 20%. At 10% & 20% Maximum Compressive strength, Flexural strength & Split tensile strength. The concrete obtained is eco-friendly.

### 2.2 The strength properties of self-curing concrete with partial replacement of fine aggregates with Quarry Dust.

**Muthuraman P, Thangapandi K, R Anuradha.**

This paper shows that 25% LWA + 1% PEG gives maximum compressive strength, tensile strength and modulus of rupture For M30 grade of concrete. Flexural behaviour of self-curing concrete is same as conventional concrete. Due increase of PEG, slump value decreases.

### 2.3 The study on effectiveness of the various curing methods on the on the properties of concrete.

**Princy KP, Dr. Elson John (November-15).**

In this research paper various Curing Compound are used.

The result obtained after the curing of 7, 14 & 28 days as compared Conventional water curing methodis given in the table :-

Curing Compound	Compressive Strength	Flexural Strength	Splitting Tensile Strength
Water Proofing	Maximum	12% decrease	7% decrease
Wax	99% increase	21% decrease	10% decrease
Acrylic Resin	96% increase	26% decrease	16% decrease

Table no. 0.1

### 2.4 The influence of accelerated curing methods on the properties of concrete.

**Saranya KP, Dr. Elson John.**

The influence of accelerated curing methods on the properties of concrete In this paper Steam curing, electrical curing, microwave curing, hot water curing and carbonation curing. MW energy for 45 min could improve the greatest 8h



early-age compressive strength of the MW-cured. After accelerated carbonation for 4 hours the compressive strength of concrete improves.

### 2.5 Partial Replacement of sand and cement by fly ash and silica fumes.

**Dara Asha Salomi, Hanumanthrao Ch.**

Partial Replacement of sand and cement by fly ash and silica fumes In this research paper cement is partially replaced by fly ash and silica fumes with varying percentage of 60% to 20%. It is concluded that using fly ash beyond 50% will decrease the physical properties of concrete. Using 10% & 50% of Fly ash and Silica fume make concrete more strong and durable.

### 2.6 Curing methods and their effect on strength of concrete.

**SS Nuruddeen Usman, Muhammad Nura Isa.**

Curing methods and their effects on the strength of concrete

The study shows that the immersion of concrete cube is the most efficient method of curing. One large scale different methods used are

- a. Immersion
- b. Sparkling
- c. Polyethylene Membrane
- d. Sharp sand curing.

It is concluded that Curing by immersion gives best physical properties, but it cannot be used on large scale.

### 2.7 Mechanical Properties of Light Weight Aggregate Concrete Using Pumice as a Coarse Aggregate.

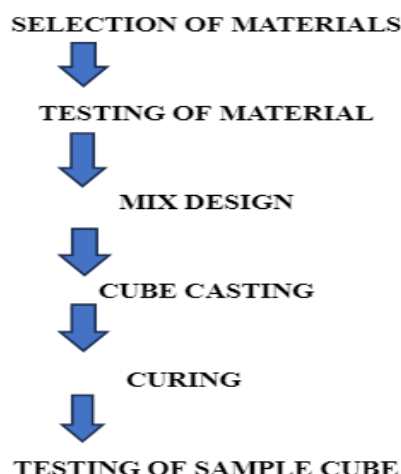
**Hayder Kadhem Adai Al-Farttoosi\*, Oday A. Abdulrazzaq, and Haleem K.Hussain.**

Mechanical Properties of Light Weight Aggregate Concrete Using Pumice as a Coarse Aggregate

As the percentage of Pumice Increases there will variations such in :-

- i. Compressive strength decreases
- ii. Equilibrium density decreases
- iii. Split tensile strength increases
- iv. Water cement ratio increases
- v. Modulus of rupture increases

## III. PROPOSED METHODOLOGY



### 3.1 SELECTION OF MATERIALS

Selection of materials can be done on the basis of their physical properties.

Following table gives the perfect values of the materials properties :-

Sr. No.	Properties	Fly ash	Brick Powder	Steel Slag	Sand
1.	Specific Gravity	2.07	2.17	2.63	2.48
2.	Bulk Density	1100 – 1200 kg/m <sup>3</sup>	1657 kg/m <sup>3</sup>	1620 kg/m <sup>3</sup>	1530 kg/m <sup>3</sup>
3.	Water Absorption	12.11 – 7.84%	-	19.13%	22.05%
4.	Fineness	290 m <sup>2</sup> /kg	-	3.55 m <sup>2</sup> /kg	2.59 m <sup>2</sup> /kg
5.	Colour	Light grey	Redish Brown	-	-

**Table no.1 properties of materials**

**DIFFERENT MATERIALS USED WHILE REPLACEMENT OF CEMENT AND SAND :-**

- 1) Fly Ash :- It is waste product of coal industry. It is also called as coal ash or pulverized fuel ash is a coal combustion product. As it is the combustion of coal finely divide residue which is used to increase the durability and workability of the concrete along with reduction of permeability.



Fig. 01

- 2) Brick Powder :- As the bricks are made up of clay and has extreme fire resistant properties, also contributes to binding of material with each other. We can use brick powder is replacement for cement.



Fig. 02

- 3) Quarry Dust :- It was made using natural aggregates of volcanic origin such as Pumice, Scoria, etc. Concrete is mostly known as grey material with good mechanical strength. In the activities of quarrying there is a crushing of the rock has been occurred by which dust forms and that dust have the properties similar to the aggregates.



Fig. 03

- 4) Coconut Shell Powder :- It is also the waste product of industrial same as fly ash it is more reliable and impactful to increase the durability of the concrete with regards to reduction of permeability.



Fig. 04

- 5) Steel Slag :- Slag of iron and steel used as aggregates for asphalt roads can be recovered as by-products. The steel slag is a residue of the production process of steel. The slag is mainly composed by: silica, alumina, titanium, iron sand and combinations of calcium and magnesium oxides.
- 6)



Fig. 05

### 3.2 TESTING OF MATERIALS

There are several types of concrete testing methods used to access the quality and performance of concrete. The testes performed on concrete are as follows:

#### 1. Workability Test

It is also known as the slump test in which we identify the workability of the concrete. It is performed to identify the property i.e. Workability of the concrete.

The concrete workability is the working of material with concrete property. The phrase ‘working properties of concrete’ non-exhaustively preparation of concrete include placing, compaction mixing and transportation.

#### 2. Slump Test

Slump test is the another type of workability test with the slump cone. A conical frustum having diameter of base 200 mm, top up diameter 100 mm and height of 300 mm known as conical slump test. The most common type of identifying the workability of concrete at the site. Even though, it is widely accepted yet the results not fully satisfied.



**3. Compaction Factor Test**

The accurately workable material is tested by falling it from height. The apparatus is made up to two hoppers on each other and at the bottom a cylinder is fitted. Every hopper is fixed with trap door at the bottom. This method is performed by the specifications of compaction factor test by IS code is given below: - IS 1199:1959 sampling and analysis of concrete.

**4. Permeability Test**

Property of concrete in which it allows to flow water from it. The water absorption test of concrete should not be confused with permeability test of concrete.

**5. Importance of Concrete Setting Tests**

Due to the water in the concrete reinforcement gets corroded. It is known that as volume get increased due to its corrosion and formation of cracks on steel due to its absorption property of water of the concrete. Hence, the permeable concrete will be suitable in order to avoid the cracks and fast corrosion of reinforcement. Therefore, it is so vital to check the setting test of the concrete.

**3.3 MIX DESIGN**

- 1) IS 10262 is usually used for the mix design for controlled concrete and we are using the mix designing proportions of materials like cement and sand mixtures with the newly replaceable materials.
- 2) As a result, we are using and then comparing the control concrete proportions of the materials with the newly replaceable waste products, likewise we are having the different ratio proportions and testing it by IS specifications.
- 3) To find right mix proportion we have to go through different laboratory as well as on field mixing test, calculations and all the examination so that after mixing it won't get spoiled.
- 4) Concrete mix designing is the process of finding accurate proportions of cement, sand and aggregates.
- 5) Most of the times it would be easier to adopt in the structures those requires higher Grade of concrete.

**3.4 CASTING**

Casting of the concrete cube is the main part of the research as we are testing as well as finding the comparative strength by differently casted cubes of concrete.

We are casting cubs firstly of controlled concrete, then we are casting the cubes of fly ash, brick powder, steel slag replaced materials.

After casting these cubes, we are keeping it for the rest for different curing periods as it would be our test while it get settled.

Like

Sr. No.	Description of cubes	Differently Cured Cubes	
		Normal	Chemical
1.	Controlled Concrete	9	9
2.	Fly Ash	9	9
3.	Fly ash + Steel slag	9	9
4.	Brick Powder + coconut shell	9	9

**Table 02. Number of Required Cubes to be Casted**

**3.5 CURING**

It is the process of attaining the moisture in the concrete and with proper temperature range as a result the concrete should get the perfect heat of hydration. And heat of hydration is the Chemical process of concrete curing between cement and water which will be resulting in the formation of settling of concrete as well as rapid and quick hardening.

And here we are comparing and testing three different curing methods,

i.e.1) Controlled curing

2) Chemical curing

#### IV. RESULT & DISCUSSION

For the experimental purposes the mix designs were made according to the M20 grade of concrete mix (cement: sand: aggregates) as 1:1.5:3. The simultaneous and percentage replacement were made with different materials concrete and then compared with the mix design of controlled concrete.

The relative compressive strength and other properties were tested according to the replacement of the materials in order to match up the properties of different replaced materials by replacing materials.

The cubes were then tested and compared with the day wise curing techniques (Normal Curing and Chemical Curing).

Concrete Mix	Curing Duration	Length (mm)	Breadth (mm)	Height (mm)	Area (mm <sup>2</sup> )	Wt. of cubes (kg)	Load of failure (KN)	Strength (N/mm <sup>2</sup> )	Type failure	Average comp. strength (N/mm <sup>2</sup> )
C	7	150	150	150	22500	8.94	288.3	11.84	Satisfactory	12.12
	7	150	150	150	22500	9.1	304.4	13.52	Satisfactory	
	7	150	150	150	22500	8.96	247.7	11	Unsatisfactory	
F	7	150	150	150	22500	8.88	266.5	11.84	Unsatisfactory	11.52
	7	150	150	150	22500	8.82	207.6	9.22	Satisfactory	
	7	150	150	150	22500	8.88	340	13.51	Satisfactory	
CB	7	150	150	150	22500	8.2	238.2	10.58	Satisfactory	10.49
	7	150	150	150	22500	8.1	213.7	9.49	Satisfactory	
	7	150	150	150	22500	8.18	256.5	11.4	Satisfactory	
PW	7	150	150	150	22500	6.92	210.8	9.36	Unsatisfactory	8.33
	7	150	150	150	22500	6.7	152.2	6.76	Unsatisfactory	
	7	150	150	150	22500	6.84	200.3	8.89	Unsatisfactory	
SQ	7	150	150	150	22500	8.88	328.2	14.58	Satisfactory	14.83
	7	150	150	150	22500	8.98	332	14.75	Satisfactory	
	7	150	150	150	22500	8.74	341.5	16.17	Satisfactory	

Table no. 03 Compression Strength Values at 7 days

The above table gives the specifications about percentage replacement of the materials with controlled concrete materials. For 7 days normal curing method the average compressive strength and we can observe that the quarry dust and the steel slag concrete's average values are more than the controlled cubes strength. In this way we find out the compressive strength values of the different material concrete for respective 14 and 28 days.



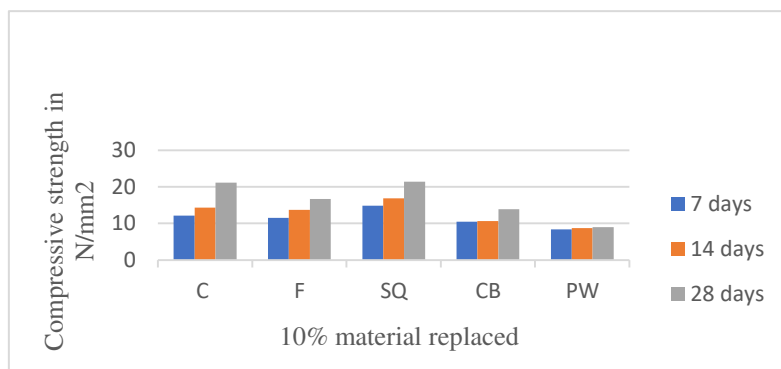


Fig. 06. Category wise distribution of compressive strength

## V. CONCLUSIONS

According to our aim the physical properties of the different materials were get entirely checked with the properties of the normal concrete; we found that the compressive strength of the SQ concrete is high in comparison with the controlled concrete and it shows the higher strength performance of the SQ concrete.

The replacement gives the financial support by addition of materials simultaneously and partially. As the materials were selected according to their different physical properties which are very much similar to the normal concrete like bulk density, water absorption property of the aggregates.

The results states that the chemically cured cubes had relatively high strength than the normal curing as the chemically cured cubes do not need water to soak in the chemical which we've added to it is polyethylene glycol, it increases the density of water in the concrete mix and provides internal moisture to the cube so that relative time of the process would get saved.

As the modern India wants more acceleration in the construction works, so the replacement of the material can identify and analyses the need and work accordingly as the replacement to river sand with the quarry dust and other sands would save the money and shows the effective construction of the structure.

We have found that the papercrete fibre concrete has low strength than any other concrete mix, used for the research. That's why we can't use it in the construction of building but it has another advantage that it is light wt. and more cost effective and ecofriendly. But we can use it in the open areas like parks and gardens, likewise we can't use coconut shell cubes in the internal structure as it contains coconut shell and it can catch the fire.

The structures like water tanks in short for storage structure as it has more strength than the other materials.

As the chemicals were added in the two forms i.e. the 1.5% of cement wt. and 2.5% of the cement wt.

The curing is the key for research work, as we go through the compressive strength tables of the chemical curing the relative strength of the chemically cured cubes is higher than normally cured cubes after successive 7, 14 and 28 days.

From the above results we get that the strength of SQ cubes having the more compressive strength than the controlled cubes the values of the compressive strengths are given in the table no.6,7 and 8, This is how we found that the SQ cubes are more suitable and affordable as compared to controlled cubes.

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