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Comparative study of Strength of M20 Grade of concrete by replacing water with starch water

DEEPAK JAIN
SOURABH DASHORE,NIKITA THORA, DEEPAK PATEL
SANGHVI INSTITUTE OF MANAGEMENT AND SCIENCE INDORE

KEYWORDS: Potato Starch, Rice Starch, Compressive Strength,Workability

ABSTRACT

There are many purpose we are using water every day in our life and it is a daily need of our life .water is used as binding agent in concrete mix design and is important ingradient for mix design of concrete ,to save water we are replacing he water content in mix design by the rice starch water fully and partially and the potato starch water fully and partially and finding the strength and other properties of concrete like workability of concrete and the compressive strength of concrete mix design Of M20 Grade Concrete at 7 , 14 , & 21 Days is 13 , 19.4 & 20.3 mpa respectively .The Strength of M20 Grade Concrete by Replacing Starch Water (Rice Starch) from Normal Water at 7 , 14, & 21 Days is 7.5 , 7.9 & 8.5 mpa respectively.

The Strength of M20 Grade Concrete by taking ratio of Starch Water (Rice Starch) to Normal Water (50 : 50) at 7 , 14, & 21 Days is 10.9 , 14.2 & 15.9 mpa respectively.

The Strength of M20 Grade Concrete by Replacing Starch Water (Potato Starch) from Normal Water at 7 , 14, & 21 Days is 8.1 , 9.3 & 10.8 mpa respectively.

The Strength of M20 Grade Concrete by taking ratio of Starch Water (potato Starch) to Normal Water (50 : 50) at 7 ,14, & 21 Days is 11.5 , 15.4 & 17.2 mpa respectively.

The Strength of M20 Grade Concrete by taking ratio of Starch Water (potato Starch) to Normal Water (25 : 75) at 7, 14, & 21 Days is 11.9, 17.65 & 18.72 mpa respectively.

It is found that the strength of M20 grade cement concrete is increase for different ratio of starch water to normal water.It is found that the workability of M20 grade cement concrete is increase for different ratio of starch water to normal water.

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INTRODUCTION

1.1 CONCRETE

Concrete is a composite material consist of mainly water, aggregate, and cement. The physical properties desired for the finished material can be attained by adding additives and reinforcements to the concrete mixture. A solid mass that can be easily moulded into desired shape can be formed by mixing these ingredients in certain proportions. Over the time, a hard matrix formed by cement binds the rest of the ingredients together into a single hard (rigid) durable material with many uses such as buildings, pavements etc., The technology of using concrete was adopted earlier on large-scale by the ancient Romans, and the major part of concrete technology was highly used in the Roman Empire. The colosseum in Rome was built largely of concrete and the dome of the pantheon is the World's largest unreinforced concrete structure. After the collapse of Roman Empire in the mid-18th century, the technology was re-pioneered as the usage of concrete has become rare. Today, the widely used man made material is concrete in terms of tonnage.

1.2 PROPERTIES OF CONCRETE

1. The Concrete is a material having high compressive strength than to tensile strength. As it has lower tensile stress it is generally reinforced with some materials that are strong in tension like steel.

2 The elastic behavior of concrete at low stress levels is relatively constant but at higher stress levels start decreasing as matrix cracking develops. Concrete has a low coefficient of thermal expansion and its maturity leads to shrinkage.

3 Due to the shrinkage and tension, all concrete structures crack to some extent. Concrete prone to creep when it is subjected to long-duration forces. For the applications various tests be performed to ensure the properties of concrete correspond to the specifications.

4 Different strengths of concrete are attained by different mixes of concrete ingredients, which are measured in psi or Mpa. Different strengths of concrete are used for different purposes of constructions. If the concrete must be light weight a very low-strength concrete may be used.

5 The Lightweight concrete is achieved by the addition of lightweight aggregates, air or foam, the side effect is that the strength of concrete will get reduced. The concrete with 3000-psi to 4000-psi is oftenly used for routine works.

6 Although the concrete with 5000-psi is more expensive option is commercially available as a more durable one. For larger civil projects the concrete with 5000-psi is oftenly used. The concrete strength above 5000 psi was often used for specific building elements. For example, the high-rise concrete buildings composed of the lower floor columns may use 12,000 psi or more strength concrete, to keep the columns sizes small.

7 Bridges may use concrete of strength 10,000 psi in long beams to minimize the number of spans required. The other structural needs may occasionally require high-strength concrete.

8 The concrete of very high strength may be specified if the structure must be very rigid, even much stronger than required to bear the service loads. For these commercial reasons the concrete of strength as high as 19000-psi has been used.

1.3 LIGHT WEIGHT CONCRETE

One of the disadvantages of concrete is its high self weight. Density of normal concrete will be in the range of order of 2200 to 2600 kg/m^3. This heavy self weight will make the concrete to some extent as an uneconomical structural material. Attempts have been done in the past to reduce the self weight of concrete to increase its efficiency of concrete as a structural material. The light weight concrete density varies from 300 to 1850 kg/m^3 by the use of various ingredients.

1. Basically there is only one method for making lightweight concrete, by inclusion of air in concrete. This is achieved in actual practice by three different ways
2. .By replacing the usual mineral aggregate by cellular porous or lightweight aggregate. Introducing the gas or air bubbles in mortar, known as aerated concrete.
3. Omitting the sand from the aggregates, called as No-fines concrete. Lightweight concrete has become more popular in recent years and have more advantages over the conventional concrete.

MATERIALS AND METHODS

In this investigation, the following materials were used:

1 Pozzolona Portland Cement of 53 Grade cement conforming to IS: 169-1989

2 Fine aggregate and coarse aggregate conforming to IS: 2386-1963.

3 Water.

4. Rice Starch

5. Potato Starch

DIFFERENT TEST METHODS FOR WORKABILITY MEASUREMENT:

The workability of concrete may be determined by the following three methods.

1. Slump TestCompaction Factor
2. TestVee-bee
3. Consistometer Test

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In this study, the slump-cone test and compaction factor tests were carried out to determine the workability of concrete. The test procedures are given below:

DETERMINATION OF WORKABILITY BY SLUMP-CONE TEST:

To find the workability of concrete thoroughly mix cement, sand And coarse aggregate according to designed mix proportions to form a homogenous mix of concrete.

Equipment's Required for Concrete Slump Test: The various components required for concrete slump cone test are as: non-porous base plate ,Mould for slump test, , measuring scale, temping rod. The mould used for the test of concrete slump cone test is in the form of the frustum of a cone have height of about 30 cm, bottom diameter of about 20 cm and top diameter of about 10 cm. The tamping rod used in the test is of steel 16 mm diameter and 60cm long and rounded at one of the end.

1. Firstly Clean the internal surface of the mould used for testing and apply oil on its surface.
2. Now Place the mould on a smooth horizontal non- porous base plate.
3. Now Fill the mould upto top with the prepared concrete mix in 3 approximately equal layers of concrete.
4. Now the tamping is done on each layer of concrete mix about 25 strokes from the rounded end of the tamping rod in a uniform manner over the cross section of the mould to be used in testing.
5. For the subsequent layers, the tamping should be penetrate into the underlying layer.
6. Now Remove the excess concrete placed over the top surface of mould and level the surface with a trowel.
7. Now Clean away the mortar or water that leaked out between the mould and the base plate.
8. Now Raise the mould from the concrete immediately and slowly in vertical direction.
9. Now for finding workability measure the slump as the difference between height point of the specimen being tested and the height of the mould

DETERMINATION OF WORKABILITY BY COMPACION FACTOR TEST

1. To find the workability of concrete thoroughly mix cement, sand And coarse aggregate according to designed mix proportions to form a homogenous mix of concrete.
2. Find the Weight of empty cylinder (W1).
3. Fill the upper hopper with the freshly prepared concrete and after 2 minutes, release the trap door of the hopper.
4. As the concrete has come to rest, open the trap door of the lower hopper of apparatus and allow the concrete mix to fall into the cylinder which brings the concrete mix to a partially compacted state
5. .Remove the excess concrete over the top of the cylinder by a trowel.
6. Clean the cylinder properly and weigh it with the partially compacted concrete (W2).
7. Empty the cylinder and refill it with the same sample of concrete in four layers, compaction of each layer by giving 25 blows with the tamping rod.
8. Level up the mi and weigh the cylinder with the fully compacted concrete (W3).

COMPACTION FACTOR= (W2 - W1)/(W3 - W1)

COMPRESSIVE STRENGTH PROCEDURE:

1. Prepare the m20 grade concrete in the required proportion is 1:1.5:3 for 15cm x 15cm x 15cm cube.

2 **Calculation for Preparing Concrete-**

2.1 Quantity of cement in one cube :-

- (shrinkage factor = 1.57)
- = 1/(1+1.5+3) = 0.1818*1.57
- = 0.28545 cubic meter.
- density of cement in 1 meter cube = 1440 kg/cubic meter.
- quantity of cement in 1 meter cube = 1440*0.28545 = 411 kg.
- volume of cube = 0.003375 cubic meter.
- quantity of cement in 1 cube = 0.003375*411 = 1.443 kg

2.2 Quantity of Fine Aggregate :-

- 1.5/(1+1.5+3) = 0.272*1.57 = 0.471cubic meter.
- density of fine aggregate in 1 meter cube = 1600kg/cubic meter
- quantity of fine aggregate in 1 meter cube = 1600*0.471 = 753.6 kg
- volume of cube = 0.003375 cubic meter.

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- quantity of fine aggregate in 1 cube = 753.6*.003375 = 2.646 kg.

2.3 Quantity of Coarse Aggregate :-

- 3/(1+1.5+3) = 0.856 cubic meter.
- density of coarse aggregate in 1 meter cube = 1560 kg/cubic meter
- quantity of coarse aggregate in 1 meter cube = 1560*.856 = 1335.36kg
- volume of cube = 0.003375 cubic meter.
- quantity of coarse aggregate in 1 cube = 1335.36*.003375 = 4.689 kg.

2. Fill the concrete in the desired mould shape of 15cm x 15cm x 15cm cube with proper compaction, after 24 hrs place the specimen in water for curing.
3. Take away the specimen from water when such as natural process time and wipe out excess water from the surface.
4. Take the dimension of the specimen to the close.
5. Clean the bearing surface of the testing machine.
6. Place the specimen within the machine in such a fashion that the load shall be applied to the other sides of the cube forged.
7. Align the specimen centrally on the bottom plate of the machine.
8. Rotate the movable portion gently by hand so it touches the highest surface of the specimen.
9. Apply the load step by step while not shock and incessantly at the speed of 140kg/cm^2/minute until the specimen fails
10. .Record the utmost load and note any uncommon options within the form of failure.

COMPRESSIVE STRENGTH = (LOAD / AREA) in N/sq.mm

RESULTS AND DISCUSSION

Workabilty Test Of Concrete :

The ideal concrete is the one which is workable in all conditions i.e, can prepared easily placed, compacted and moulded. In this chapter, the workability is assessed by two methods as follows:

Slump Cone Test:. The test was conducted for fresh concrete prepared before the moulding process.Workability Results obtained from slump cone test for M20 grade of concrete is shown in below

Slump Cone Test Results :-

Sr. No.	Content	Slump Value (in mm)
1.	Standard Water	28
2.	Rice Starch Water	110
3.	Diluted Rice Water (50 : 50)	67
4.	Potato Starch Water	92
5.	Diluted Potato Starch Water (50 : 50)	73
6.	Diluted Potato Starch Water (25 : 75)	47

The workability from the slump cone test is in increasing manner as the mix proportion replacement increasing. The workability range of concrete increasing as mentioned while being in medium range overall.

Compaction Factor Test:

The compaction factor test was conducted to the same mix that tested for workability by slump cone. The results obtained from the compaction factor test for M20 grade of concrete is

Compaction Factor Test Results

Sr. No.	Content	Compaction factor
1.	Standard Water	0.86
2.	Rice Starch Water	0.91
3.	Diluted Rice Water (50 : 50)	0.80
4.	Potato Starch Water	0.88

5.	Diluted Potato Starch Water (50 : 50)	0.79
6.	Diluted Potato Starch Water (25 : 75)	0.82

The workability of M20 grade of concrete by compaction factor test is similar to that of slump cone test.

Viscosity Test Results :-

The viscosity test of normal water and potato and rice starch water is done and following results should be obtained:

Viscosity Test Results :-

Sr. No.	Content	Viscosity (centipoise)
1.	Standard Water	1
2.	Rice Starch Water	55
3.	Diluted Rice Water (50 : 50)	29
4.	Potato Starch Water	41
5.	Diluted Potato Starch Water (50 : 50)	25
6.	Diluted Potato Starch Water (25 : 75)	12

Compressive strength:-The compressive strength test of M20 grade of concrete is done by replacing water by potato starch and rice starch fully and partially by by making 9 cubes of 150mm*150mm*150mm cube is given below :

Compressive Strength Test Results

Sr. No.	Content	7 Days (mpa)	14 Days (mpa)	21 Days (mpa)
1.	Standard Water	13	19.4	20.3
2.	Rice Starch Water	7.5	7.9	8.5
3.	Diluted Rice Water (50 : 50)	10.9	14.2	15.9
4.	Potato Starch Water	8.1	9.3	10.8
5.	Diluted Potato Starch Water (50 : 50)	11.5	15.4	17.2
6.	Diluted Potato Starch Water (25 : 75)	11.9	17.65	18.72

CONCLUSION

The following conclusions are made based on the experimental investigations on compressive strength, slump cone test, compaction factor test :-

1. The Strength Of M20 Grade Concrete at 7 , 14 , & 21 Days is 13 , 19.4 & 20.3 mpa respectively .
2. The Strength of M20 Grade Concrete by Replacing Starch Water (Rice Starch) from Normal Water at 7 , 14, & 21 Days is 7.5 , 7.9 & 8.5 mpa respectively.
3. The Strength of M20 Grade Concrete by taking ratio of Starch Water (Rice Starch) to Normal Water (50 : 50) at 7 , 14, & 21 Days is 10.9 , 14.2 & 15.9 mpa respectively.
4. The Strength of M20 Grade Concrete by Replacing Starch Water (Potato Starch) from Normal Water at 7 , 14, & 21 Days is 8.1 , 9.3 & 10.8 mpa respectively.
5. The Strength of M20 Grade Concrete by taking ratio of Starch Water (potato Starch) to Normal Water (50 : 50) at 7 ,14, & 21 Days is 11.5 , 15.4 & 17.2 mpa respectively.
6. The Strength of M20 Grade Concrete by taking ratio of Starch Water (potato Starch) to Normal Water (25 : 75) at 7, 14, & 21 Days is 11.9, 17.65 & 18.72 mpa respectively.
7. It is found that the strength of M20 grade cement concrete is increase for different ratio of starch water to normal water.
8. It is found that the workability of M20 grade cement concrete is increase for different ratio of starch water to normal water.
9. In future if we use starch as a admixtures (like Cassava , maize etc) with starch water so we can gain the strength equal to the normal water & neglecting normal water.

10. It is found that the setting time of concrete is increased by the addition of starch water namely rice and potato. So whenever a delay in placing of concrete is necessary, we can use these Starch water in definite proportion.
11. It can be act as Viscosity Modifying agent.

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