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ANALYSIS OF THE EFFECT OF RED SLUDGE, HYDRATED LIME & BASALT FIBER ON THE STRENGTH PARAMETER OF CONCRETE BY PARTIAL REPLACEMENT OF CEMENT

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Abstract

In response to the growth of the construction sector, there has been a massive rise in the consumption of cement and concrete for various kinds of construction. In the forthcoming ten years, the same rate is predicted to continue, which might have an impact on the environment. the availability of raw materials needed to make cement and manufacture. Concrete is scarce and expensive and produces with more energy. The resources are beginning to run out due to the rising demand. Incorporating industrial waste products and by-products in cement production and concrete construction is crucial to resolving this issue. Here, an experiment was performed to replace Portland Cement with red mud and hydrated lime in particular grades of concrete at varying proportion and examine the impact on the strength of the concrete by putting into consideration the cementation behavior of red mud. Here, an effort has been made to create a product using important industrial waste, like red mud, to partially replace cement with hydrated lime and basalt fiber. This project displays the findings of research on the manufacture of concrete members utilizing a material combination that mostly consists of red mud, lime, and basalt fiber. The present study primarily focuses on the concrete's compressive strength, split tensile strength, and flexural strength characteristics, which are significant parameters to be studied in the manufacturing of concrete with various raw material proportions.

Keywords: *Red Sludge; Line Fiber; Basalt Fiber; Cement; Concrete.*

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1. INTRODUCTION

India, it is the fastest growing country across globe. With the increase in technology, economy, industrialization. There is increase in demand of civil structures house, flats, apartment offices, industries, roads, highways, bridges. And when it comes to construction, the main material we require in construction is concrete. Concrete is the widely used construction material in the world and for all types of civil structures. Civil structures which include houses, flats, apartment, bungalows for residential purposes, industries, cottage, steel plants for commercial purposes, it is also use in construction of roads (reinforced roads), highways, airports, bridges, tunnels. Dams, a

structure to hold large amount of water is also made from concrete, the stored water in dam is use in many different ways like irrigation, navigation, hydroelectricity, flood control, fishing. It consists of cement, aggregates and water in a require ratios. Concrete, is very important component in civil structures which help structure to provide strength and durability but it eventually provides low tensile strength and low strain, because when plain cement is used it may result in minor cracks after setting of cement. Concrete is the second-most-used substance in the world after water, and is the most widely used building material. Its usage worldwide, ton for ton, is twice that of steel, wood, plastics, and aluminum combined. Concrete is expected to be a key material for structures resilient to climate disasters, as well as a solution to mitigate the pollution of other industries, capturing wastes such as coal fly ash. This concrete generation evolves 5-8% of the whole planet's human produced CO2. It has been also predicted that with the increasing world's population, the demand for concrete is expected to grow to approximately 20 billion tonnes a year by 2050. Concrete is absolutely indispensable in modem society.

1.1 Red Mud

Red mud, also known as bauxite residue, is a type of industrial waste created during the Bayer process used to convert bauxite into alumina. Iron oxides, which give it its red colour, are among the many oxide compounds that make up this substance. The Bayer method accounts for over 95% of the world's alumina production; for every tonne of alumina produced, 1 to 1.5 tonnes of red mud are also created. Carl Josef Bayer invented the Bayer process, which is the main industrial method of processing bauxite to create alumina (aluminum oxide). . Red mud is the output of Bayer's process from the aluminum sector that is produced as waste. It should be distributed properly because it is a very caustic chemical material that can contaminate ground water and pose health risks. For these sectors, disposing of such materials is a significant issue. Red mud is a solid waste that is produced worldwide in aluminum facilities. About 35 million tonnes of red mud are generated in Western nations.

1.2 Hydrated Lime

A subtype of dry powder formed from limestone is called hydrated lime. It is made by converting oxides in quicklime to hydroxides by adding water. Movable air locks, screw feeders, conveyor belts, drag chain conveyors, and pneumatic conveyors are just a few of the numerous ways that lime can be fed and transported. A lime slurry tank with a mixer and a water supply control valve can be ordered if the lime needs to be turned into a slurry. Ca is its chemical symbol (OH).

1.3 Basalt Fiber

The material known as basalt fiber is created from the incredibly fine basalt fibres, which are made up of the materials hematite, metamorphic rock, and olivine. It is comparable to glass fibres and has excellent physical and mechanical qualities while being comparatively less expensive than carbon fibre. It can be used as a composite to make items like camera tripods and is used as a protective textile in the automotive and aerospace industries.

Basalt continuous fibre production is a one-stage process that involves melting, incorporating the basalt, and extracting the fibres. Basalt is only heated once. BCF is further processed into materials using "cold technologies" that use little or no energy. Crushed basalt from a well selected quarry source is used to make basalt fibre. For the manufacturing of fibre, basalt with a high acidity (above 46% silica concentration) and decreased iron content is preferred. In contrast to other composites like glass fibre, almost no materials are used when it is made. Basalt is merely cleansed before being melted.

2. LITERATURE REVIEW

(a) Akarsh .N . K [2017]: The study present the work of examines the likelihood of supplanting Portland cement by red mud. As a result of putting away issue, the waste contrarily influences the earth. To tackle this issue, Portland cement was supplanted up to 40% of red mud by weight of cement. The Proprieties of the concrete, like compressive, tensile and flexural strength of red mud concrete were evaluated. This study shows that the addition of red mud on enhances the properties of concrete.

(b) P. Syam Sai [2017]: In this study experiments have been performed to evaluate the quality attributes of the aluminum red mud. Test samples were made with the replacement of 0- 20% at an interval of 50% of red mud and 5% of hydrated lime with cement bond in M40 and M50 grade concrete. To impart cementations property of red mud, hydrated lime is incorporated. This study emphasizes on the promising usage of red mud in the sustainable development.

(c) Mahin Sha O B [2016]: In this study experiments were done to supplant the cement by red mud in concrete for various rates and to studies its impacts on the quality and different properties of the concrete. The test result shows that the addition of red mud up to 20% shows the properties of the concrete comparable with the conventional concrete [06].

(d) A. B. Sawant et al: Studied significance of red mud over Portland cement by partial replacement of cement up to certain extent [07].

3. CONCLUSION

The purpose of this study is to determine the strength parameters of red mud concrete, which is prepared by replacing cement with red mud and hydrated lime in the standard concrete-making procedure. A number of different kinds of experiments are conducted. Laboratory work is the focus of the investigation that was carried out. In order to do this task, the materials that are utilised are as follows: red mud, lime, cement, fine aggregate, course aggregate, and basalt fiber.

CEMENT:

Cement is a grey color powder material, use in mostly all type of civil work. It is binding or adhesive material that is use in construction to make structure compact and durable. Limestone, clay, and marl are the three most essential raw materials for making cement. In the broadest sense, cement can be defined as a substance with

cohesive and adhesive qualities that can bind mineral pieces into a dense mass. This concept covers a wide range of cementing substances. For construction applications, the term "cement" only refers to the adhesives used with rocks, sand, bricks, and other building materials. Since it is utilised at various stages of construction in the form of mortar or concrete, cement is the most crucial component of structural projects.

RED MUD:

Red mud, also known as bauxite residue, is an industrial waste produced during the Bayer process of converting bauxite into alumina. It is made up of a variety of oxide compounds, including iron oxides, which give it its red colour. The Bayer process produces about 95 percent of the alumina produced globally; for every tonne of alumina produced, around 1 to 1.5 tonnes of red mud are also created.

HYDRATE LIME:

Calcium hydroxide, more often known as slaked lime, is an inorganic substance that has the formula Ca (OH)2 in its chemical make-up. The result of combining or slaking quicklime (calcium oxide) with water results in the formation of an odourless, colourless crystal or a white powder.

BASALT FIBER:

A material called basalt can be used to make a high-performance, non-metallic fibre called basalt fibre. This fibre is manufactured by melting basalt rock at a high temperature.

Mix Design Mix Design for samples of M30 used as per IS10262:2000.

Table 1: Mix design

M-30 CONCRETE MIX DESIGN		
As per IS 10262-2009 & MORT&H		
1	Grade Designation	M30
2	Type of Cement	OPC 53 grade
3	Maximum Nominal Aggregate size	20mm
4	Maximum Cement Content	310 kg/m3
5	Minimum Water Cement Ratio	0.45
6	Workability	50-75 mm
7	Exposure Condition	Normal
8	Degree of Supervision	Good
9	Type of Aggregate	Crushed Angular Aggregate
10	Maximum Cement Content	540 kg/m3

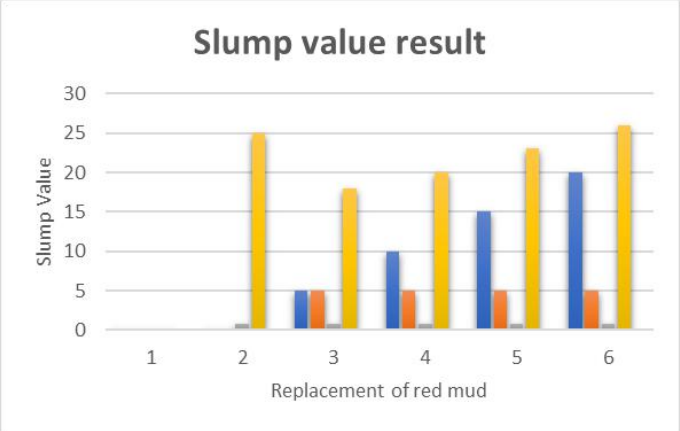
Table 2: Replacement of red mud

% Replacement of red mud	0	5	10	15	20

4. TEST & RESULT

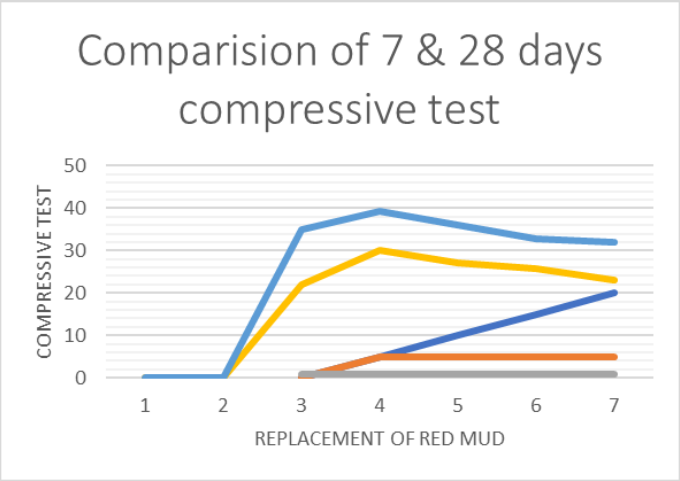
SLUMP TEST

This is a test that is performed to determine the consistency of the concrete. This test enables us to determine the amount of water that has been mixed into the concrete paste, which, to put it another way, we may say helps us determine the water level. In the case that an excessive quantity of water is added to the paste of the concrete mixture, this will lead to the formation of segregation, which will ultimately cause the concrete structure to fail to give the requisite strength and durability.



COMPRESSIVE STRENGTH TEST

The results of this test provided us with a general concept of the properties of concrete. With the use of this test, we will be able to determine whether or not the concrete work has been completed correctly. In contrast, compressive strength refers to a material's or structure's capacity to support loads applied to its surface without buckling or cracking under the pressure. When a material is subjected to compression, the size tends to decrease, and when it is subjected to tension, the size tends to increase.

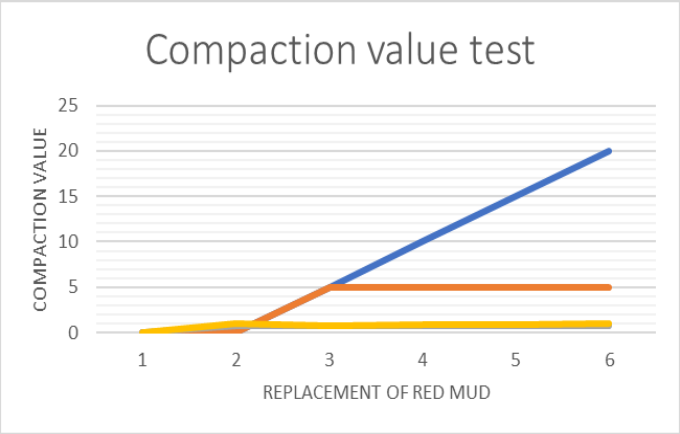


The compressive strength of concrete is determined by a wide variety of parameters, including the ratio of water to cement, the strength of the cement, the quality of the concrete material, and quality control measures

taken during production of the concrete, amongst others. The compressive strength test, commonly known as the CST, is used to determine how resistant a concrete block is to being compressed, in addition to providing an indication of the characteristics of concrete.

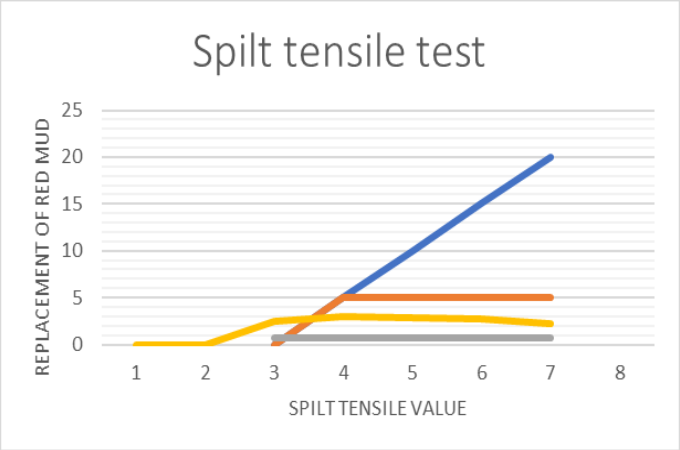
COMPACTION FACTOR TEST

Although it was mainly developed for use in a laboratory setting, the compacting factor test can also be carried out in the field if necessary. It is more precise and sensitive than the slump test, and it is especially helpful for concrete mixtures that have very low workability. It is typically utilised when concrete is to be compacted by vibration. The approach is applicable to plain and air-entrained concrete that is created using lightweight, normal weight, or heavy aggregates that have a nominal maximum size of 38 millimetres or less. Aerated concrete and no-fines concrete, on the other hand, are not included in the scope of this method.



SPILT TENSILE STRENGTH TEST

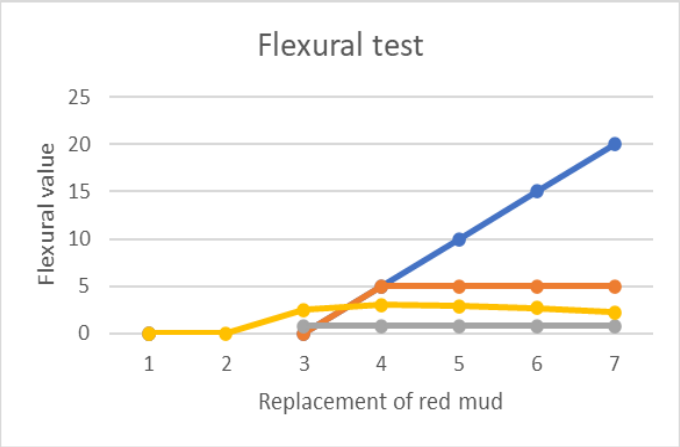
The splitting tensile strength test is used to measure the tensile strength of hardened concrete. Small changes in the ratio of water to cement, the amount of each ingredient, an increase in the slump, etc., can change the strength of the concrete you want. This, in turn, changes how strong and stable structures are.



There are several ways to find out how strong concrete is. Concrete and structures should be tested for quality at different stages, from when they are being made to when they are hard. Quality tests are an important part of making sure that a building is built well. This article talks about the splitting tensile strength test, which is used to figure out how strong concrete is. Apparatus used: Testing machine, Plate or Supplementary Bearing bar, bearing strips, Cylinder specimen, Tamping rod.

FLEXURAL TEST

The flexural test on concrete according to ASTM standards is described. The differences between the ASTM standard, the Indian standard, and the British standard regarding the flexural test on concrete, if any, are noted. Indirectly, the flexural test measures the tensile strength of concrete. It evaluates the ability of an unreinforced concrete beam or slab to resist bending failure.



5. CONCLUSION

The following are some of the findings that can be derived from the experimental investigations that were carried out on the subject of replacing red sludge, fibre, and hydrated lime with cement % in order to determine the optimal percentage replacements for cement:

1) The optimal replacement percentage of red mud with cement by weight has been determined to be 30 percent. This is because the addition of red mud to M30 concrete increases the pozzolanic property of the cement, making the M30 concrete more pozzolanic.
2) The use of red mud in combination with cement results in an improvement in binding quality by demonstrating the same setting time as ordinary cement. In addition, the strength parameters of M30 grade concrete are improved by up to 30 percent when red mud is used as a replacement.
3) The percentage of red mud in concrete has a direct relationship with the amount of water it can absorb.
4) An increased percentage of red mud both raises the amount of water that the concrete can absorb and lowers the amount of strength it has.
5) The value of flexural strength was measured to be at its highest point when red mud concrete seemed to have no replacement at all.

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