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Experimental Study On Partial Replacement of Cement with Dolomite Powder and Brick Kiln Dust

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ABSTRACT:

This experimental study investigates the feasibility of partially replacing cement with dolomite powder and brick kiln dust in concrete. This work discusses the result of an experimental investigation into the evaluation of a concrete mix with replacement of cement by dolomite powder and brick kiln dust up to 20% on M25 mix. The results show that partial replacement of cement with dolomite powder and brick kiln dust can improve the compressive strength, Split tensile strength, Flexural strength and workability of concrete, while reducing the environmental impact of cement production. The optimal replacement percentages are determined, and the implications for sustainable construction practices are discussed. The findings of this study contribute to the development of more sustainable and environmentally friendly concrete mixtures.

Key words: Dolomite Powder, Brick kiln Dust.

1. INTRODUCTION

Concrete plays very important role in construction industry as a construction material. It is a stone like hard material obtained by mixing cement, sand (fine aggregate), coarse aggregate and water in some specific proportions. Portland cement is considered as the best building material due to its high mechanical strength. Cement industry which consume most of energy and emits greenhouse gases, leads to be responsible for 7% of the global CO2 emission. Cement, fine aggregate, coarse aggregate, mineral admixtures, chemical admixtures and water are the important constituents of concrete. Cement is most important constituent of concrete, since its binds the aggregates and resists the atmospheric action. Portland cement concrete is now a days vastly used as construction material because of its good physical and mechanical properties, its economy, awesome durability, ease with which it can be created, the ability to frame it into any shape, size and its high compressive quality.

Global consumption of concrete has increased with the developments and innovations in the construction industry. The demand for cement in the construction industry can be met to some extent with the use of some locally available and cheaply available wastes. These wastes not only replace cement but also help to reduce the solid waste that is dumped into the environment. There are so many wastes on this earth which can be replaced for cement for some extent. Every waste has some own merits and demerits. Nowadays, there is the huge demand of concrete in this modernization world. So in

the field of civil engineering the main aim of any construction is to get high strength and durability with effective cost. And also, it's our duty to save the environment from harmful gases. The main purpose of doing partial replacement of cement with dolomite and kiln waste ash is to solve these problems.

2. OBJECTIVES OF STUDY:

The main objectives of this study are:

1. To investigate the effects of partial replacement of cement with dolomite powder and brick kiln dust on the mechanical properties of concrete.

2. To determine the optimal replacement percentages of cement with dolomite powder and brick kiln dust.

3. LITERATURE REVIEW:

Tugci Busra et. al (2023) The study of expansive soil using brick dust as a stabiliser led to a notable decrease in the soil's behaviour related to swelling and shrinking. The soil's plastic limit and shrinkage limit increased when marble dust was added as a stabilising agent, but its liquid limit, plasticity index, and shrinkage index fell. The engineering characteristics and behaviour of the expansive soil were enhanced by the addition of brick dust at a rate of 50% of the soil's dry weight. The soil's swelling and shrinking decreased when compared between 100% black cotton soil and a mixture of 50% black cotton soil and 50% brick dust.

Prithvi Pati et. Al (2022) The study focuses on replacing some of the fine aggregate in concrete with crushed brick detritus. It draws attention to the expanding concern regarding environmental sustainability in the construction industry as a result of the depletion of natural resources and the rising amount of waste produced by construction and demolition operations.

Saif Saad Mansoor et. al (2020) This study includes the use of waste resources like silica fume and waste glass powder as pozzolanic materials in concrete as partial cement substitutes. The article explores the effects of different replacement levels on mortar properties and emphasises the potential of waste clay brick as a pozzolanic material for partially replacing cement.

Shivangi Pandey, Anisha Mire. (2019) This paper deals with the effective use of dolomite powder in cement. It is focused on M20 grades of concrete by nominal design. The percentage of Dolomite powder which replaces cement are 5%, 10%, 15% and 20% by the weight of cement to form concrete. The compressive strength of concrete with dolomite powder is compared with those of the standard specimens. The results indicate that replacement of cement with dolomite powder increases the compressive strength of concrete in optimum mix.

L. Ranjith Kumar, J. Kiran, P. Rangarajan (2017) The purpose of this work is to describe the effect of fine ground dolomite on important physical and mechanical properties of concrete. Dolomite powder has some similar characteristics of cement. The replacement percentages tried were 0%, 5%, 10%, 15% and 20% by weight of cement. The compressive, split tensile and flexural strengths of concrete with dolomite powder were compared with those of the reference specimens. The results indicate that replacement of cement with dolomite powder increases the compressive, split tensile and flexural strengths of concrete

J Sateesh Kumar (2016) have done on their research on "Physical and Chemical characteristics of dolomite for partial replacement of cement in M20 Concrete" The investigation of this paper to study the fresh & hardened concrete when cement is partially replaced by dolomite powder. The percentage of dolomite powder are replaced cement in this investigation are 0%, 5%, 10%, 15%& 20%.The fresh property is workability and hardened properties are compressive strength, flexural strength, split tensile strength . 5%wt and more than 20%wt dolomite limestone into cement always reduces compressive strengths after 7 and 28 days. Specimens containing 10% dolomite limestone powder by weight have the maximal compressive strengths.

Hemraj R. Kumavat (2013) Investigated brick waste for its use as a replacement of cement and sand in cement mortar as it behaves as a pozzoloana. It may make an important contribution towards decreasing the adverse effect of the production, disposal and the dumping of brick waste on the environment. His findings show that richer mixes gives lower value of bulk density and higher values of compressive strength for sand replacement with brick waste up to 40%.

Ms. Monica C. Dhoka (2013) Carried out experimental study on green concrete and described the properties of concrete and its strength with the use of waste materials. She described about green concrete in which we can reduce the pollution in environment by adopting suitable proportion of materials like cement and can improve the durability of concrete under the serve condition.

4. MATERIALS:

A. Cement: The Ordinary Portland Cement of 53 grade conforming to IS: 12269-1987 is used.

B. Fine Aggregate: The fine aggregate type used in the study was Natural sand.

C. Coarse Aggregate: Coarse aggregate are the crushed stone is used for making concrete.

D. Dolomite Powder: Dolomite is a carbonate material serene of calcium magnesium carbonate. The term is also used to relate the sedimentary carbonate rock dolostone. Dolostone is composed primarily of the mineral dolomite with a stoichiometric ratio of 50% or greater content of magnesium substitution calcium, often as a result of metamorphism. Dolomite is a rock forming mineral which is noted for exceptional wettability and dispensability as well as moderate oil and plasticizers absorption. Dolomite has good weathering resistance.

Fig. Dolomite Powder

E. Brick kiln Dust: There are two major ingredients from which building bricks are made, one is clay and other is sand. Brick dust is a waste product obtained from different brick kilns and tile factories. There are numerous brick kiln which have grown over the decades in an unplanned way in different part of the country. Tons of waste products like brick dust or broken pieces or flakes of bricks (brickbat) come out from these kilns and factories. So far, such materials have been used just for filling low lying

areas or are dumped as waste material.

Fig. Brick kiln dust

F. Water: In this research potable water free from organic substance was used for mixing as well as curing of concrete.

5. CASTING:

Casting programme consists of Preparation of moulds as per IS 10086:1982, preparation of materials, weighing of materials and casting of cubes. Mixing, compacting and curing of concrete done according to IS 516:1959.

Concrete mix is were prepared as per design mix and for each mix following specimens of both conventional and partial cement replaced concretes were casted.

Table1: Proportion of Dolomite powder and Brick kiln dust

Specimen Designation	%Cement	% Dolomite Powder	% Brick kiln Dust
NM	100	0	0
TR1	80	5	15
TR2	80	10	10
TR3	80	15	5

6. TESTINGS:

1.Compressive strength test: Concrete cube specimens (150 mm x 150 mm x 150 mm) for computing compressive strength.

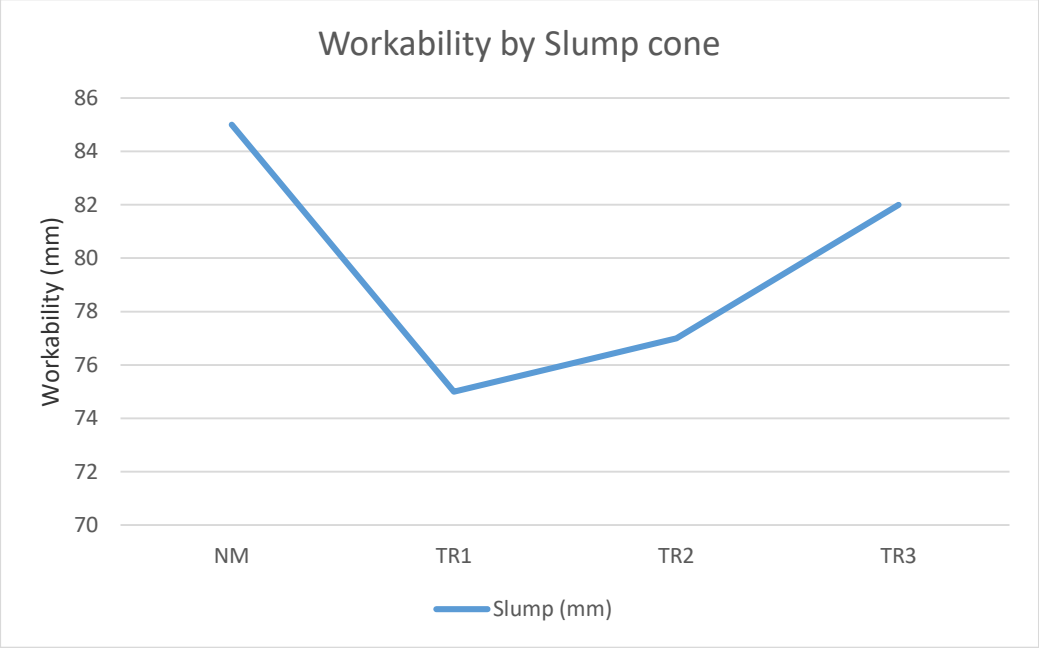
2. Split tensile strength: Concrete Cylinder specimens (150 mm Dia. and 150 mm Height) for computing compressive strength.

3. Flexural strength test: Concrete Beam specimens (150 mm x 150 mm x 700 mm) for computing Flexural strength.

7. RESULTS:

Table No. 2. Workability by Slump Cone Results

Specimen Designation	% Cement	% Dolomite Powder	% Brick kiln Dust	Workability by slump Cone (mm)
NM	100	0	0	85
TR1	80	5	15	75
TR2	80	10	10	77
TR3	80	15	5	82

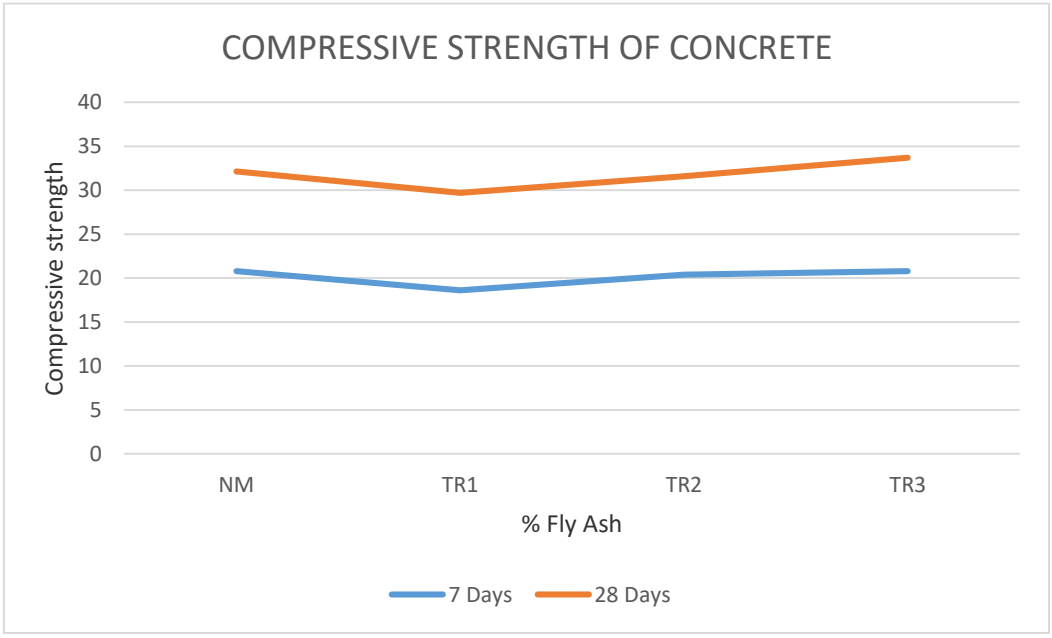


Graph 1. Workability of Concrete

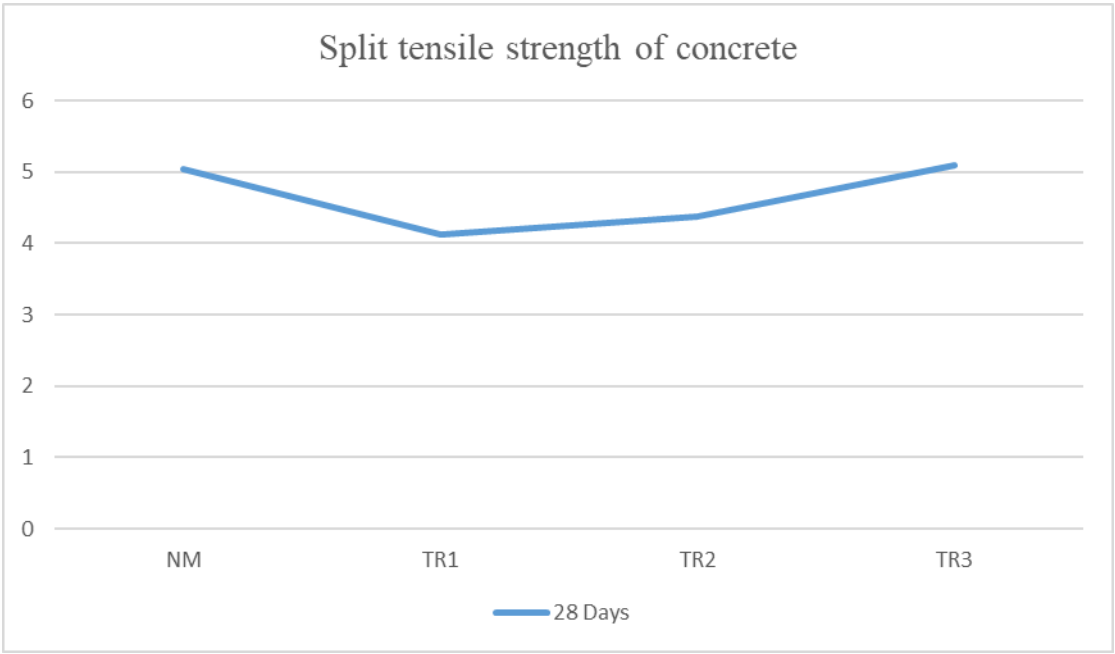
Table No. 3. Test results of Hard Concrete

Specimen Designation	% Cement	% Dolomite Powder	% Brick kiln Dust	Compressive strength(Mpa)		Split Tensile strength (Mpa)	Flexural strength (Mpa)
				(7Days)	(28Days)	(28Days)	(28Days)
NM	100	0	0	20.80	32.15	5.04	7.22
TR1	80	5	15	18.60	29.70	4.12	5.92

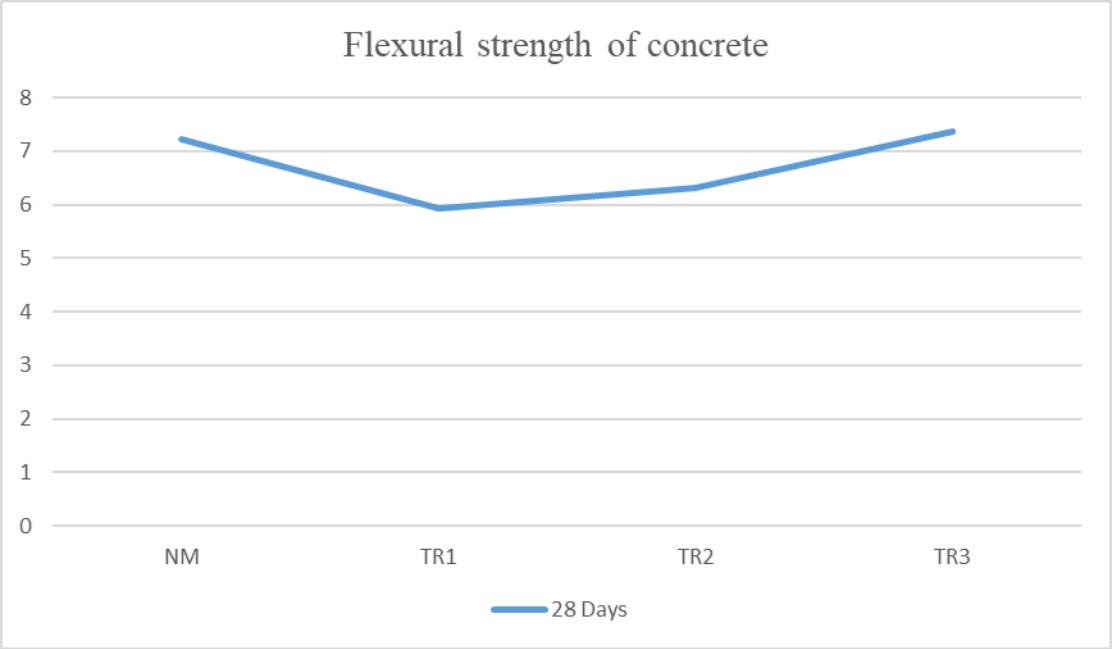
TR2	80	10	10	20.40	31.60	4.38	6.32
TR3	80	15	5	20.80	33.70	5.10	7.36



Graph 2. Compressive Strength of Concrete



Graph 3. Split tensile Strength of Concrete



Graph. 3 Flexural Strength of concrete

8. CONCLUSION:

1. From the experimental analysis Properties of concrete found enhanced with incorporation of dolomite and brick dust.
2. Concrete with 15% replacement of cement with Dolomite powder and 5% replacement of Brick kiln ash shows good mechanical properties (Compressive Strength).
3. Concrete with 15% replacement of cement with Dolomite powder and 5% replacement of Brick kiln ash shows good Split tensile strength.
4. Concrete with 15% replacement of cement with Dolomite powder and 5% replacement of Brick kiln ash shows good Flexural Strength.
5. As we increase the percentage of Brick kiln dust workability of concrete goes on decreasing.

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