

Study and Experimentation on Red Mud and Natural Fiber

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Abstract: This study is limited to the investigation of the efficiency of compressed stabilized earth block in producing an alternative walling material for low cost housing using soil and coir. Due to high cost of sand in the market, the analysis of stabilized earth blocks will reveal that this could be a substitute to reduce the cost of the entire building or used stabilized earth blocks where there is no sand in such an area where the work is going to be sited. Does a great job would throughout this work, although it is limited in scope to assess their suitability as standard concrete aggregates.

In line with sustainable development and the urgent need to provide shelter for the Worlds growing population, there is a need for alternative environmental kind of researches in construction that lessen demands on renewable resources.

Keywords: Red Mud, Natural Fiber, Aggregate, Concrete.

INTRODUCTION- Concrete has the unique distinction of being the only building material that is really manufactured on the site, using locally accessible materials, with its ability to be cast to any desired shape and sizes. This important property can offset all of its shortcomings. The ingredients can be classified into two group's i.e. - active and inactive. The active group consists of cement and water, inactive group consists of fine and coarse aggregates. The cement and water form a paste that hardens and bonds the aggregates together. Sometime admixtures are added to improve the properties of the concrete.

Generally a concrete mix consists of about 10 to 15% cement, 60 to 75% aggregates and 15 to 20% water. Entrained air in many concrete mixes may also take up another 5 to 8%

EXPERIMENTAL STUDIES- To facilitate the extraction of fibers, coconut husks were soaked in water for one month and later placed in 10% concentration of sodium hydroxide (NaOH) for seven days, before physical extraction of the fibers by hand. Fibers were separated while minimizing structural damages during the extraction process. The fresh water was meant to remove the pith particles and the lignin from the surface of the fibers.

PREPARATION OF CUBE - In order to keep the similar powder content in concrete mixtures, the addition of red mud was by replacement of cement, taking both cement and red mud as binder. In Kalinga University, the binder was defined as the sum of cement and red mud by mass, whilst in Chongqing University the binder was defined as the sum of cement and 50% red mud by mass, based on their individual trials for the fresh concrete with desired workability. Concrete with red mud by 0–30% mass of binder was manufactured to investigate the effect of red mud addition on the properties of concrete.

Table: Chemical composition (%) of Red Mud Soil

COMPONENTS	WEIGHT %
Al ₂ O ₃	20-22
Fe ₂ O ₃	40-45
SiO ₂	12-15
TiO ₂	1.8-2.0
CaO	1-2
Na ₂ O	4-5



Fig- Compressive Strength Test



Fig- Split Tensile strength



Fig- Shear Strength Test

RESULTS-

Table: Test results of compressive strength

% replacement of cement by RM	Red Mud with 0.5% COCONUT FIBRE (N/mm ²)	Red Mud with 1% COCONUT FIBRE (N/mm ²)
Ref. mix PCC	40.75	40.75
2	40.89	43.12
4	41.93	44.16
6	43.56	45.49
8	46.68	48.45
10	44.45	46.38
12	44.31	44.45
14	43.41	43.76
16	41.78	42.53
18	40.31	41.64
20	38.52	40.10

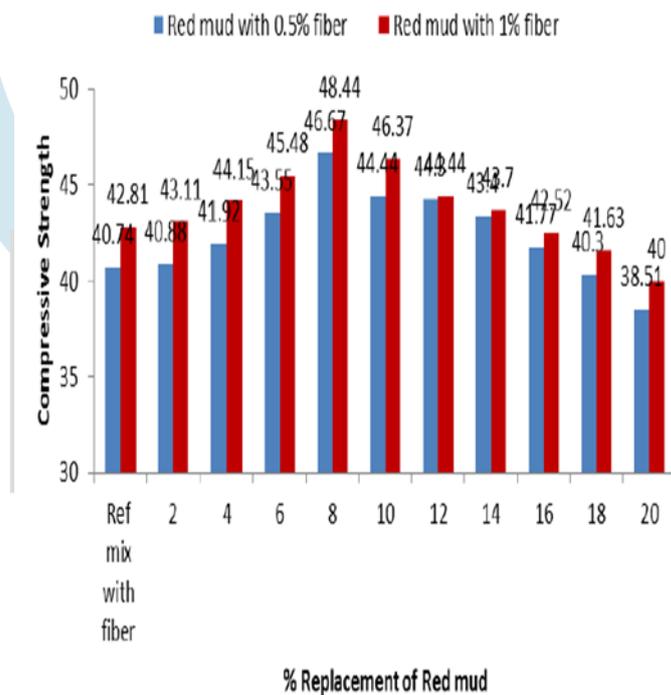


Fig- Variation of compressive strength

Table 4: Test results of Split Tensile Strength

% replacement of cement by RM	Red Mud with 0.5% COCONUT FIBRE (MPa)	Red Mud with 1% COCONUT FIBRE (N/mm ²)
Ref. mix PCC	2.94	2.95
2	2.826	3.369
4	3.124	3.678
6	3.488	3.994
8	4.026	4.519
10	3.913	4.306
12	3.828	4.157
14	3.444	3.736
16	3.066	3.427
18	2.690	3.127
20	2.509	3.018

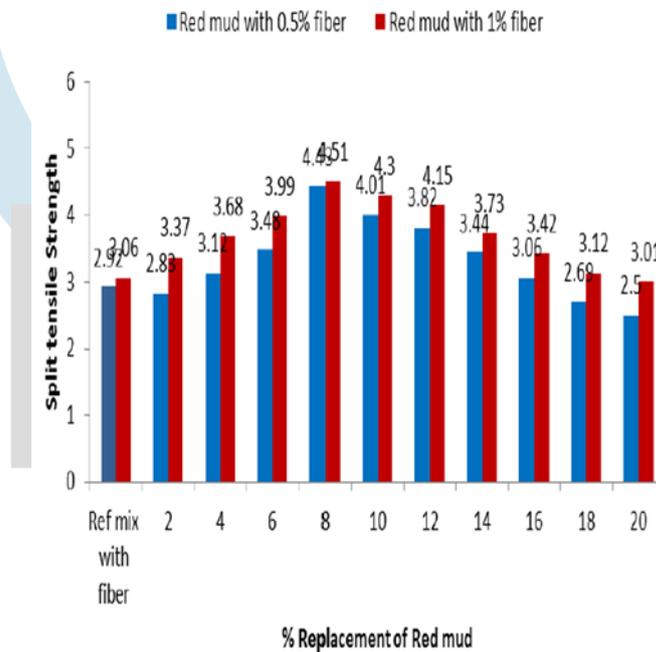
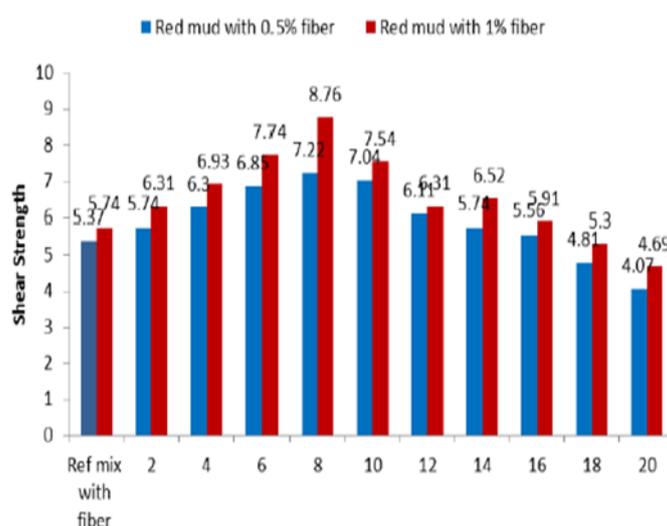


Fig- Variation of Split Tensile Strength

Table 4.3.3.1: Test results of Shear Strength

replacement of cement by RM	Red Mud with 0.5% COCONUT FIBRE (MPa)	Red Mud with 1% COCONUT FIBRE (MPa)
Ref. mix PCC	5.372	5
2	5.743	6.312
4	6.304	6.933
6	6.856	7.744
8	7.226	7.855
10	7.047	7.545
12	6.118	6.316
14	5.749	6.527
16	5.569	5.918
18	4.812	5.308
20	4.073	4.699

**Fig 4.3.3.2: Variation of Shear Strength**

Compressive Strength- Standard Cube Specimens of dimensions 150x150x150mm were cast and cured for 28 days in immersion tank. They are tested on 3000 KN capacity compression testing machine as per IS 516-1959. It can be observed that the compressive strength of FRC Red Mud concrete has shown maximum increase in strength for both 0.5% and 1% of Coconut fiber content at 8% replacement of Red Mud. The increase is 14.55% for 0.5% of coconut fiber and 18.90 for 1% coconut fiber.

Split tensile Strength Test- Cylindrical specimens of diameter 150mm and length 300mm were prepared. Split tensile test was carried out on 3000 KN capacity compression testing machine as per IS 5816-1999. It can be observed that the split tensile strength of FRC Red Mud concrete has shown maximum increase in strength for both 0.5% and 1% of GI fiber content at 8% replacement of Red Mud. The increase is 37.67% for 0.5% coconut fiber and 54.45 for 1% coconut fiber

Shear Strength Test-- These specimens were tested on 3000 KN capacity compression testing machine. A loading arrangement was made such that a direct shearing force was applied on the shorter arm of the 'L' shaped specimen (i.e. over an area of 150mm x 60mm). It can be observed that the shear strength of FRC Red Mud concrete has shown maximum increase in strength for both 0.5% and 1% of GI fiber content at 8% replacement of Red Mud. The increase is 34.45% for 0.5% of coconut fiber and 46.74% for 1% coconut fiber.

CONCLUSION-

The following conclusions are drawn by analysing test results of various strength tests.

1. Red Mud replaced FRC has shown increase in compressive strength when compared to FRC without Red Mud for both fibre content of 0.5% and 1% up to 8% Red Mud content. Beyond that it decreases with increase in Red Mud content. The increase is 14.55% and 18.90 % for 0.5% and 1% Coconut fibre respectively.
2. Red Mud replaced FRC has shown increase in Split Tensile strength when compared to FRC without Red Mud for both fibre content of 0.5% and 1% up to 8% Red Mud content. Beyond that it decreases with increase in Red Mud content. The increase is 37.67% and 54.45 % for 0.5% and 1% Coconut fibre respectively.

3. Red Mud replaced FRC has shown increase in Shear strength when compared to FRC without Red Mud for both fibre content of 0.5% and 1% up to 8% Red Mud content. Beyond that it decreases with increase in Red Mud content. The increase is 34.45% and 46.74% for 0.5% and 1% Coconut fibre respectively.
4. It is observed that increase in Red Mud content will decrease the compressive, split tensile and shear strength of concrete. This is probably due to loss of workability.

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