

A Study on Mechanical Properties of Concrete Subjected to High Temperatures

A. HARIKA¹, Dr. C. SASHIDHAR², Dr. T SURESH BABU³

¹ II M.Tech, Visvodaya Engineering College, Kavali, India

² Professor of civil engineering and controller of examination cell JNTU Anantapur, India

³ Professor and Head, Department of Civil Engineering, Visvodaya Engineering College, Kavali, India

Abstract: The high consumption of raw materials by the construction sector, results in chronic shortage of building materials and the associated environmental damage. Concrete industry is particularly important as it is not only responsible for consuming natural resources and energy but also for its capacity of absorbing other industries waste and by-products. For this reason the civil and environmental engineers have been challenged to convert the industrial waste to useful building and construction materials. In recent years the construction industry has shown considerable interest in the utilization of waste. To create products made of stone, the shape of the stone must be decorated through cutting, shaping and finishing, which can release dust and slurry sludge, in addition to these the waste stone cutting pieces are also generated. The stone pieces are creating disposal problems in and around the production area. At present the stone waste generating in exploration area and polishing industry are dumping in low lying area and in and around the road way. In Andhra Pradesh, Tadipatri is located in Anantapur District Basically this region is much potential for black layered stone. This stones are used in the construction industry for floors. The main aim of research work is to utilize the stone waste in the construction industry. Generally for concrete works crushed granite stone is used as coarse aggregate. In the proposed research work the waste produced by the polishing industries can be replaced in the place of granite and the Mechanical and Thermal properties were measured by heating IS standard cubes and cylinders at 5 °C/min to temperatures of up to 800 °C results are to be studied. The obtained results of mechanical property measurement are compared with results obtained in other studies as well as with existing code provisions to evaluate their applicability. The research work is mainly focused to utilize the waste for the concrete works and later stages it may be recommended to use for the construction industry. The waste may be partially and fully replaced in placed of natural granite.

While these studies provided valuable information on concrete strength as a function of temperatures, almost all used specimens made with normal strength concrete made of granite aggregate. Thus, in light of the results of recent studies, which have shown that concrete behaviour at elevated temperature may be significantly different from that of Normal Strength Concrete. To study the thermal strength properties of concrete produced with stone waste aggregate. The coarse aggregate will be replaced by stone waste aggregate from 0 to 100% The compressive strength and split strength test of the concrete is to be tested under 0^o, 100^o, 200^o, 400^o, 600^o and 800^o temperatures and conclusions are to be drawn on their performance.

Keywords: Construction Sector, Building Materials and the Associated Environmental Damage.

1. INTRODUCTION

Since concrete is the most important part in structural construction, the aggregate content should be in a form of good strength for structural purposes. Concrete is made up of aggregate, cement and water. Through this combination of Materials, three – quarter of the mix is governed by aggregate. The aggregate itself is categorized as fine and course aggregate. In this study, the scope of research will be focused on the use of coarse aggregate using lime stone material. Lime stone is one of the aggregate to be used in concrete,

1.1 General Information of aggregate :

Since three-quarters of volume of concrete is governed by aggregate, it is not surprising that its quality is of considerable importance. Not only may the aggregate affects the strength of the concrete, aggregate with undesirable material would not get a good and strong concrete but also its can produce low durability and performance of the concrete.

In fact, the aggregate can absorb heat, water, chemicals and also its physical properties will influence the performance of concrete. Aggregate cheaper compare to cement, therefore it is possible an economic value to put into consideration. But economy not the only reason why to select aggregate , it is also have engineering advantages on concrete, so that it can bring higher volume stability , produce better durability than the hydrated cement paste alone.

1.2 Particle shape and texture:

Aggregate, whether crushed or naturally reduced in size, it can be divided into many groups of rocks having common characteristics. The aggregate to be used in the concrete shall have good shape and surface texture. In the case of crushed rocks, the particle shape depends not only on the nature of the parent material but on the type of crusher and its reduction ratio,

1.3 Back ground of the research:

In general granite aggregate is commonly used in industrial construction. Though IS 383-1970 code specifies the use of limestone and other aggregate for construction works, but it was very meager in reality. In this regard a ray of light was focused on use of lime stone aggregate for slabs elements. At present the generation of lime stone aggregate is discussed in detail. During working time of machine a waste is coming from each machine and these is dumping in around town. . After having a look over this scenario a thought came up and it leads to utilize the waste material in the concrete industry. In this connection it was decided that to utilize the waste as coarse aggregate after making the waste in 20 and 12 mm aggregate. For this crusher was used to obtain single graded material of 20 and 12 mm aggregate. After having this aggregate, an experimental work planned on two way slabs to know the behaviour in punching aspect.

1.4 Significance of the research:

In construction industries, the use of aggregates is the most importance material in composition of concrete. Places having granite aggregate should have no problem in construction projects, but for places where the other type of aggregate is also available on par with granite, to curb the use of excessive granite material, in other words, to preserve the natural good material (granite) for future generation, it is necessary to use other available material in to some extent. Due to this reason this study should be carried out in the approaching method to overcome the problem as well as beneficial to local people.

The advantages of this study are:-

1. To provide some information about the use of limestone aggregate.
2. Beneficial and economic value to local people.
3. New finding during the test and methods required to overcome the problems.
4. Have chances to explore the used of local material in construction industries.

2. LITERATURE REVIEW

1. HanifiBinicietal (2007) studied the mechanical properties of concrete containing marble and lime dust. The results compared with conventional concrete. The results showed that marble and lime dust concrete increase workability and abrasion resistance is comparable to that of conventional concrete. Abrasion resistance is increased as the rate of marble and lime dust increased. Further the results also indicated there is an increase in sodium sulphate resistance. The conclusion of the work is, use of marble and lime dusts are gives durable for the concrete production.

2. Karaca and Elci (2008) are investigated the opportunity and feasibility of using four marbles, two lime stone, two travertine and two granite types that are being quarried in Turkey as coarse aggregate. The properties such as oven dry density, porosity, water absorption, uni-axial compressive strength, Loss Angeles abrasion etc were carried on four types of aggregates. The results showed that waste of dolmitic marble and limestone are more suitable for concrete works. For green word and the continuous able natural sources the waste stone use in concrete industry is feasible.

3. Marmolet.al (2010) examined the use of granite sludge waste in production colored cement based mortars. He reported the use of granite sludge was as replacement to cement upto 10% is does not affect the strength characteristics.
4. Ali Ergun (2011) studied the use of diatomite and waste marble powder as partial replacement of cement on the mechanical properties of concrete. The results revealed that, 10% Diatomite and 5% of waste marble powder as replace to cement having good compressive strength
5. Shiruleet.al (2012) studied the replacement of cement with marble dust powder in concrete. The results showed that the 10% replacement by weight of cement increases the compressive strength of cube and also reported that replacement beyond 10% is in effective to compressive strength. ElhamKhalizadehShiraziet.al (2012) examined the use of stone waste in concrete. The results showed that the substitution of 5% of fine aggregates by stone waste caused higher compressive strength than the control specimens

3. OBJECTIVES & SCOPE OF PRESENT STUDY

The main objectives of the present experimental work are discussed below:

3.1 Objectives of the Test Program:

1. To find the efficacy of the lime stone aggregate for civil constructions.
2. To know the fresh concrete properties of lime stone aggregate concrete.
3. To know the behaviour of compressive and split tensile strength of lime stone aggregate.

4. EXPERIMENTAL PROGRAMME

The experimental program was designed to investigate the strength at 28days.

Based on the availability of equipment in the laboratory experimental work was conducted on cube and cylinders so that it leads to evaluate compression and split tensile test Total of 30 cubes and 20 cylinders with 25% replacement with lime stone aggregate with temperature changes according to time variation i.e for cubes 2hr 4hr and 6hrs.And for cylinders time variation is 2hr and 4hrs.To study the above properties mix M20 was considered. The size of each cylinder is 150 mm in dia and 300 mm in height. The size of each cube is 150mmx150mmx150mm

5. MATERIALS USED

The different materials used in this investigation are:

5.1 Cement: Cement used in the investigation was 53 grades ordinary Portland cement confirming IS: 12269: 1987.

5.2 Fine Aggregate: Locally available river sand passing through 4.75 mm I.S .Sieve is used. The specific gravity of the sand is found to be 2.75

5.3 Natural Coarse Aggregate: Crushed granite aggregate available from local sources has been used. To obtain a reasonably good grading, 60% of the aggregate passing through 20 mm I.S. sieve and retained on 12.5mm I.S. Sieve and 40% of the aggregate passing through 12.5mm I.S. Sieve and retained on 10 mm I.S

5.4 Water: Potable fresh water available from local sources was used for mixing and curing of LSA and NAC slabs.

5.5 Lime stone aggregate: The raw material of Lime stone aggregate was obtained from stone polishing industries. The generated waste material was is not able to use as it is, as coarse aggregate in the concrete. So there is a need to develop as graded aggregate to use in concrete. To convert the waste as coarse aggregate the waste material was transported to crusher unit and made as 20 and 12.5 mm aggregate.

6. CASTING

The cubes were cast in steel moulds of inner dimensions of 150 x 150 x 150mm, the cylinders were cast in steel moulds of inner dimensions as 150mm diameter and 300mm height .All the materials are weighed as per mix design and kept a side separately was transported to crusher unit and made as 20 and 12.5 mm aggregate.

7. TEST SET UP AND TESTING

The test set up for conducting cube and cylinders compressive strength and split tensile test is conducted. Compression test on cubes is conducted with 2000kN capacity compression testing machine. The machine has a least count of 1kN. The cube was placed in the compression-testing machine and the load on the cube is applied at a constant rate till to failure of the specimen and the corresponding load is noted as ultimate load. Then cube compressive strength of the concrete mix is then computed by using stand formula.(This test has been carried out on cube specimen at 28 days .

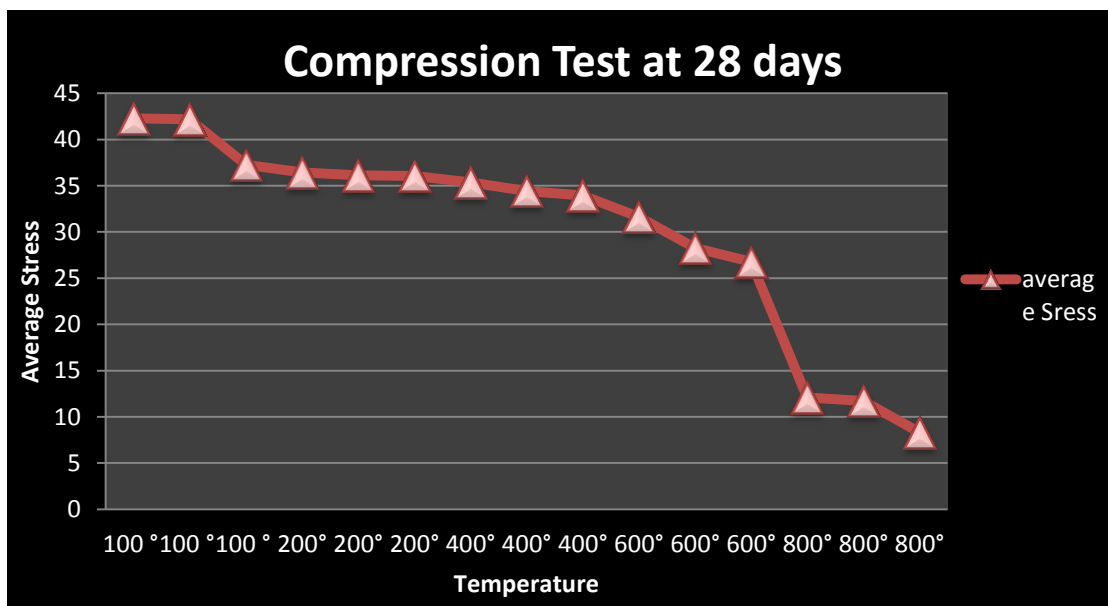
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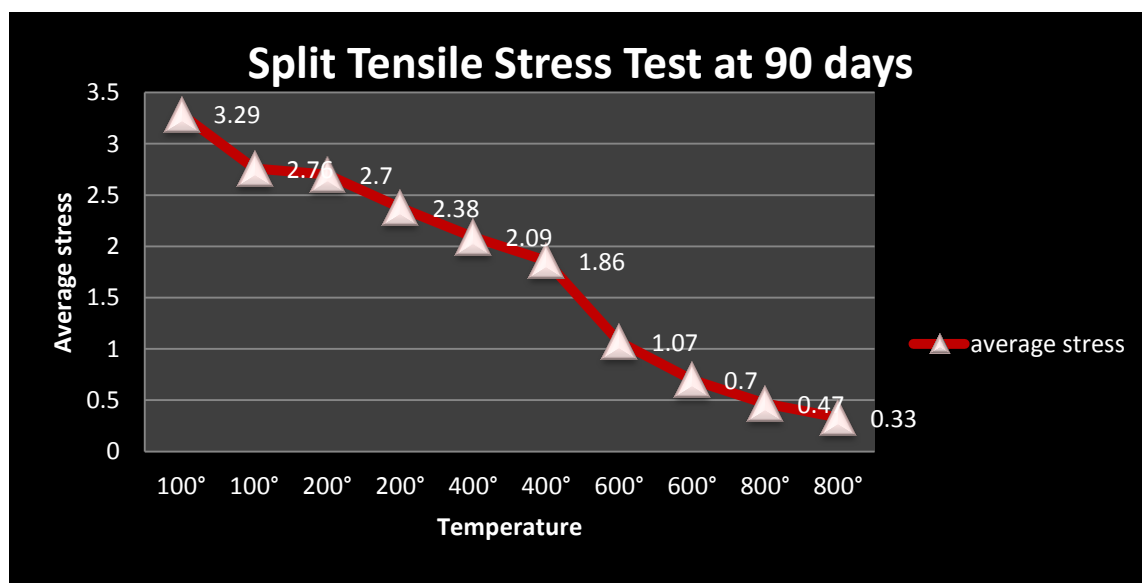
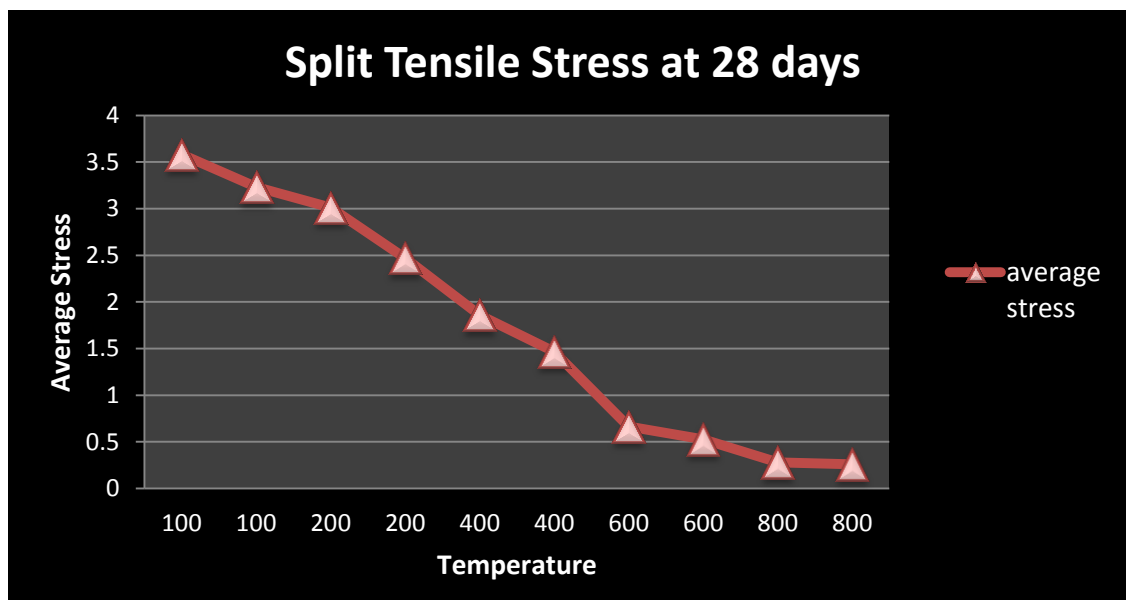
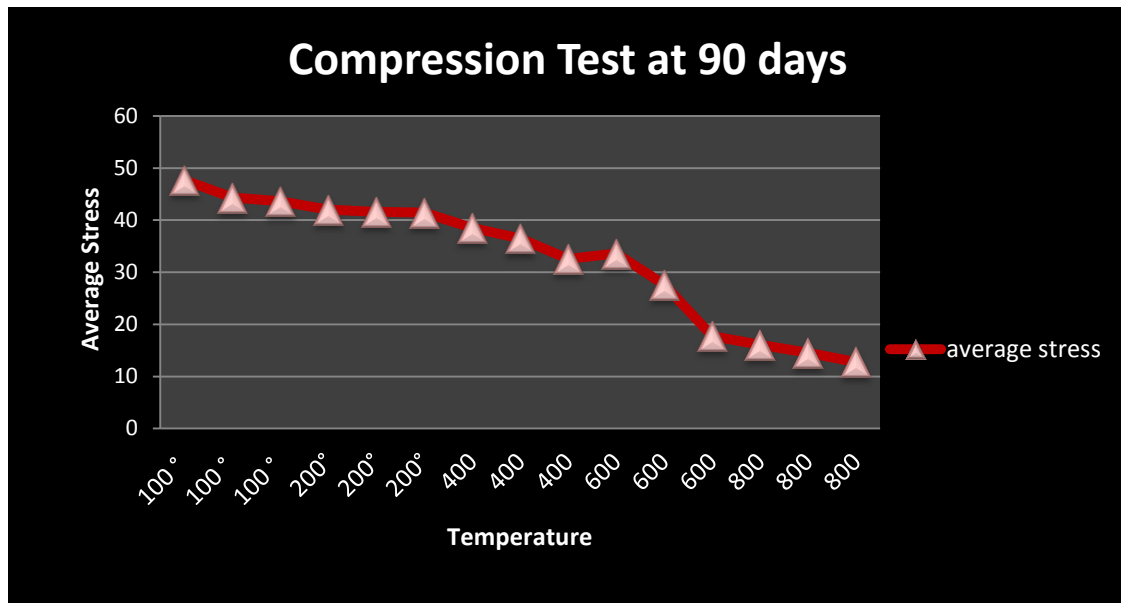
Muffle furnace is the state of the art equipment, manufactured to the most quality standards. The application of the equipment are many from heating and drying, fusing glass, creating enamel coatings, ceramics and soldering and brazing articles, more sophisticated high voltage testing whenever it is opted for. The muffle furnace is designed for working up to maximum temperature of 1000° c.

In this study before testing the specimens the cubes and cylinders are heated in furnace by changing the temperatures at 100°,200°,400°,600°,800° respectively with time variation i.e 2hrs 4hrs and 6hrs.After heating tests are conducted to know the strength.



9. RESULTS & DISCUSSION





10. CONCLUSIONS

The following conclusions may be drawn from the present experimental work

1. The compressive strengths were decreased with increase the lime stone aggregate in the concrete mix at 28 days
3. The split tensile strengths were decreased for lime stone aggregate concrete compared with granite aggregate concrete.
4. As the temperature increases the ultimate strength decreases with time variation.
6. The failure modes are similar for both lime stone and granite aggregate concrete.
7. The use of lime stone aggregate for concrete works is demonstrated in compression, split tensile strengths
8. This study could enlighten the local peoples to use of limestone aggregate for concrete works (minor works at initial stages) at normal temperature.

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