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Study on Mechanical Properties of concrete by partial replacement of Quarry Dust and Saw Dust Ash in Cement

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ABSTRACT

Cement and fine aggregates are the major materials used in construction. Increase in the demand for these materials lead to the skyrocketing price of the construction. Due to this, the lower- and middle-income families are not able to build their own houses. There were studies about the research institutions are looking for alternatives can be used for construction to reduce the construction cost. The physical properties and chemical composition of saw dust ash (SDA) as a 15% constant replacement in cement and Quarry dust in fine aggregate proportions of 5%, 10%, 15%, 20%, 25%, and 30%, as well as the workability and compressive strength properties of the concrete, were researched. On fresh concrete, slump and compacting factor tests were performed, as well as compressive strength testing on hardened concrete. The concrete cubes were tested at seven different ages: seven, fourteen, twenty-six, sixty-six, and ninety days. SDA was found to be an excellent pozzolan, with a total SiO2, Al2O3, and Fe2O3 content of 73.07 percent. As the SDA concentration grew, the slump and compacting factor both dropped, indicating that the concrete became less workable. As the amount of SDA replaced increased, the compressive strength fell. Concrete containing Quarry Dust and SDA has a reduced compressive strength at first, but it improves dramatically after 90 days.

Keywords: Quarry Dust,Saw Dust Ash, Compressive Strength, Split Tensile strength, Flexural Strength Test

I.INTRODUCTION

Concrete is the most frequently used construction material on the planet, and it owes its popularity to two factors. For starters, concrete is utilized far more than any other construction material for a wide range of constructions, including dams, pavements, building frames, and bridges. Second, concrete is used in far greater quantities than any other material. Its global output outnumbers steel by a ratio of ten in tonnage and more than a factor of thirty in volume. Concrete and steel are the two most popular structural materials utilized in concrete structures. A structural material is one that can support not only its own weight but also the weight of additional parts. The flexibility, durability, sustainability, and economy of concrete have made it the most frequently used building material on the planet. In the manufacturing of one ton of cement of lime stone, 80 Units of electric power apart from one ton of CO_2 at large into the atmosphere. Out of the total CO_2 emission (from a variety of resource) worldwide, even industries contribute about 7% of CO_2 emissions. Annual cement manufacture rate of the world is increasing very much year by year.

Fly Ash, Saw Dust Ash, Ground Granulated Blast Furnace Slag, rice husk ash, silica fume, zeolite is some of pozzolanic materials which can be utilized as a part of concrete as incomplete substitution of bond. Various investigation is exploring going on India and also on board to consider the constrain of utilization of these pozzolanic materials as bond substitutions and the outcomes are eager. The quality, mechanical and different components of cement rely upon the property of its fixing, extent of blend, procedure of compaction and other control amid setting and curing.

Sawdust is made up of fine wood particles and is produced as a by-product of cutting, grinding, drilling, sanding, or otherwise pulverizing wood using a saw or other tool. It is also a by-product of several wood-dwelling creatures, birds, and insects, such as the woodpecker and carpenter ant. It can be dangerous in the manufacturing industry, notably because of its flammability. Particleboard is mostly made up of sawdust. Particleboard is a common usage for sawdust, and coarse sawdust can be used to make wood pulp. Sawdust can be used in a variety of ways, including as a filler, as an alternative to clay cat litter, and as a fuel. It was commonly employed in icehouses until the advent of refrigeration to keep ice frozen during the summer.

It's been utilized as a scatter and in creative exhibits. It's also sometimes used to absorb up liquid spills, making it easier to gather or sweep them away. As a result, it used to be ubiquitous on barroom flooring. It's utilized in the production of cutter's resins. Pykrete, a slow melting, considerably stronger kind of ice, is formed when it is mixed with water and frozen. In the production of charcoal briquettes, sawdust is used. Other experts disagree, claiming that the premise that "dilution is the cure to pollution" is no longer valid in environmental research. The impact of sawdust on the breakdown of a tree in a forest is comparable, but the difference is in magnitude. Sawmills may store hundreds of cubic meters of wood residue in a single location, so the problem becomes one of concentration.

Year after year, the amount of industrial waste produced rises. Waste generated by manufacturing or industrial activities is referred to as industrial waste. Quarry dust is one sort of industrial waste. Quarry dust is produced as a by-product of the crushing of rocks in rubble crusher units for the manufacture of aggregates. Quarry dust waste has been used in the construction sector for a variety of purposes, including road construction and building materials.

Lightweight aggregates, bricks, tiles, and autoclave blocks are made from quarry dust waste. Quarry dust waste is a waste product generated by the stone crushing industry and is widely available, averaging 200 million tonnes per year. This will result in waste disposal issues, as well as health and environmental degradation. Furthermore, environmental pollution from quarry dust waste and heavy metals has been an issue in our globe for many years. Quarry dust has been observed to stymie crop growth and flowering by settling on leaf surfaces, interfering with normal photosynthetic and other exchanges at the leaf-atmosphere interface.

Quarry dust is a concentrated by-product of the crushing process that can be used as aggregates in concrete, particularly fine particles. Quarrying activities involve crushing rock into various sizes; the dust produced during this process is known as quarry dust, and it is disposed of as waste. As a result, it becomes a waste product that also pollutes the air. As a result, quarry dust should be used in construction projects to minimize construction costs, save construction materials, and ensure that natural resources are effectively utilized. Most developing countries are under pressure to replace fine aggregate in concrete with an alternative material, either partially or completely, without affecting the concrete's quality. Quarry dust has been used in the construction industry for a variety of purposes, including building materials, road construction materials, aggregates, bricks, and tiles. The current study focuses on the effects of varying sand replacement proportions with quarry dust on the characteristics of concrete. The purpose of this study is to investigate the effects of adding quarry dust to normal concrete and to determine the rate at which compressive strength develops.

II. MATERIALS AND METHODOLOGY

Cement: Cement: Cement is a binder substance used in construction that sets and binds together other materials. UltraTech cement supplied commercially available 53 grade ordinary Portland cement with a specific gravity of 3.15 and a fineness modulus of $225m^2/kg$ for this study..

Aggregate: After cement, the aggregate is the basic material used in any concrete to comprise the body of concrete for increasing the strength to the material quantity, and to minimize the consequential volume change of concrete.

Fine Aggregate: For filling the voids present in coarse aggregate, the fine aggregates usage plays an important role in concrete. In this investigation natural sand was used as fine aggregate. Sand was obtained from Kundu River near Nandyal in Kurnool district.

Coarse Aggregate: In the present investigation crushed aggregates of 20mm size was used. The specific gravity of coarse aggregate is 2.75. The aggregate was obtained from crushing machine is near by our surroundings.

Saw Dust Ash: Sawdust is also known as wood dust. It is the by-product of cutting, drilling wood with a saw or any other tool; it is composed of fine particles of wood. Saw dust concrete is light in weight and has satisfactory heat insulation and fire resistance values. After refined the wood it becomes saw dust and it burns becomes as ash and it sieve 750µ is replaced in cement.

Quarry Dust: Quarry dust is a concentrated by-product of the crushing process that can be used as aggregates in concrete, particularly fine aggregates. Quarrying activities involve crushing rock into various sizes; the dust produced during this process is known as quarry dust, and it is disposed of as waste. As a result, it becomes a waste product that also pollutes the air. Most developing countries are under pressure to replace fine aggregate in concrete with an alternative material, either partially or completely, without affecting the concrete's quality. Quarry dust has been used in the construction industry for a variety of purposes, including building materials, road construction materials, aggregates, bricks, and tiles. The current study focuses on the effects of varying sand replacement proportions with quarry dust on the characteristics of concrete.

Mix Proportions:

M25-grade concrete is employed in this study, with a constant W/C ratio of 0.5. The percentage of cement replaced with Saw Dust Ash was kept constant at 15%, while Fine Aggregate was replaced with Quarry Dust in the concrete mixes (0 percent , 5 percent , 10 percent , 15 percent , 20 percent , 25 percent and 30 percent).

Mix Designation	Proportions of Binding Materials
A1	Normal Concrete
A2	15% SDA+ 0% QD
A3	15% SDA + 5% QD
A4	15% SDA + 10% QD
A5	15% SDA + 15% QD
A6	15% SDA + 20% QD
A7	15% SDA + 25% QD
A8	15%SDA + 30% QD

III. EXPERIMENTAL INVESTIGATION

Batching:

Batching is the technique of measuring concrete proportions, either by volume or by mass, in order to prepare a concrete mix. The quantities of fine aggregate, cement, coarse aggregate, Fine Aggregate, Quarry Dust, and Saw Dust Ash are measured using the weight batching method.

Mixing of concrete:

The needed quantities of concrete materials were charged into a high-capacity laboratory concrete mixer.

The concrete was delivered into the pan for casting the specimens after it had been thoroughly mixed, i.e., it had attained a uniform color and workable consistency.

Casting of specimens:

For casting specimens, the concrete was poured in three layers in typical metallic moulds and compressed with a tamping rod by giving each layer 25 blows. A thin coat of oil was applied to the inside walls of the molds before placing the concrete in them to make removal easier. Then moulds were placed on table vibrator for 30 seconds after thoroughcompaction the top surfaces of specimens were finished smoothly.

Curing of specimens:

The concrete specimens were air dried for 24hours and then the specimens were de-moulded and then kept for curing. Marking was done on the specimens to identify the percentage of steel slag and copper slag and their combinations. And then the specimens were placed in water tank for curing. All the specimens have been cured for desired age and then tested.

IV.RESULTS AND DISCUSSION

This chapter explains the mechanical properties of concrete. The compressive strength, split tensile strength and Flexure strength of mechanical tests for concrete mixture with Quarry Dust and Saw Dust Ash are to be tested and relative discussions are presented.

Compressive Strength

The compressive strength of M25grade concrete mixture by replacing FA with Quarry Dust as 0%,5%, 10%, 15% 20% 25% and 30% and Saw Dust Ash as replaced with cement as 15% is investigated. The results of compressive strength of A1, A2, A3, A4, A5, A6, A7 and A8 concrete mixtures tested at 7 days, 14 days, 28 days, 56 days and 90 days are presented.

Table.1 Compressive Strength Test

Mix Design	Mix Proportion	Compressive strength N/mm^2				
		7-days	14-days	28-days	56-days	90-days
A1	Normal Concrete	27.02	28.36	31.56	32.75	33.62
A2	15% SDA	28.05	29.14	31.66	32.82	33.76
A3	15% SDA +5% QD	28.56	29.84	32.31	33.17	33.91
A4	15% SDA + 10% QD	29.25	30.13	33.64	33.86	34.21
A5	15% SDA + 15% QD	32.63	31.67	34.78	34.91	33.13
A6	15% SDA + 20% QD	31.27	31.88	32.07	32.24	32.71
A7	15% SDA + 25% QD	30.72	30.61	30.45	31.80	32.14
A8	15% SDA + 30%QD	26.73	27.12	30.28	30.42	31.61

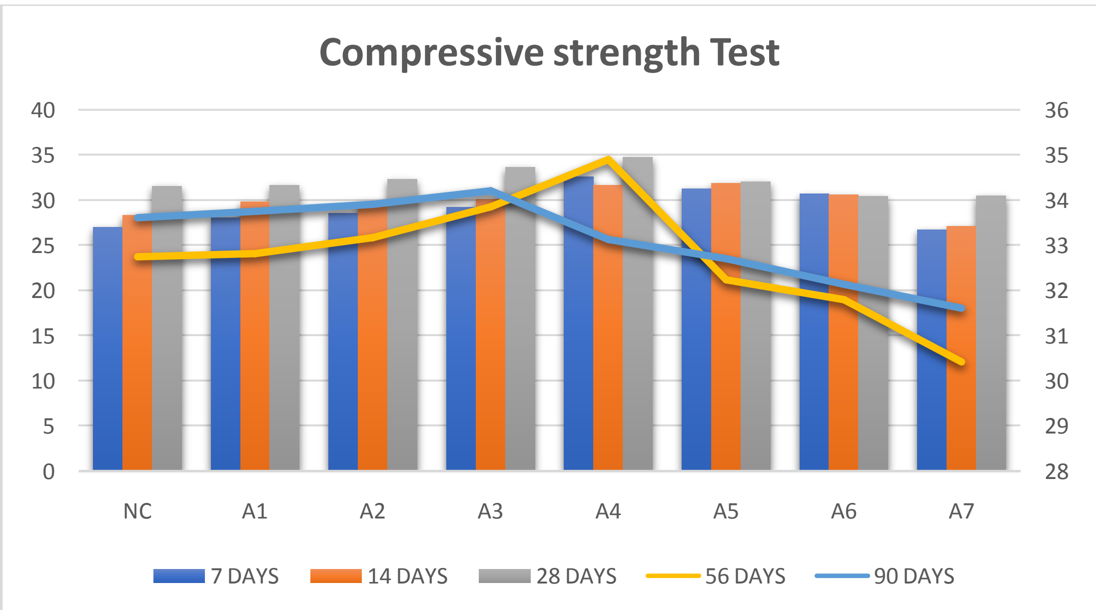

Fig. 1 Compressive Strength Test

Split Tensile Strength:

The Split Tensile strength of concrete is measured to be the most valuable and significant mechanical property of concrete since it gives the overall picture of the concrete quality. The Split Tensile strength of M25grade concrete mixture by replacing FA with Quarry Dust as 0%,5%, 10%, 15% 20% 25% and 30% and Saw Dust Ash as replaced with cement as 15% is investigated. The results of compressive strength of A1, A2, A3, A4, A5, A6, A7 and A8 concrete mixtures tested at 7 days, 14 days, 28 days, 56 days and 90 days are presented.

Table:2 Split Tensile Strength Test

Mix Design	Proportions of coarse aggregate	Split Tensile strength N/mm^2				
		7-days	14-days	28-days	56-days	90-days
A1	Normal Concrete	2.93	3.13	3.29	3.52	4.02
A2	15% SDA	3.24	3.37	3.42	3.56	4.13
A3	15% SDA +5% QD	3.41	3.50	3.56	3.67	4.17
A4	15% SDA + 10% QD	3.70	3.73	3.82	3.91	3.98
A5	15% SDA + 15% QD	3.85	3.92	4.05	4.16	4.20
A6	15% SDA + 20% QD	3.71	3.64	3.52	3.43	3.30
A7	15% SDA + 25% QD	3.60	3.41	3.36	3.23	3.20
A8	15% SDA + 30%QD	3.54	3.32	3.13	3.06	2.86

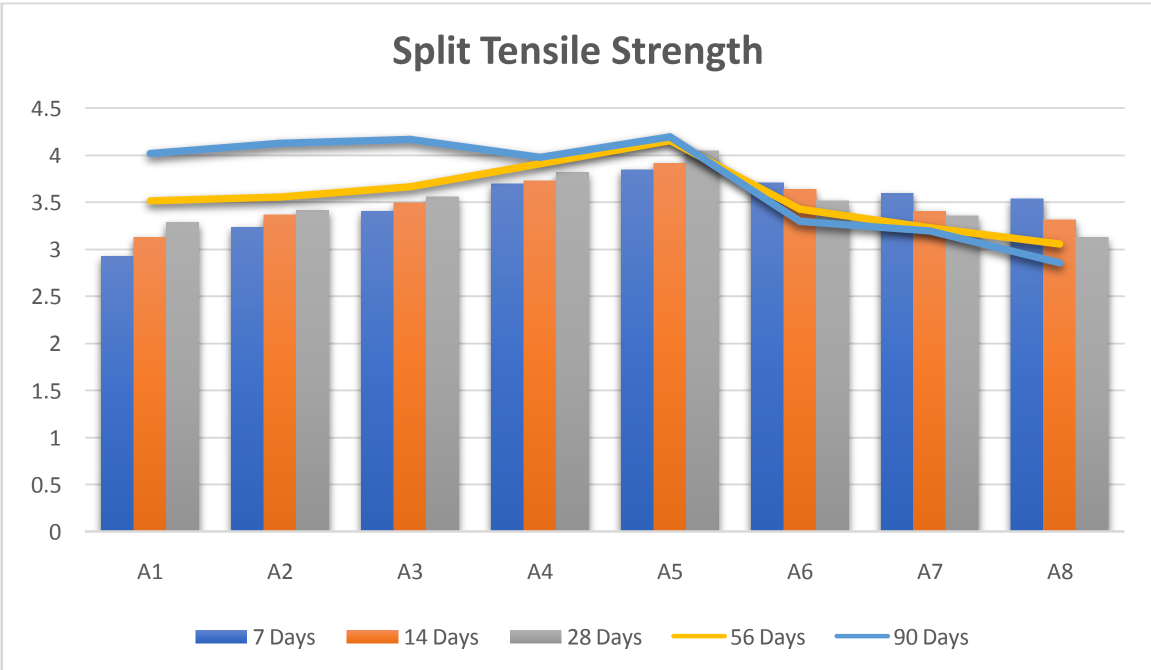

Fig. 2 Split Tensile Strength

Flexural Strength:

The Flexural Strength of concrete is measured to be the most valuable and significant mechanical property of concrete since it gives the overall picture of the concrete quality. The Flexural strength of M25grade concrete mixture by replacing FA with Quarry Dust as 0%,10%, 15% 20% 25% and 30% and Saw Dust Ash as replaced with cement as 15% is investigated. The results of compressive strength of A1, A2, A3, A4, A5, A6, A7 and A8 concrete mixtures tested at 7 days, 14 days, 28 days, 56 days and 90 days are presented.

Table:2 Flexural Strength Test

Mix Design	Proportions of coarse aggregate	Flexural strength N/mm^2		
		28 days	56 days	90 days
A1	Normal Concrete	8.54	8.63	8.78
A2	15% SDA	8.61	8.71	8.82
A3	15% SDA +5% QD	8.73	8.86	8.96
A4	15% SDA + 10% QD	8.81	8.87	9.01
A5	15% SDA + 15% QD	8.87	9.02	9.12
A6	15% SDA + 20% QD	8.79	8.86	8.72
A7	15% SDA + 25% QD	8.53	8.70	8.64
A8	15% SDA + 30%QD	8.01	8.51	8.45

Table 3: Flexural Strength Test

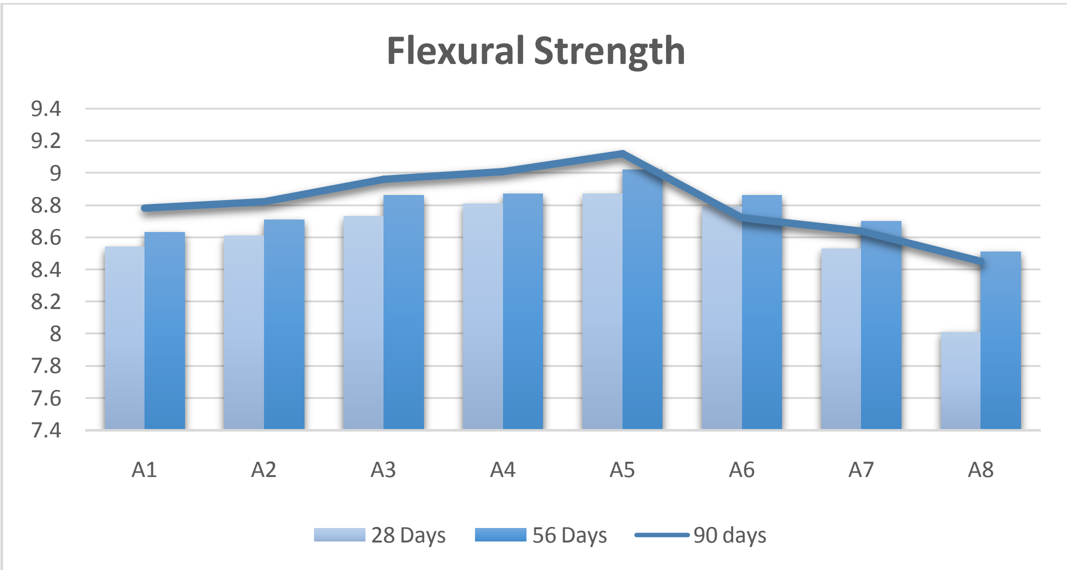

Fig: 3 Flexural Strength Test

V.CONCLUSION

- Based on Research for the study of behaviour of conventional by partial replacement of Quarry Dust and Saw Dust Ash
- The compressive strength of M_{25} concrete increases with increase in the replacement of Fine Aggregate with Quarry Dust as 5%, 10%, 15%, 20%,25%, and 30% and Saw Dust Ash constant as 15%. Maximum compressive strength is obtained as 15% SDA & 15% of QD when compared with conventional concrete.
- The Split Tensile strength of M_{25} concrete increases with increase in the replacement of Fine Aggregate with Quarry Dust as 5%, 10%, 15%, 20%,25%, and 30% and Saw Dust Ash constant as 15%. Maximum compressive strength is obtained as 15% SDA & 15% of QD when compared with conventional concrete.
- The Flexural strength of M_{30} concrete increases with increase in the replacement of Fine Aggregate with Quarry Dust as 5%, 10%, 15%, 20%,25%, and 30% and Saw Dust Ash constant as 15%. Maximum compressive strength is obtained as 15% SDA & 15% of QD when compared with conventional concrete.
- As I concluded that comparing with normal concrete the proportion 15% SDA & 15% QD is to be optimum where the strength is proportionally increased.

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