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An Experimental Study on the Properties of Concrete with the Partial Replacement of Cement by Fumed Silica and Coarse Aggregate by Recycled Aggregate

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Abstract - *The use of recycled aggregates is definitely an important step towards sustainable enlargement in the concrete industry & in the disposal of waste from construction. RA is a legal alternative to natural aggregates that help preserve the surroundings. Most of critical parameters influence the uses of recycled aggregates are the changeability in the aggregate properties. The quality of the materials collect & sent to the recycle plant affects the quality of the recycled aggregate. Therefore, the current limitations of recycling facilities make it difficult to produce recycled aggregates at an acceptable rate & the quality. The customers concern about the permanence of production & the unpredictability of rock properties. The key objective of the present study project is to explore the unpredictability of the properties of the aggregates and the effect on the production of concrete. Because of this, it is essential to evaluate the property before using the unit. Cementations materials such as silica fume have cementations properties that increase the strength of concrete & the silica substance of concrete and artificial sand; that provides greater power than river sand and it is less economical for use. Pozzolanic materials provide strength and also play an important role in economics and ecology. Silica fumes are a byproduct of silica alloys, which provide increasing strength and high stability & act as on fillers. The cement particle size is greater than particle size.*

In this study with the help of 13 mixes proportions prepare 39 Total Number of Samples. Use M-25 grade of concrete in this work cement is replaced by silica fume by 0%, 10%, 20%, and 30%. And CA replaced with RA by 0%, 10%, 20%, and 30%. For analysis testing of concrete done in both the stages one is workable stage and another is hardening stage.

Key Words: **Recycled Aggregate, Properties of Concrete, Physical Properties of Concrete, and Mechanical Properties of Concrete**

1.INTRODUCTION

Portland cement is the main component of conventional concrete. The process used to make cement in the construction industry releases large amounts of carbon dioxide and raises the temperature. Due to its unsustainable nature, the cement manufacturing process reduces the natural resources of limestone. Innovative pozzolan materials such as silica dust and fly ash. The introduction of pozzolan material as a partial alternative to cement reduces the uncontrolled use of cement and improves the planned management of resources and by-products in various industries. The main components of pozzolan used in this study are fly ash and silica fume. Fly ash is a by-product of coal dust combustion in thermal power plants. Silicone fumes are a by-product of the silicon or ferrosilicon manufacturing industry.

Concrete is the most widely used building material in the world. These are commonly used developer materials which include fixing agent, fineness, gross aggregate and required amount of water. Stone has played a pivotal job in the human endeavor for most braille in history and its use has increased since ancient times. The overall size is generally used as a gross size in high-density creation and recently some design countries have been interested in providing a typical size to meet the growing infrastructure development needs. In particular, the common interest in the creation of a state is very high due to the rapid development of the infrastructure. In recent years, the regular resources available have rapidly decreased due to the development of modern creation and the related increase in use, and conversely, it is clear that there are many materials that damage the soil, produced by high production. The civil engineering development industry should be one of the potential buyers of mineral resources so that it produces a lot of solid waste as a separator stone. Stone is perhaps the most widely used natural material due to its unusual expression. The Earth

offers us many ordinary stone objects that we must throw away as extraordinary wealth.

1.1 Silica Fume:

Silicon powder is a by-product of electric furnaces used to produce silicon or silicon metal alloys. Materials with very fine particles (average diameter of 0.1 m) containing more than 80% silica are highly pozzolanic. This product is suitable for use as a supplement to Portland cement. In addition to economic potential and energy saving, the use of pozzolan additives in concrete also has many technical advantages, including resistance to sulfuric acid and acidic water, and high-end strength. Unlike other pozzolan byproducts such as fly ash, CSF is unique in that it has a better and faster pozzolan effect.

1.2 Proposed study

In this study with the help of 13 mixes proportions prepare 39 Total Number of Samples. Use M-25 grade of concrete in this cement is replaced with silica fume by 0%, 10%, 20%, and 30%. And coarse aggregate replaced with recycled aggregate by 0%, 10%, 20%, and 30%. For analysis testing of concrete done in both the stages one is workable stage and another is hardening stage.

2. OBJECTIVE

- To get the uses of silica fume and used aggregate in the concrete.
- To reduce additional stress of recycled waste on environment.
- Discover the properties of soft and hard concrete with silica fumes and aggregates.
- To find out the compressive strength of construction and demolition aggregates used to make concrete.

3. METHODOLOGY

3.1 Concrete

Concrete is a building material consisting of cement, fine aggregate (sand) and coarse aggregate, mixed with water and hardened over time. Portland cement is a type of cement that is widely used to make concrete. Concrete technology involves studying the properties of concrete and their practical application. In the construction of buildings, foundations, pillars, beams, slabs and other components are loaded with concrete.
In addition to concrete, there are many different types of adhesives used in road construction, such as lime for lime concrete and bitumen for asphalt concrete. In this study, M-25 grade concrete was used to produce OPC 43 grade cement, sand and aggregate, with a ratio of 1: 1: 2 (cement: sand: aggregate).

Common concrete tests:

1. Compression Test
2. Tension Test
3. Flexural Test
4. Rapid Chloride Penetration Test
5. Slump Test of concrete
6. Air Content Test of concrete
7. Water Permeability Test of concrete

Test used for concrete

a) Slump Test
b) Compressive Strength Test

3.2 Cement

In this Portland cement, sold under the Ultratech Cement brand, and was used for the experiment. In order to protect concrete in closed containers from the effects of time, priority is given to finding the concrete in a single operation. The concrete is then tested according to IS: 8112-2013 and certified according to the organization's requirements.

Table -1: Properties of Cement

S. No.	Physical Properties	IS: 8112-2013
1.	Fineness of cement	✓ Minimum 225 (m^2/kg)
2.	Normal consistency of cement	✓ Not specified
3.	Initial timing of setting for cement	✓ Minimum of 30 min
	Final timing of setting for cement	✓ Maximum of 10 hr
5.	Cement Specific gravity (SG)	✓ {3.15}
6.	Compressive strength for cement	
	On 3rd day strength	✓ Min.27Mpa
	On 7th day strength	✓ Min. 33Mpa
	On 28th day strength	✓ Min. 43Mpa

Common Cement Tests:

1. Fineness Test
2. Consistency Test
3. Setting Time Test
4. Strength Test
5. Soundness Test
6. Heat of Hydration Test
7. Tensile Strength Test
8. Chemical Composition Test

Test used for concrete

1. **Fineness Test**
2. **Consistency Test**

3. **Test of Initial time setting**
4. **Test of final setting time**
5. **Compressive Strength Test**

3.3 Aggregate

Most of the aggregate is retained on the 75mm IS sieve and is only a better material than the various types described in this standard. As on IS: 2386-1963, measurements such as aggregate weight, impact gradient, rate of water absorption and density are taken.

Common Aggregate Tests:

1. Crushing test
2. Abrasion test
3. Impact test
4. Soundness test
5. Shape test
6. Specific gravity and water absorption test
7. Bitumen adhesion test

Test used for Aggregate

1. **Abrasion test**
2. **Crushing Test**

3.4 Admixture

Super plasticizer is the fourth generation of super plasticizer for concrete. It meets the requirements of high quality water reducing super plasticizer. It is also called FOS-Guard, Ether Polycarboxylate or Concrete Plasticizer. Super plasticizer additives contain special chemicals that help reduce water in concrete and provide better workability. This helps create an integrated concrete mix.

4. RESULT AND DISCUSSION

In this section, perform the results of experimental work. The results are displayed in graph and tabular format. Results will vary for cement, coarse aggregate and concrete.

4.1 Result of Cement

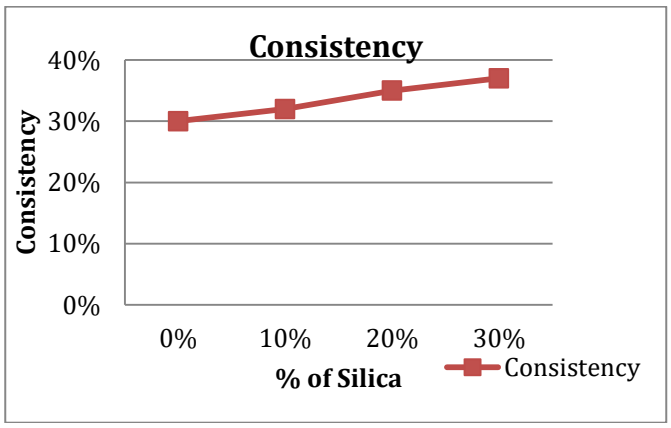

Fig. 1 Consistency Test of Cement Due to Replacement of Silica Fume

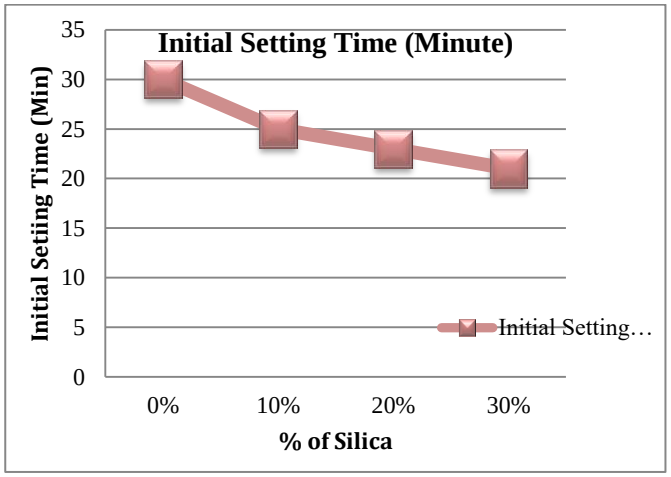

Fig. 2 (Initial) Setting Time of Cement Due to Replacement of Silica Fume

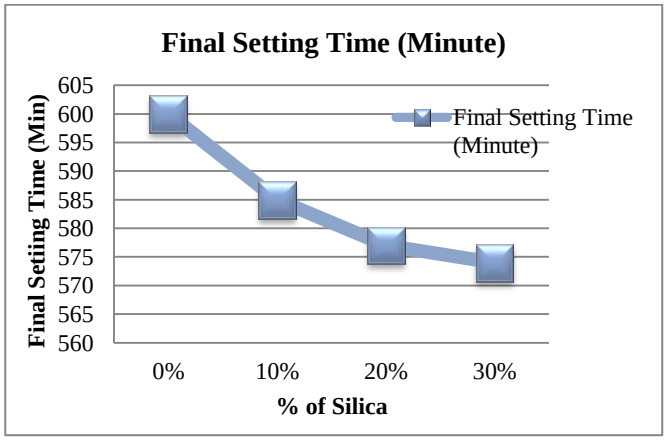

Fig. 3 Final Setting Time of Cement Due to Replacement of Silica Fume

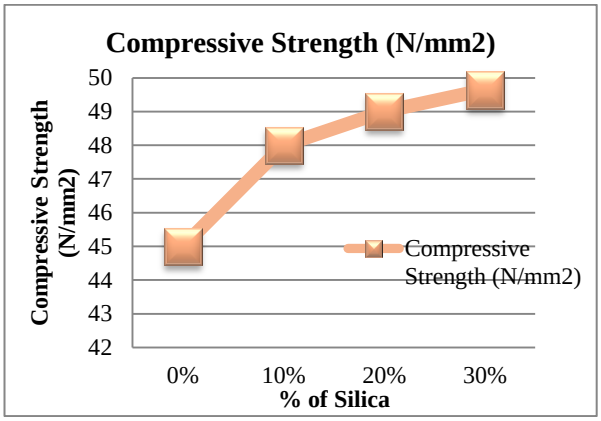

Fig. 4 Compressive Strength of Cement Due to Replacement of Silica Fume

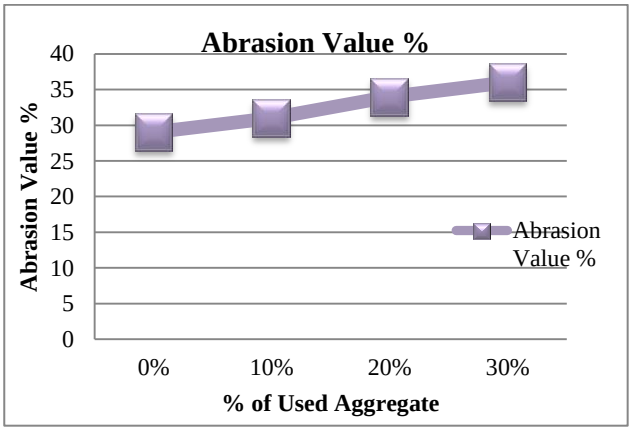

Fig. 7 Abrasion Test of Aggregate Due to Replacement of Used Aggregates

4.2 Result of Aggregate

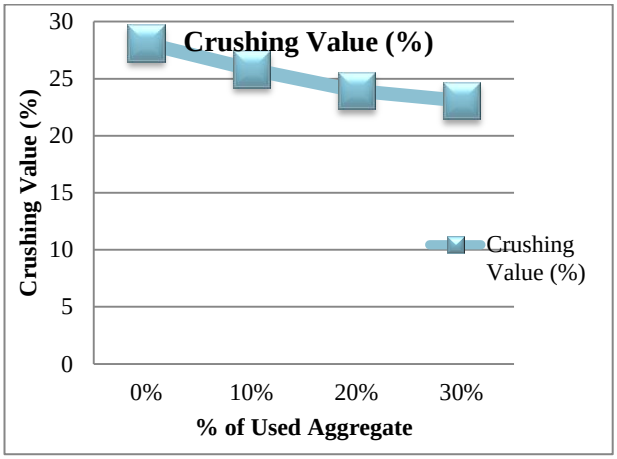

Fig. 5 Crushing Test of Aggregate Due to Replacement of Used Aggregates

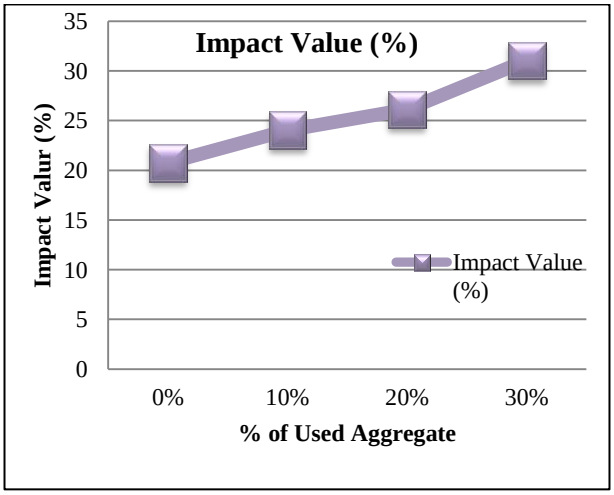

Fig. 6 Impact Test of Aggregate Due to Replacement of Used Aggregates

4.3 Result of Concrete:

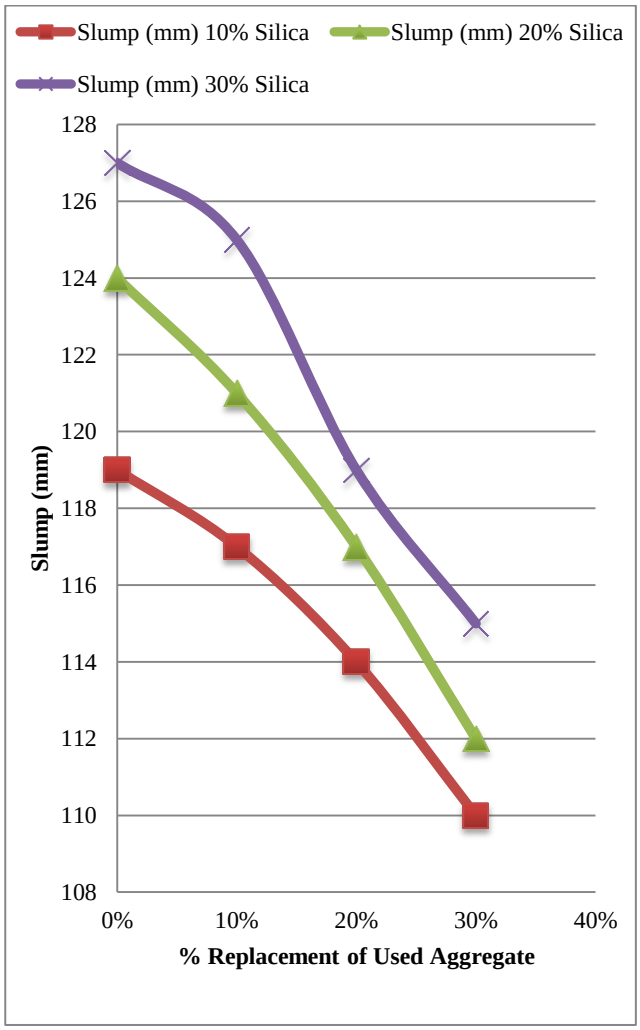

Fig. 8 Slump Test for 10%, 20% and 30% substitute of Cement with Silica and Varying % of Aggregate replacement with Used Aggregate

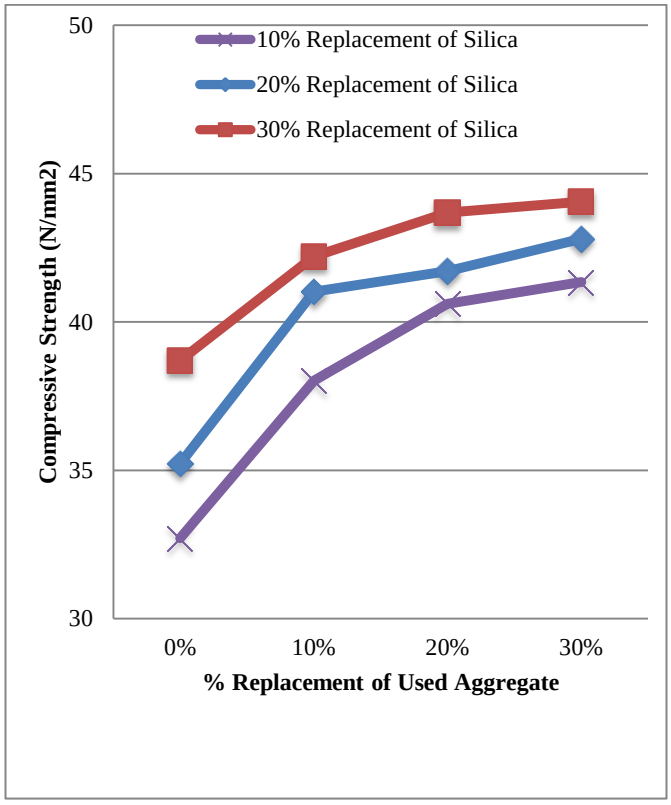

Fig. 8 Compressive Strength for 10%, 20% and 30% Substitute of Cement with Silica and Varying % of Aggregate Substitute with Used Aggregate

5. CONCLUSION

In this study with the help of 13 mixes proportions prepare 39 Total Number of Samples. Use M-25 grade of concrete in this cement is replace with SF by 0%, 10%, 20%, and 30%. And CA replaced with RA by 0%, 10%, 20%, and 30%. For analysis testing of concrete done in both the stages one is workable stage and another is hardening stage. Also study the cement and aggregates with silica fume and used aggregates respectively.

5.1 Cement with Silica Fume

- Normal Consistency of cement without silica fume it will be 30% and after the replacement of silica fume by 10%, 20% and 30% consistency of cement is 30%, 32%, 35% and 37% respectively increases.
- Initial Setting time of cement without silica fume it will be 60 minute and after the replacement of silica fume by 10%, 20% and 30% Initial Setting time of cement is 58, 50 and 47 respectively decreases.
- Initial Setting time of cement decreases as increase in % replacement of silica fume.
- Final Setting time of cement without silica fume it will be 600 minute and after the replacement of silica fume by 10%, 20% and 30% Final Setting time of cement is 585, 577 and 574 respectively increases.
- Final Setting time of cement increases as increase in % replacement of silica fume.
- Compressive Strength of cement without silica fume it will be 45N/mm2 and after the replacement of silica fume by 10%, 20% and 30% consistency of cement is 48N/mm2, 49N/mm2 and 49.65N/mm2 respectively increases.

5.2 Aggregate with Used Aggregate

- Crushing value of aggregates without used aggregates it will be 28.09% and after the replacement of used aggregates by 10%, 20% and 30% crushing value of aggregates is 225.81%, 23.94% and 23.06% respectively decreases.
- Impact Value of aggregates without used aggregates it will be 20.75% and after the replacement of used aggregates by 10%, 20% and 30% Impact Value of aggregates is 24.03%, 26.12% and 31.05% respectively increases.
- Abrasion Value of aggregates without used aggregates it will be 29% and after the replacement of used aggregates by 10%, 20% and 30% Abrasion Value of aggregates is 31%, 34% and 36% respectively increases.

5.3 Concrete with Silica Fume and Used Aggregates

- Mix proportion with 10% silica fume and coarse aggregates are replaced with used aggregates by varying % slump value decreases 119mm to 110mm.
- Mix proportion with 20% silica fume and coarse aggregates are replaced with used aggregates by varying % slump value decreases 124mm to 112mm.
- Mix proportion with 30% silica fume and coarse aggregates are replaced with used aggregates by varying % slump value decreases 127mm to 115mm.

- Effect on slump due to increase in % of silica fume value of slump also increases.
- Mix proportion with 10% silica fume and coarse aggregates are replaced with used aggregates by varying % compressive strength increase 32.72 N/mm2 to 41.35 N/mm2.
- Mix proportion with 20% silica fume and coarse aggregates are replaced with used aggregates by varying % compressive strength increase 35.23 N/mm2 to 42.80 N/mm2.
- Mix proportion with 30% silica fume and coarse aggregates are replaced with used aggregates by varying % compressive strength increase 38.70 N/mm2 to 44.06 N/mm2.
- Increase in % of silica fume value of compressive strength also increases.

6. FUTURE SCOPE OF WORK

- This study can be carried out with other more resistant and durable types of concrete (egg M40 and M50).
- This Study can also be carried out with 2% increment in silica fume with self-compacting concrete.
- The studio is broken down into other common types of clay, glass and wood dust. This means that almost any closed construction project and demolition work can be done from waste, but construction glass can be powdered glass along with construction debris. Use glass boxes and cut wood instead of glass boxes and sticks
- Further evidence of alternative wave comparisons between the use of aggregates and all used aggregates for M25 cement.
- Comprehensive pollution counter and soft cut glass powder.

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