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Effect of Different Coloured Glass Powder, Limestone Waste Powder as Partial Sand Replacement and Flyash as Partial Cement Replacement in M30 Concrete

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ABSTRACT- Limestone waste is a byproduct of the aggregate production process in the rubble crusher Limestone unit, which involves the crushing of rocks. The use of limestone waste as a sand substitute in construction materials would alleviate the environmental problems created by the large-scale depletion of natural sand sources such as river and mining sands. Every year, millions of tonnes of waste glass are produced around the world. Glass is disposed of in landfills once it becomes a trash, which is unsustainable because it decomposes in the environment. The use of various coloured glass powder as a partial sand substitute could be a critical step toward the creation of long-term infrastructure systems. Fly ash is the bound residue of coal's clay mineral deposits. most of which are aluminum silicate in compositionhappens as a result of high temperatures generated during coal combustion in thermal power plants. To improve the properties of Portland cement concrete fly ash used. The purpose of this experiment was to see how fractional replacement of sand with lime stone waste powder[LSW], different coloured glass powder, and cement with Fly ash affected the several fresh and cured qualities of concrete. So, in my research, I'm utilising M30 grade and a constant mix of different coloured glass powder in sand. Workability tests, compressive strength testing, and split tensile tests were performed to determine the ideal combination that results in the highest percentage of strength.

KEYWORDS- Compressive strength, Different coloured glass, limestone waste, split tensile test and Fly ash.

I. INTRODUCTION

Concrete is a building material made up of a durable, chemically inert particle ingredient known as a mixture (typically made up of various types of sand and gravel) and cement. As a bonding ingredient or cement, the Assyrians and Babylonians employed clay. Lime and mineral cement were employed by Egyptians. By mixing hopped-up brick into the cement and adding pebbles as a rough mixture, British engineer John Smeaton made the first stylish concrete (hydraulic cement) in 1756. Joseph Aspdin, an English artificer, invented a cement in 1824 that has remained the most widely used in concrete manufacturing ever since. By burning ground rock and clay along, Joseph Aspdin made the first true artificial cement. The materials' chemical characteristics were altered by the burning procedure, and Joseph Aspdin produced stronger cement than would have been produced by using simple crushed rock. Concrete's other significant component is the reinforcement. Aside from the cement, there's the mixture. Sand, crushed stone, gravel, slag, ashes, burned sedimentary rock, and burned clay are all examples of aggregates. Concrete slabs and smooth surfaces are made with fine mixture (fine refers to aggregate diameters). For huge constructions or cement sections, a coarse mixture is used. Until recently, the majority of attention has been focused on concrete's compressive strength, which has been linked to the porousness of the cement paste matrix, as well as the quantity and structure of the particles. Mechanical strength is highly difficult to relate to microstructure because it is based on flaws rather than any overall average feature. As a result, the fine print of the pore home has received relatively little attention. Unfortunately, it's possible that this is a semiconductor diode to the idea that concrete is merely an artefact material for which no microstructure understanding is required. However, there is a lot of the concrete in the infrastructure in the United States and Europe, for example, has been deteriorating faster than expected, with much of this deterioration due to the corrosion of reinforcing steel caused by the ingress of chloride and other ions from road salts, marine environments, and ground soils. As a result, close attention is being devoted to the transport properties of concrete (diffusivity, porousness, sorptivity, and so on), which, while still difficult to relate to pore structure and microstructure, are easier to test in a very basic approach than compressive strength. This has led to a renewed interest in the microstructure of concrete, with the hope that concrete could beimproved. Advanced composites, which require the same old materials science methodology of process, microstructure, and characteristics to develop and control.

II. LITERATURE REVIEW

- Prof Geeta batham,Akash shrivastava[1]; Experimental study on role of limestone powder and Glass powder fly Ash as cement replacement in concrete,for this study concrete mix is prepared in various mix designation is T3/M2,T3/M4 and T3/M5 are prepared.W/C ratio is varies between 0.4 to 0.5 and determine to physical property and workability ,compressive strength,split strength.so flyash can be used as alternate cement.
- Dr Bharat Nagar, Sudhanshu Kumar [2]; Experimental study on utilization of waste glass powder as partial replacement of fine aggregate. This experimental study was found optimum percentage of glass waste powder was found to be 25% by weight of fine aggregate at which addition of glass waste powder increases the compressive strength of concrete in 28days in extent of 11.56% which is approximately equal to M30 grade of concrete. Results proved that glass powder can be used as a way for safe disposal of waste glass and can be used as fine aggregate.
- Bharat Nagar,Prof V.P Bhargava [3]; Research on effect of Glass powder on various properties of concrete. Waste glass powder is used in various %age such as 5%,10%,15%,20%,25%....50%.The conclusion is glass powder can be used in ordinary Portland cement up to 23 to 25%.
- P.Turget (Aug 2013)[4]; Experimental study on Fly ash block containing limestone and glass powder waste. Using glass powder as coarse aggregate at 30% compressive strength of masonry blocks without Portland cement was 25 and 34MPa and add greater than 75micronmeter FA +limestone waste.so lp, gp, and fly ash(class c) can be used to produce masonry blocks without Portland cement. Hence limestone can be used as fine aggregate.

III. OBJECTIVES

- To investigate and assess the feasibility of utilizing rock waste, various colored glass waste, and ash in concrete in terms of its structural attributes, such as strength.
- To have a comparative research of concrete workability.
- To evaluate the use of rock waste, glass waste, and ash as partial replacements for sand and cement, respectively.
- Compare the appearance of rock waste, waste glass, and ash concrete to that of normal cement concrete.
- Based on the research findings, draw conclusions and make recommendations, as well as identify areas for further investigation.
- The tests that will be performed on the concrete will be as follows:

- Test of compressive strength
- Tensile test with a split tensile test
- Workability evaluation (slump test)

A. Composition of Concrete

- Cement, Aggregates,water, Admixtures.
- GENERAL STUDY OF WASTE MATERIALS
- Limestone waste
- Differentcoloured glass powder
- Fly ash

B. Physical properties of Limestone and Different Coloured Glass

Different colored glass is created by melting natural and abundant raw materials such as sand, soda ash, and limestone at extremely high temperatures to create a new material. The Composition of Rock Limestone is a type of stone that can be found near the layer's surface. When it comes into contact with water containing dissolved carbonic acid gas or a mild acid, it tends to acidify and erode. Carbonate is the most common component of rock. Rock has a number of distinct physical qualities.

Limestone is a member of the nursing team. Carbonate, often known as calcite, is the most abundant component. Shells, bones, and other calcium-rich items sink to the bottom of the ocean and take precedence over all other options. Years of fabric growth, as well as water pushing down on the layers, leads the lowest material to solidify and form rock.

Limestone and glass are usually impermeable, heavy, and compact materials. It's typically fine-grained, with a density ranging from 2.5 to 2.7 kilograms per cubic centimeter. Some lime-stone is polished and so marketable. The color of rock varies from white to off-white. Glass has a density of 2.5, resulting in a mass of 2,5 kg per m2 per mm of thickness, or 2500 kg per m3. The compressive strength is quite high, with 1000N/mm2 equaling 1000MPa. This means that a 10tonne load is required to shatter a 1cm cube of glass.

Table 1: Physical and Mechanical Properties of Limestone Waste (LSW)\DGP

Property	**Results**
Specificweight	2.61,2.65
Bulk density(t/m^3)	1.68,1.5
Waterabsorption%	2.1
Finedustcontent%	15.17

C. Utilization Ofwaste Materials

The use of sedimentary rock debris as a fine mixture in concrete has been popular in recent years, with large-scale research being conducted at Egypt's Suez Canal University. According to recent research findings, concrete made with sedimentary rock waste as a fine mixture has a greater future strength due to the better building materials.

Using different coloured glass at a constant proportion of 5%.

D. Environmental Impact of Sand Extraction

The fine mixture that is a part of concrete is sometimes included in construction grade stream sand. Excessive sand mining in streams lowers the streambed, which can lead to bank erosion. The loss of sand in streambeds and along coastlines causes river deepening, which might result in saline - water intrusion from the Close Ocean. Excessive sand mining in streams could endanger bridges, stream banks, and nearby structures. Stream sand mining causes huge changes in channel shape, resulting in the destruction of aquatic and bank habitat. Bed degradation, bed coarsening, falling water tables along the steam bed, and channel instability are all effects. These physical consequences cause bank and aquatic aggregate degradation, as well as the undermining of bridges and other structures. If waste glass is used in place of sand in some percentage, it will reduce the problems caused by stream sand mining.

IV. FLYASH

A. Overview of Flyash

Fly ash, also known as flue-ash, is one of the wastes produced during combustion and consists of small particles that ascend with the flue gases. Bottom ash is ash that does not rise. In the context of industry, ash usually refers to the ash produced after coal burning. Electricity precipitators are commonly used to capture ash. Other particle filtration equipment before the flue gases reaches the chimneys of coal-fired power plants, and bottom ash separate from the rock bottom of the chamber is referred to as coal ash in this scenario. The constituents of ash vary depending on the supply and makeup of the coal being burned, although all ash contains significant levels of silica (SiO_2) (both amorphous and crystalline) and unslaked lime (CaO), both of which are endemic materials in various coal-bearinggeological layers.

B. Characteristics of Ash

Ash is divided into two categories: category F and sophistication C. Category F ash comes from the combustion of hard coal or coal and is twelve pozzolanic in nature, while sophistication C comes from wood coal or sub-bituminous coal. Each pozzolanic and self-hardening feature is present in Category C ash. As a result, in order to use the fabric in a variety of applications, it must be properly characterized.

C. Physical Properties of Ash

The outstanding physical features of fly ashes are specific gravity, loss on ignition (LOI), and specific surface area. The specific gravity of ash can range from 1.3 to 4.8. Within the relative density of the fabric, the iron component concentration plays a critical effect. For fly ashes containing a lot of iron complex, the specific gravity is high, and vice versa. The inclusion of opaque spherical magnetic iron-ore and iron-ore particles in sufficient quantities can raise the relative density value to around 3.6% to 4.8. On the other hand, as the amount of quartz and mullite increases, the specific gravity drops. Coal particles with certain minerallic impurities, on the other hand, can have a lower relative density, ranging from one.3 to 1.6.

D. Utilization of Fly Ash

Fly ash has both crystalline and amorphous phases. crystalline stages include quartz, mullite, sillimanite, crystallization, mineral, iron sulphates, magnetic iron ore, and so on. The amorphous phases may be largely composed of silicon oxide and silicates of atomic number 13, but they may also contain traces of atomic numbers 11 and 19, as well as atomic numbers 20, magnesium, and iron in various quantities. Fly ashes' reactivity is determined by their non-crystalline or glass content. The chemical makeup of the high atomic number 20 ash in the glass differs significantly from that of the low atomic number 20 ash, and hence the reactivity differs significantly. :

The Mission Energy Foundation, a long-standing, private, non-profit organization dedicated to disseminating information in the globalizing energy sector, is pleased to announce its first international summit, FLYASH Utilization 2013, with strong backing from various Indian Ministries.

Simultaneous Utilization of LimestoneWaste,Different colored glass powder waste and Fly Ash in Concrete:

Some of the cement in this concrete has been replaced by the fly as hand sand, limestone, and glass powder trash. The possibility for both of these wastes to be used in concrete contributes to the sustainability of the concrete industry while also protecting the environment by reducing CO_2 emissions. The most serious waste disposal issue has also been resolved.

E. Various Experimental Tests

- Slump Test
- Compressive Strength Test
- Split Tensile Test.
- 04.SIEVE ANALYSIS.
- Concrete Mix Design (GradeM-30)
- The mix use dinthetrials is the designmixM30.M stands for mix and 30 for characteristic compressive strength concrete gains after 28 days which is 30KN/mm2.
- Characteristic strength at 28days 30Mpa
- Maximum size of aggregate 20 mm.
- Degree of workability 0.8C.F.
- Type of exposure Moderate.

1) Test data of Materials

Target mean strength=fck+ts= Fck +1.65 x (Standard deviation)
The standard deviation for different grade of concrete as per clause 9.2.4.2IS 456-2000
Standard deviation is 5 for M30 to M50.
Fck = 30 + 1.65 x 5
Fck= 38.5N/mm2

2) ConcreteM30

The various design parameters are:
Water cement ratio =0.45(Mild Exposure) as per IS456 -2000
Compaction factor =0.80
Cement content =437.778Kg/m3 Fine aggregate = 684kg(for one cube)
Coarseaggregate =1075 kg(for one cube)
Water content = 197 liters
Calculation Amount of cement content:
W/C =0.45
197/C = 0.45
C =197/0.45 = 437.77kg/m3.
Volume =0.03469

3) Mix Proportion

Four trials of experiments for mixing were carried out, each based on an individual investigation. Individual mixes were used to determine the composition of both wastes, yielding the most positive results. The following are the possible combinations.

4) Trial Mix

- 1 : 1.55 :2.46 {in accordance with IS 10262}.
- 1. M00%LSW,0DGP + 0%FA..(1 :1.55 :2.46)
- M110%LSW, 5% DGP+10% FA(1 :1.46 :2.73)
- M220%LSW, 5%DGP+20% FA (1 :1.45 :3.06)
- M330%LSW, 5%DGP+30% FA (1 : 1.44 : 3.5)
- M440%LSW,5%DGP+40% FA (1 : 1.41 : 4.0).

5) Sieve Analysis

Specific gravity of cement	3.15
Specific gravity of coarse aggregate	2.63
Specific gravity of fine aggregate	2.54.
Zone factor for s and Water cement ratio	2.0.45

Sieve analysis helps to determine the particle size distribution of the coarse and fineaggregates. This is done by sieving the aggregates as per IS: 2386 (Part I) – 1963. In thiswe use different sieves as standardized by the IS code and then pass aggregates through them and thus collect different sized particles left over different sieves. The apparatus used are:
A set of IS Sieves of sizes–80mm, 63mm, 50mm, 40mm, 31.5mm, 25mm, 20mm, 16mm, 12.5mm, 10mm, 6.3mm, 4.75mm, 3.35mm, 2.36mm, 1.18mm, 600µm, 300µm, 150µm and 75µm.

The LSW, GPW obtained is properly mixed with the sand to form assort of blended sand. The Fly ash is blended with cement .Then this blended sand and blended cement is mixed with the other constituents by hand mixing .The mixture proportion was in accordance with IS 10262.
Slump test (is :7320 -1974):

Slump is a measurement of the workability or fluidity of concrete. It's a method of determining the consistency or stiffness of concrete. A slump test is a technique for determining concrete consistency. The stiffness, or consistency, of the mixture reveals how much water has been utilized. The stiffness of the concrete mix should be matched to the finished product quality criteria.The concrete slump test is used to determine a property of freshly laid concrete. The test is an empirical evaluation of fresh concrete's workability. It assesses uniformity between batches, to be more explicit. Apparatus required is metallic mould, Metallic tray and mould known as slump cone of size 100mm ,200mm and 300mm.

Table 2: Slump Test

FlyAsh %	LSW,dgp %	w/cratio	Water(Kg)	Cement(Kg)	FineAggregate(Kg)	FlyAsh (Kg)	LSWgw (Kg)	CoarseAggregate(Kg)	Slump(mm)
0	0	0.45	6.83	15.19	23.67	0.00	0	37.39	40
10	10,5	0.45	6.83	13.69	20.12	1.5	3.55	37.39	45
20	20,5	0.45	6.83	12.19	17.76	3	5.91	37.39	47
30	30,5	0.45	6.83	10.67	15.39	4.5	8.28	37.39	52
40	40,5	0.45	6.83	9.19	13.02	6	10.6	37.39	55

6) Compressive Strength Test (IS 516 :1959)

This is the most significant test applied to concrete because it gives an idea of all the features of concrete. This single test can be used to determine whether or not concrete has been correctly installed. Depending on the size of the aggregate,

.size of cube is 15 cm X 15 cm X 15 cm .cubes are used for the cube test. Cubical moulds measuring 7.06cm x 7.06cm are frequently used for the majority of the works. After 7 or 28 days of curing, these specimens are evaluated on a compression testing equipment. Specimens should be loaded gradually at a rate of 140 kg/cm2 per minute until they fail. The compressive strength of concrete is calculated by dividing the load at failure by the area of the specimen.
Table 3: Compressive strength=load/Area

Table 3: Compressive strength test

S. No.	Fly Ash %	LSW, DGP %	Avg.load@ 7 days (KN)	Avg. Load@ 28days(KN)	Avg. Compressive Strength @7days(N/mm^2)	Avg. Compressive Strength @28days (N/mm^2)
1	0	0	439.8	835.650	19.55	37.14
2	10	10,5%	466.875	859.725	20.75	38.21
3	20	20,5%	492.525	888.7	21.89	39.5
4	30	30,5%	434.47	843.750	19.31	36.5
5	40	40,5%	425.025	769.950	18.89	34.22

7) Split Tensile Strength TEST (IS :5816 -1999)

The stress developed due to the application of load on the concrete at which failure occurs is called tensile strength of that concrete. Split tensile strength of a concrete specimen is defined as tensile stresses occur due to application of compressive load along its length.
Apparatus used; digital compression machine.
This test is conducting on cylinders having dimensions 150mm *300mm.
The Cylinder specimen is putted properly on the machine while performing this test.
Applied load gradually increases until the specimen collapse.
At the time of failure of specimen,the reading is noted down
Formula used;

$$T = 2P/\pi Ld \text{ N/mm2.}$$

Table 4: Split Tensile strength test for LSW, DGP-FA Concrete

S. No.	FlyAsh %	LSW. %	DGPW %	Split Tensile strength (7days)	Split Tensile strength (28d ays)
1	0	0	0	3.24	3.86
2	10	10	5	3.41	4.63
3	20	20	5	3.58	4.86
4	30	30	5	3.31	4.08
5	40	40	5	2.5	3.34

V. GRAPHICAL REPRESENTATIONS AND RESULTS

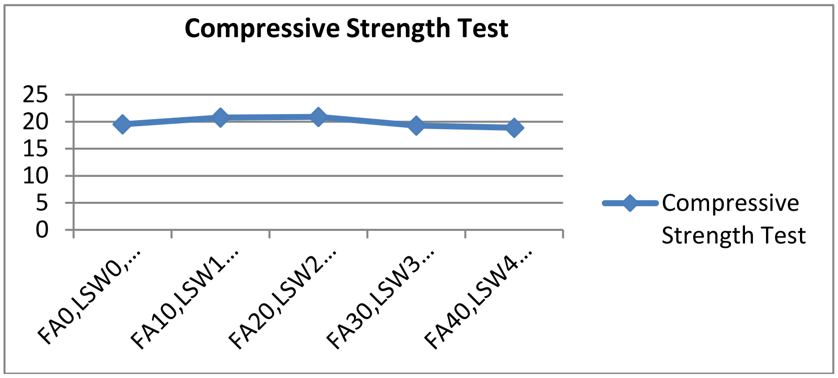

Figure 1: Representation of compressive strength after 7 days

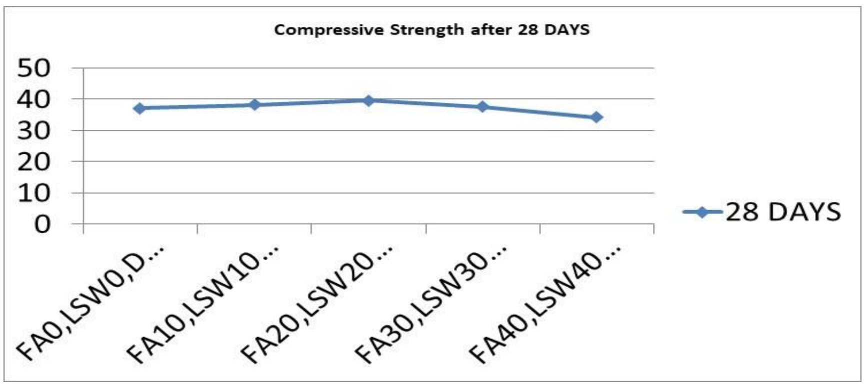

Figure 2: Representation of compressive strength after 28 days

28 Days Compressive Strength Test (N/mm^2)

A. *Compressive Strength Result*

DGP, LSW-FA concrete: compressive strength decrease from 21.89 Mpa to 18.89 Mpa at 7days of testing and from 39.55 Mpa to 34.22 Mpa at 28 days. 20% replacement it gives optimum value which are greater than the target mean strength value.

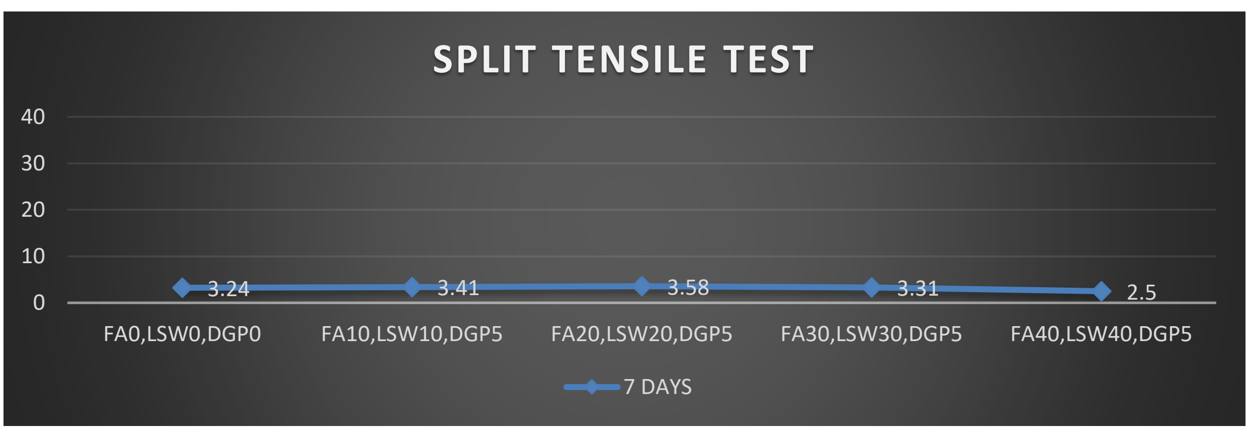

Figure 3: Split tensile test after 7 days

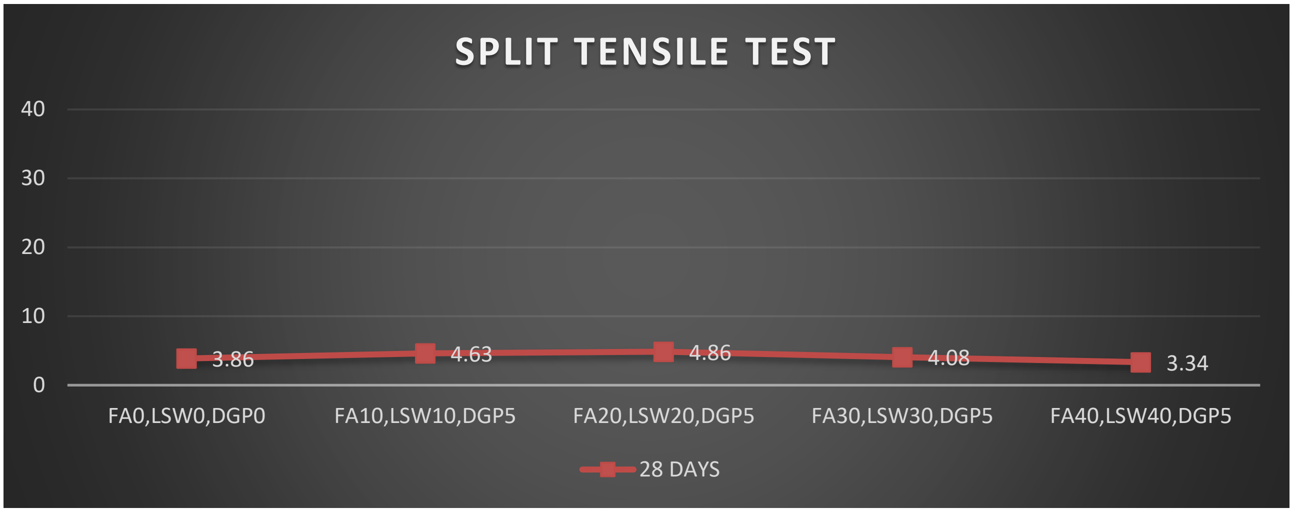

Figure 4: Split tensile test after 28 days

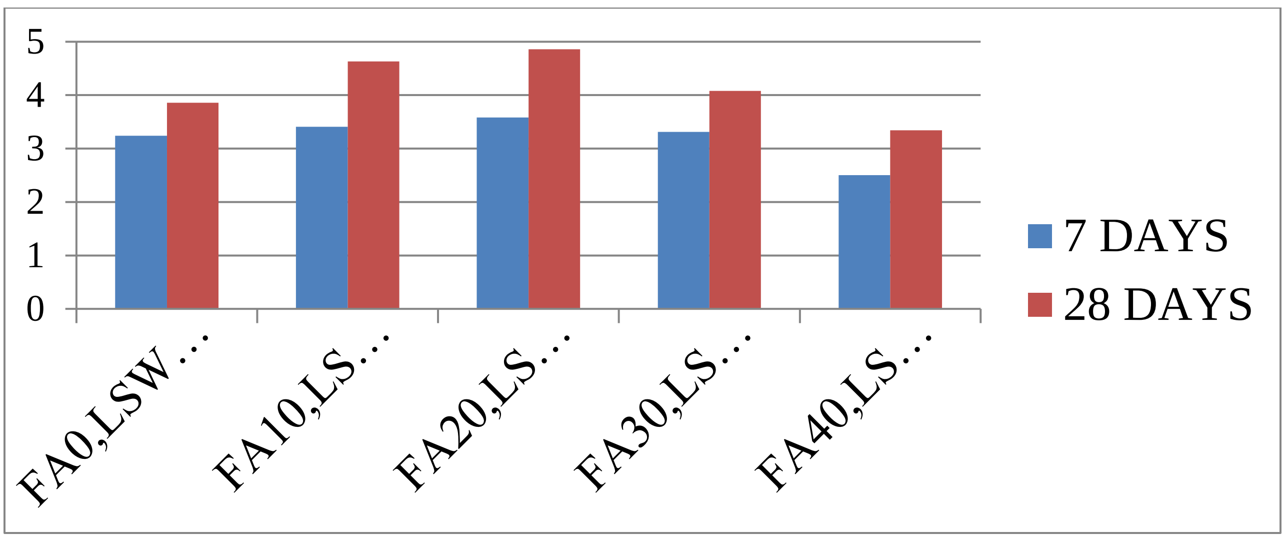

Figure 5: Split tensile test after 7 and 28 days respectively

***B. Split Tensile Strength* Result**

Dgp, LSW-FA concrete, Split tensile strength decreases from 3.58 to 2.5MPa at 7days of testing and from 4.86 to 3.34 at 28days.when 20% waste materials are replaced it gives the optimum strength.

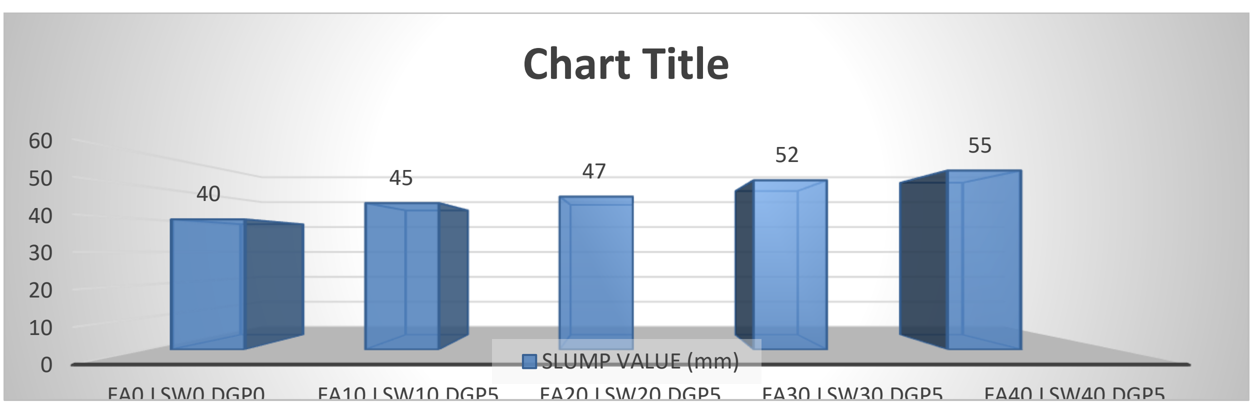

Figure 6: Chart of Slump test

C. *Effect on Workability*

The slump test results for LSW, GPW-FA concrete, which show an increase in workability. The slump was 40mm in a standard concrete reference mix and steadily climbed to 55mmin a mix comprising 40% fly ash and 45% limestone waste-glass powder waste.Degree of workaibility is medium workability and the concrete is plastic concrete.

VI. CONCLUSION

After carefu and elaborate study of effect of various waste materials on concrete properties, it can be concluded that:

- Limestone waste, Different coloured glass powder, Fly ash can be used as a supplementary aggregates and cementitious materials which in longer run can reduce our dependency of cement , fine aggregates for the making of concrete and also helps in reducing the waste disposals in open landfills, which can create significant health issues to the residents living around it.
- A combined use of limestone waste, glass Waste and fly ash in concrete has shown positive result for 20%..(20% flyash,5% different coloured glass and 20% limestone waste) .by using water cement ratio as 0.45
- Flyash can be used upto 20%, different coloured glass powder waste 5% and limestone waste 20%.as replacement of cement and fine aggregate.
- By using these waste materials there is an increase in workaibility.
- Use of lime stone and fly ash in concrete can prove to be economical as it is non useful waste.
- Use of lime stone waste in concrete will eradicatee disposal problem of lime stone waste and prove to be eco-friendly thus paving way for greener concrete.
- From the experimental work result, it is obvious that ordinary Portland cement can be replaced with fly ash and natural sand with limestone waste and different coloured glass waste powder will increase the strength parameters meanwhile resulting in the reduction of the usage of cement and natural sand helps in saving the environment and also the natural resources.

VII. FUTURE SCOPE

- Further studies can be carried out by varying the percentages of limestone waste, glass waste powder and fly ash in concrete and the flexural strength and strength characteristics of that concrete can be determined.
- Different type of waste materials like marble waste, tilepowder, stone dust can be used as fine aggregate. And Egg shell powder, hyposludge (paper sludge) can be used as cement.
- More experiments can be carried out by varying the water cement ratio with different percentages of limestone waste, glass waste powder and fly ash in concrete and the water absorption test, density test, and workability of that concrete can be determined.
- In future further studies can be carried out on the different grades of concrete so as to calculate whether that is also going to be beneficial for our future generation or not.
- By using different coloured glass, limestone waste, it can reduce our dependency on natural sand for the future construction purposes.

CONFLICTS OF INTEREST

The authors declare that they have no conflict of interest.

ACKNOWLEDGEMENT

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