A STUDY ON CONCRETE USING PLASTIC WASTE AS PARTIAL REPLACEMENT OF FINE AGGREGATE AND METAKOLIN AS AN ADMIXTURE

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Abstract : The major problem in the construction industry nowadays is inadequate and unavailability of construction materials, However the main environmental problem is the disposal of PVC plastic waste ss. In this experimental study, the use of plastic in concrete has been tried and studied to focus the behavior of compression members under different proportions of plastic.PVC plastic waste -based concrete cubes and cylinders were manually cast and the strength of the test concrete was evaluated in terms of compression and partition stress. According to research it comes to known that the strength of the plastic changed the compression in terms of compression and partitioning and can be compared to conventional concrete.

The purpose of this current study is to partially replace fine aggregate by PVC plastic waste granules (0%, 5%, 10%, 15% and 20%) that will provide the advantage of reducing dead weight composition. This combination of cubes and cylinders was subjected to compression and split stress to find the strength parameter.

IndexTerms **- Concrete, PVC Plastic Waste, Strength, Workability and Light Weight.**

I. INTRODUCTION

The problem of solid waste discarding and management of all countries is accompanied by major environmental, economic and social issues. A complete waste management system, which requires resource reduction, reuse, recycling, landfill, and incineration needs to be enforcement to control the expand waste disposal problems. Typically, plastics do not recycle into the same type of plastic products, which are made from plastics, which are often not recycled. The use of biodegradable plastics increases if some of them are added to plastics for processing and recycled plastics are not recycled due to temperature variation. The project aims to assess the probability of use of plastic waste from PVC to replace some small aggregates in concrete composites.

Among different waste fractions, PVC plastic waste management deserves special attention for the unused properties that cause many environmental problems. About 40 million tonnes of solid waste generate every year in India.It is growing fastly 1.5 -2% per year. Plastics account for 12.3% of the total waste produced, most of which are from bottled water. PVC plastic waste cannot be removed by dumping or burning, as it creates uncontrolled fires or pollutes the soil and pollutes.

Research carried out on this topic in some countries like USA and UK. However, very limited examine carried out about plastic in concrete in india. Therefore, attempt is made on the employ of PVC plastic waste as partially replacing of fine aggregate and its mechanical behaviour is investigated.

OBJECTIVES

- To find mechanical properties of concrete containing fine aggregate as a replacement of pvc plastic waste powder.
- To find out optimum percentage of waste material replacement by pvc plastic waste powder can be replaced by means of fine aggregate in concrete respectively.
- To determine the durabily of new combination of concrete materials.
- To produce lightweight polymer concrete for multi-purpose use.

II. LITERATURE REVIEW

[1] Shyam S, [2] Drishya P, [3]Gibi Miriyam Mathew, [4]Sruthy B investigated that Maximum strength is attained at 5% HDPE Powder compressive strength increase to 16.6% .

[1] Jibrin Sule,[2] Sule Emmanuel,[3] Ismaila Joseph, [4] Osagie Ibhadobe, [5] Emeson Sunny, The recycled plastic aggregates can be used up to 15% replacement of fine aggregates in the concrete mixture.

[1] S. Das,[2] M. T. Alam, [2] I. Chowdhury, in this paper addition of plastic the concrete strength is gradually diminishing. From our investigation, it was found that for 28 days the compressive strength of 28 days is 32.03 MPa, 4% is 31.23 MPa, 6% is 30.02 MPa, 8% is 27 MPa and 10% is 25.39 MPa.

[1] Amalu.R.G, [2] Azeef Ashraf, [3] Muhammad Hashim, [4] Rejith.K.U, [4] Vijitha.V , this paper Main benefit of this project is workability it will be increased because the plastic have been less absorbing water content

III. MATERIAL AND METHODOLOGY

Fine Aggregate: The river sand which is naturally available use as a fine aggregate. The sand properties were determined by testing according to IS 2386 (Part- I).

Table 1 Physical Property of Fine Aggregate

Properties	Sand
Sieve analysis	Zone II
Fineness modulus	2.871
Specific Gravity	2.64
Water Absorption	1.77
Bulk Density	1.62 (Loose) 1.76 (Compacted)

PVC PLASTIC WASTE

- PVC plastic waste is an industrial by-product obtained during the production pvc pipe.
- Plastic waste background is usually very low and they are light weight than other concrete material.
- Therefore, nowadays utilization of secondary materials is being encouraged in construction field.
- Several researches have investigated the possible use of pvc plastic waste as fine aggregate in normal concrete and its effect on different mechanical properties of concrete.

Figure : 1 PVC Plastic Waste

Table 2 Physical Property of PVC Plastic Waste

Test Parameter	**Result**	**Test Method**
Sieve Analysis	**ZONE 3**	**IS 383-1970**
Finesse Modulus	**1.97**	
Colour	**GREAY**	
Bulk Density (kg/m^3)	**1.545**	**IS:2386 (P-3) (1963)**
Specific Gravity	**0.76**	**IS:2386 (P-3) (1963)**

Coarse aggregate: Crushed Coarse aggregate conforming to IS 383-1987 was used. Coarse aggregate of size 20mm and10 mm were used.

Table 3 Physical Property of Coarse Aggregate

Properties	20mm	10mm
Specific Gravity	2.88	2.99
Water Absorption	1.46%	0.29%
Aggregate Impact Value	9.21%	9.33%
Aggregate Crushing Value	11.75%	9.98%
Flakiness Index	10.89%	25.26%
Elongation Index	6.84%	7.66%
Bulk Density	1.657 (Loose) 1.75 (Compacted)	1.53 (Loose) 1.68 (Compacted)

METAKOLIN

- Metakaolin, is a relatively new material in the concrete industry, is effective in increasing strength, reducing sulphate attack and improving air-void network.
- Metakaolin used as a admixture.
- Increase strength and improve workability of concrete.
- In our project Metakaolin used with 10% weight of cement. When used metakolin as a mineral admixture so increase strength of concrete.

Table 4 Properties of Metakaolin

Chemical composition	**Properties**
Silica (SiO2)	54.3
Alumina Al2O3	38.3
Calcium oxide CaO	0.39
Ferric oxide Calcium oxide (Fe2O3)	4.28
Magnesium oxide (MgO)	0.08
Potassium oxide (K2O)	0.50
Sulphuric anhydride (SO4)	0.33
LOI	0.68
Specific gravity	2.5
Physical Form	Powder
Colour	Off White

Table 5 Mix Proportion for grade M30 For (0% plastic waste)

Aggregate. Proportions as per table 2 of IS 383			**0.60**	**0.40**	**Admixture**
Water	**Cement**	**Sand**	**(20mm)**	**(10mm)**	**Super plasticizer**
148	370	519	682.2	454.2	2.2
0.45	1	1.40	1.84	1.21	0.05

Table 6 Mix Proportion for grade M30 For with plastic waste

Aggregate. Proportions as per table 2 of IS 383			**0.60**	**0.40**	**Admixture**	**Admixture**
Water	**Cement**	**Sand**	**(20mm)**	**(10mm)**	**Metakolin**	**Super plasticizer**
148	352	772.83	712.77	475.02	35.2	4.12
0.53	1	2.19	1.87	1.87	0.1	1.25

Table 7 Pvc Plastic Waste Weight For The Mix

% replacement (by volume)	**Weight of pvc plastic waste used (kg)**	**Weight of Fine aggregate after replacement**
5	0.1095	2.19-0.1095 = 2.085
10	0.219	2.19- 0.219= 1.971
15	0.3285	2.19-0.3285 = 1.8615
20	0.438	2.19-0.438 = 1.752

IV. RESULTS

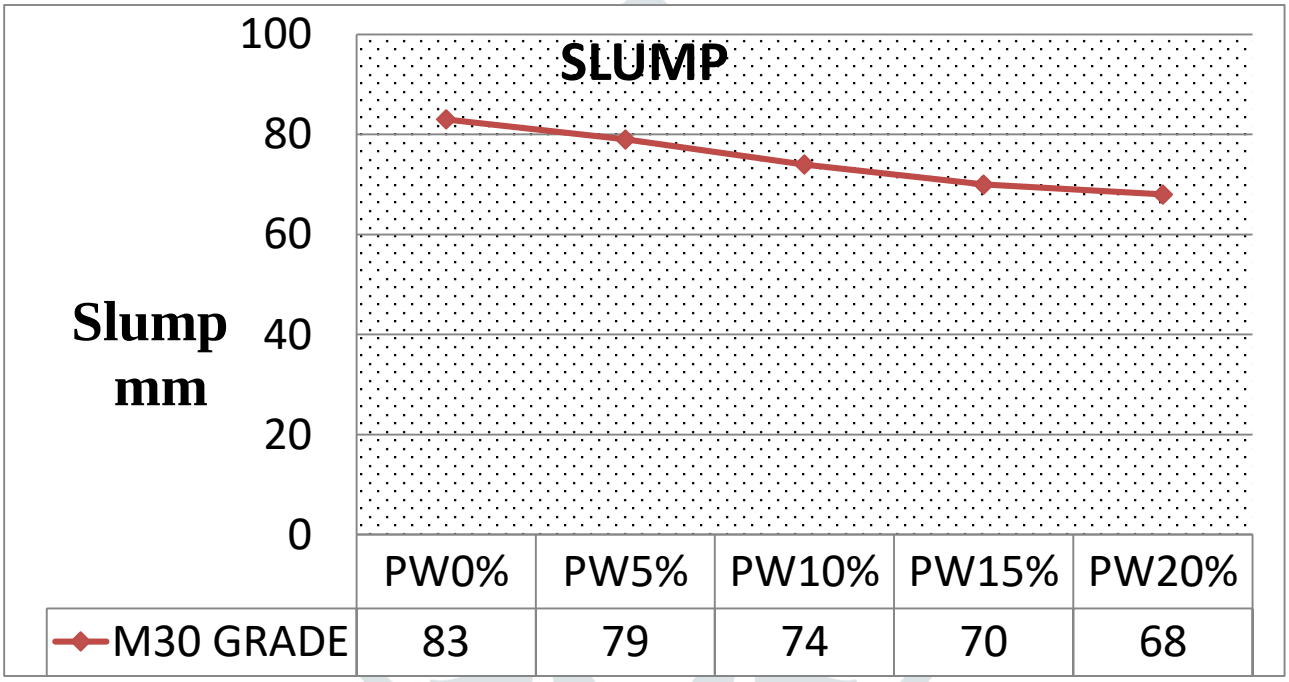
Workability:

- The concrete slump test measures before it sets the workability of fresh concrete.
- It tests the Workability of fresh produced concrete, and thus the ease with which in concrete flows.
- In workability increase with pvc plastic waste % increase.
- The slump test is used for the measurement of a property of fresh concrete as per IS: 1199 – 1959.

Table 8 Slump Test Results

SR. N0.	W/C ratio	Percentage of plastic replaced (%)	Height of mould H1 (mm)	Height of subsided concrete H2 (mm)	Slump H1– H2 (in mm)
1	0.42	0	300	217	83
2	0.42	5	300	221	79
3	0.42	10	300	226	74
4	0.42	15	300	230	70
5	0.42	20	300	228	68

Fig. 2 Slump Values Comparison



Compressive Strength Test:

- Determination of compressive strength using by cube where size of cube specimen is 150×150×150 mm and this test was performed on a 2000 KN capacity compression testing machine.
- The Bureau of Indian Standards suggests that Concrete's compressive strength should be the basis for the determination of all properties and the study of concrete response. As such more emphasis was given on this test. Concrete's compressive strength was assessed at 7 days , 14 days, and 28 days in age.
- The Compressive strength of cube specimen is calculated using the following formula:

$\sigma = P/A$

Where, P = failure load

A = cross sectional area of cube in mm

Table 9 Compressive Strength Test Result

PVC WASTE	7 Days M30	28Days M30
PW0%	22.41 N/mm^2	36.57 N/mm^2
PW5%	23.09 N/mm^2	38.97 N/mm^2
PW10%	24.66 N/mm^2	40.4 N/mm^2
PW15%	23.67 N/mm^2	39.06 N/mm^2
PW20%	23.09 N/mm^2	38.97 N/mm^2

Fig. 3 Compressive Strength Values Comparison 7-Days

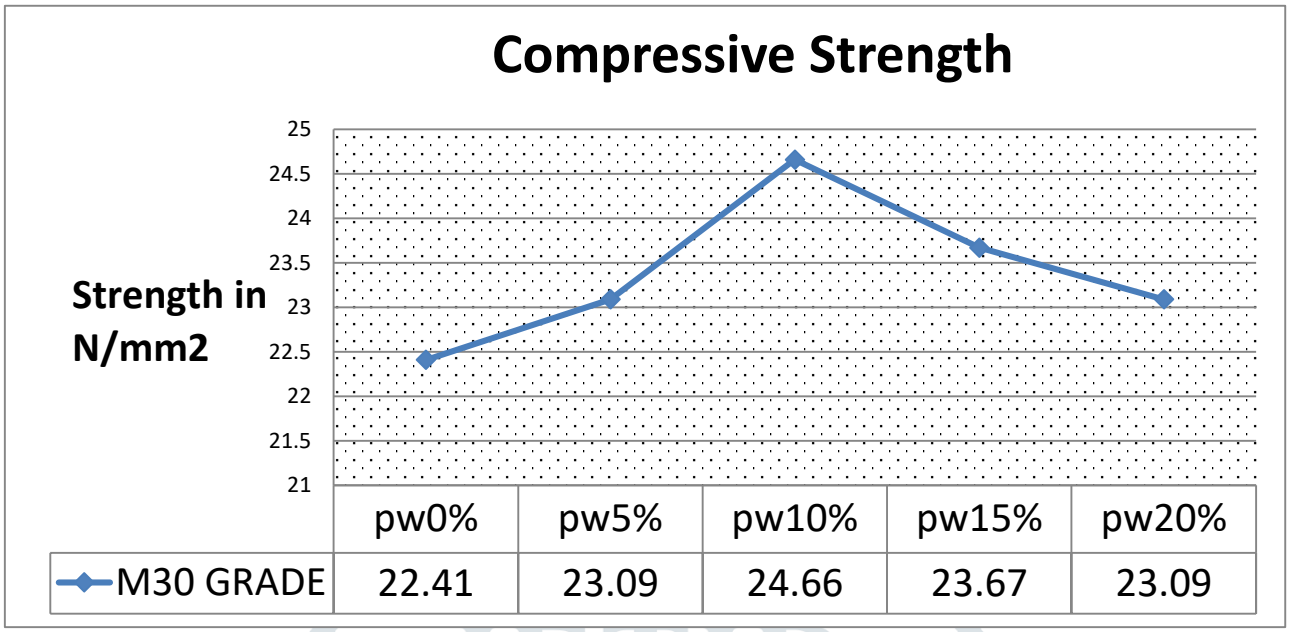
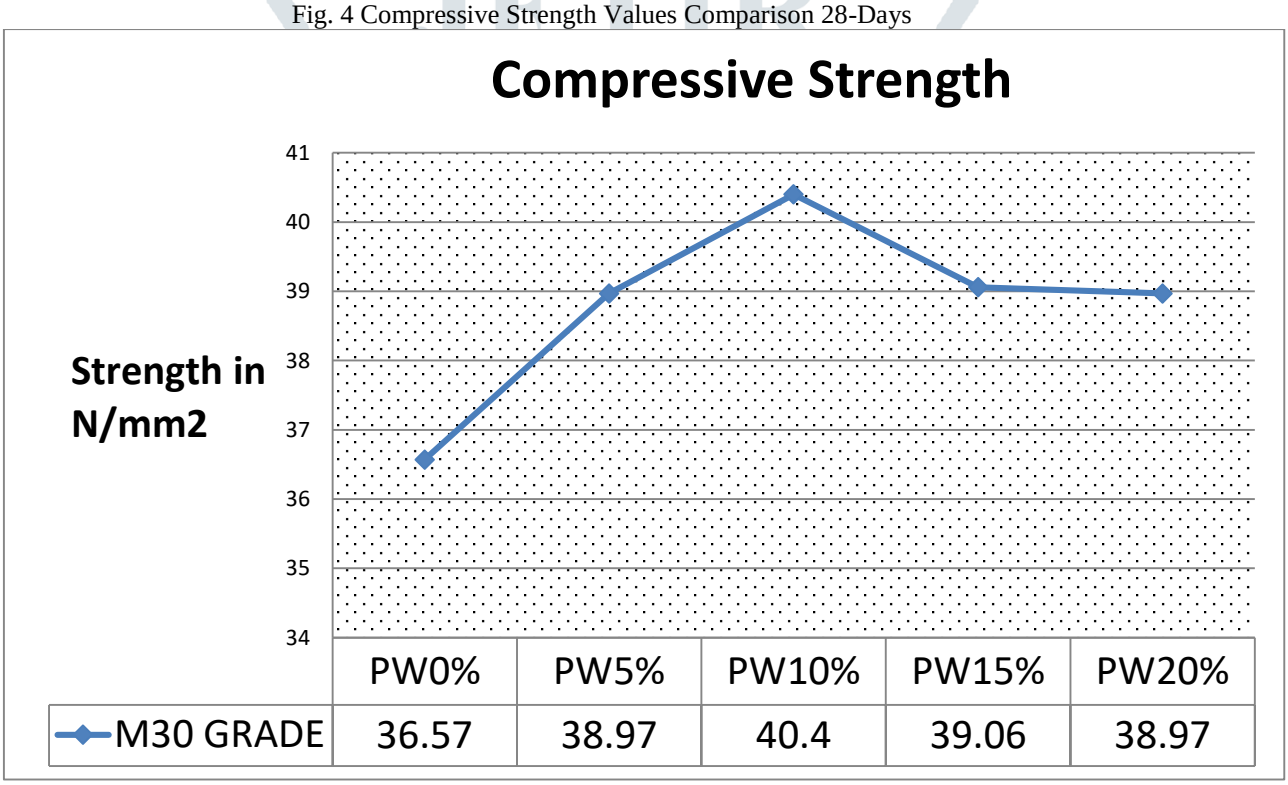


Fig. 4 Compressive Strength Values Comparison 28-Days



Flexural Strength Test

- **Beam mould** of size 10 x 10 x 50 cm (when size of aggregate is less than 19 mm).
- The load shall be applied through two similar rollers mounted at the third points of the supporting span that is, spaced at 20 or 13.3 cm centre to centre.
- The load shall be divided equally between the two loading rollers, and all rollers shall be mounted in such a manner that the load is applied axially and without subjecting the specimen to any torsional stresses or restraints.
- The **Flexural Strength mould** specimen is calculated using the following formula:

$$f_b = pl/bd^2$$

where, b = width of specimen (cm)

d = failure point depth (cm)

l = supported length (cm)

p = max. Load (kg)

Table 9 Strength Flexural Test Result

PVC WASTE	7 Days M30	28Days M30
PW0%	0.97 N/mm^2	4.62 N/mm^2
PW5%	1.84 N/mm^2	7.7 N/mm^2
PW10%	1.97 N/mm^2	7.98 N/mm^2
PW15%	2.03 N/mm^2	8.06 N/mm^2
PW20%	2.2 N/mm^2	8.21 N/mm^2

Fig. 3 Flexural Strength Values Comparison 7-Days

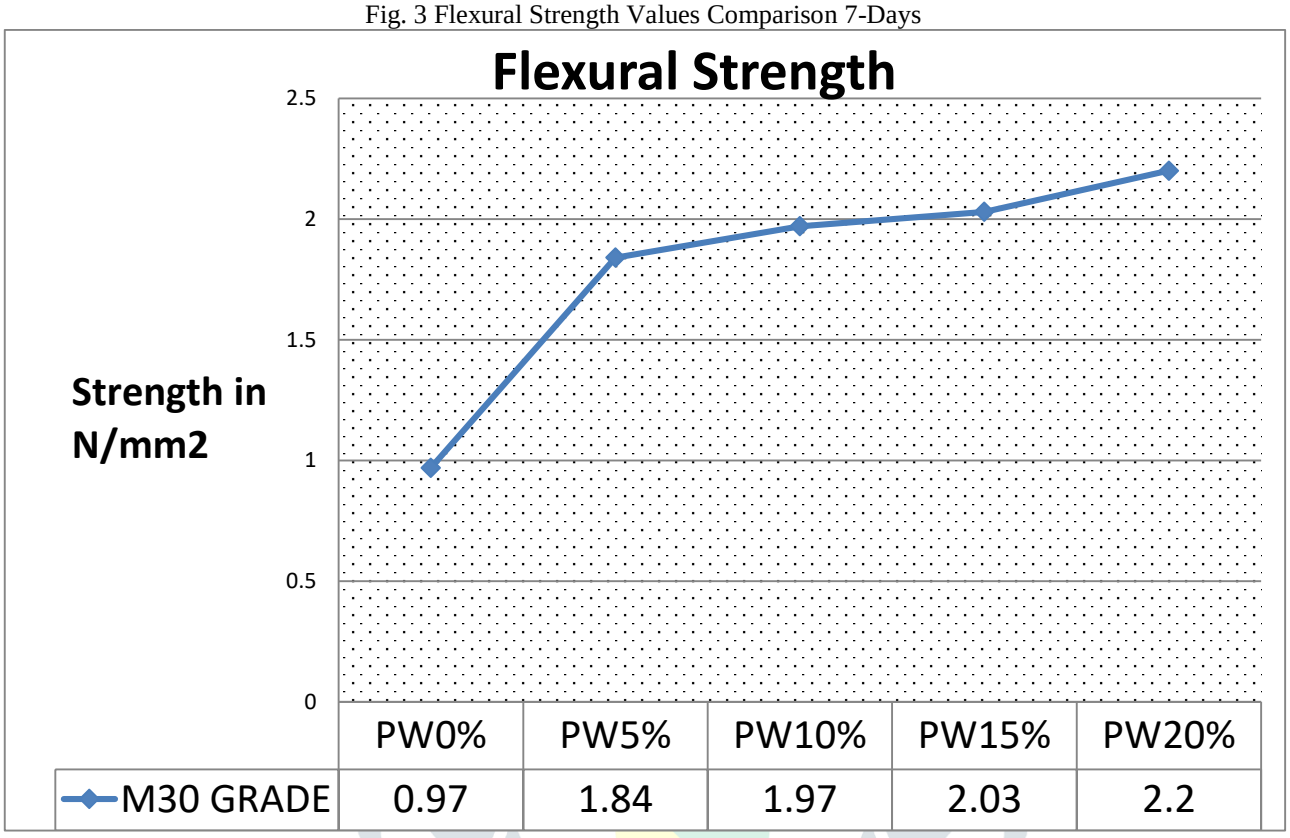
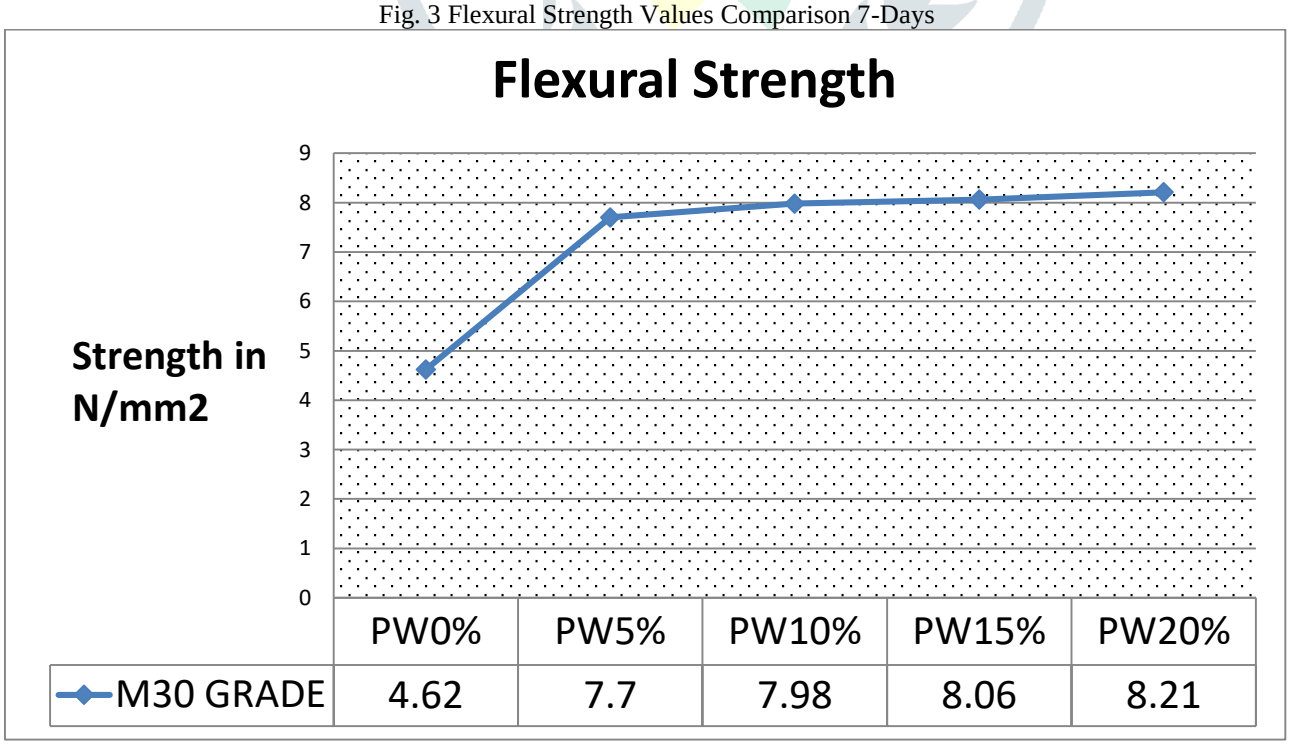


Fig. 3 Flexural Strength Values Comparison 7-Days



CONCLUSION

- It is observed that there is change in workability (Slump test) for the M30 grade of Concrete treated with 10% of PVC plastic waste when compared to normal concrete.
- It is observed that there is 1.9% increase in strength for the M30 grade of Concrete treated with 10% of when compared to

of PVC plastic waste normal concrete.

- It is observed when of PVC plastic waste % increase with weight of concrete decrease.
- Optimum value of PVC plastic waste is 10%.
- It is observed when of PVC plastic waste % increase with Flexural Strength increase.

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