International Journal of Engineering Science Invention (IJESI)
ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726
www.ijesi.org ||Volume 7 Issue 10 Ver II || Oct 2018 || PP 01-11

Partial Replacement Of Cement With Fly Ash And Cow Dung Ash By Using Quarry Dust As A Fine Aggregate

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***Abstract**: A conventional concrete is a mixture of cement, coarse aggregate and fine aggregate. The cement is a main constitute in concrete which binds the coarse and fine aggregate. Use of cement in concrete industry is increasing day by day due to growing population and industrialization but production of cement leads to environmental problem due to emission of high amount of carbon dioxide and fine aggregate (River sand) obtain from Rivers. The availability of River sand now days is an issue due to restrictions on mining because of environmental issues which cause increase in price of River sand. The Fly ash is a by-product obtained from coal power station and disposal of fly ash is a big issue. Cow dung ash is a by-product which obtained by burning cow dung cakes. Cow dung cakes used as a fuel for domestic purposes whereas Quarry dust is a byproduct of crushing of rocks in crushing plants which can be use as a fine aggregate in a concrete partially or fully. Cow dung ash and Fly ash both posses cementitious properties and can be use as a partial replacement of binder (cement) in concrete. So, this work is carried out to study the effect on the properties of concrete and cement when cement is partially replaced by fly ash and cow dung ash at various percentages (0% fly ash+0% cow dung ash), (10%fly ash+5%Cow dung ash), (20%fly ash+8 cow dung ash), (30% fly ash +10% Cow dung ash) and (40% fly ash +12% cow dung ash) and Fine aggregate is fully replaced by Quarry dust. The tests are performed compressive strength, workability of concrete, standard consistency and initial final setting time of cement. The M25 mix is design for proposed mix calculated for compressive strength test cube prepared for different percentage of replacement and cured for 7, 14 and 28 days. The Results shows the maximum compressive strength for (10% fly ash +5% cow dung ash) in 28 days, workability of a concrete decreased as the percentage of fly ash and cow dung ash increases in concrete. It also shows that the standard consistency and initial final setting time increased as the percentage of fly ash and cow dung ash increases in the concrete.*
***Keywords –** Fly ash, Cow dung ash, Quarry dust, Concrete, Enviroment.*

Date of Submission: 01-10-2018 Date of acceptance: 12-10-2018

I. Introduction

Cement is a second largest used material in the world. Demand of a cement increases due to increase in population and industrialization etc. Cement is main constitute of concrete. Concrete is a mixture of cement, fine and coarse aggregate. In this cement is a binding material which binds the sand and aggregate together and form a rigid mass. Cement is responsible for strength and durability in the structure. But in the production of cement CO_2 emits in large amount. It is about 0.8-0.9 tone in the production of 1 tone cement. This cause depletion of ozone layer and environmental pollution which leads greenhouse effect and the cost of cement are also very high. It also requires very high temperature of about 1500^0C due to which large amount of heat liberated during the production of cement. So, it is necessary to find the material which is act as a binding material in concrete and also environmental friendly and liberate less amount of energy during the production of cement. Whereas River sand is mostly used material as a fine aggregate from longer time but these days availability of River sand is matter of concern because of over use of river sand by concrete industry due to this restrictions increase on mining of River sand.

The construction industry is largely depends on the cement and other natural resources such as water, aggregate .Hence it is necessary to find a material which is of best quality and environment friendly and liberate less amount of energy in production. In this order to reduce the cement content in concrete many researchers tried to reduce the content by using different pozzolanic material such as Fly Ash, Lime, Silica fume, GGBFS, Rice husk etc.

In this project Fly Ash and Cow dung ash (CDA) used as a partial replacement of cement in concrete and Quarry dust used as a fully replacement of River sand to reduce the environmental problem and the cost of concrete by using byproducts. Fly ash and Cow dung ash (CDA) added in concrete at different percentage and obtain the compressive strength, workability, standard consistency and initial final setting time at different percentage replacement of cement. This effort can reduce the amount of CO_2 emission which generated during

the production of cement by reducing the cement content in the concrete through replacement the cement partially by fly ash and cow dung and obtain the percentage which will give desire strength and durability.

1.1 Objective Of This Study

The Objective of this study is to be observed.

- The effect of this on compressive strength of concrete.
- The effect of this on workability of concrete.
- The effect of this on initial and final setting time of cement.

1.2 Need Of This Study

- Utilize the byproducts like Cow dung ash, fly ash and Quarry dust in preparation of concrete.
- To reduce the problem of Environmental pollution.

II. Material And Methodology

2.1 Material Used

2.1.1 Cement

The Ordinary Portland Cement of Grade 43 used in this experiment. IS 12269 gives the chemical and physical requirements of 43 Grade Cement. The Physical properties of cement given in table no.3.1.

S.N	Property	Value
1.	Specific Gravity	3.15
2.	Standard Consistency	30%
3.	Initial Setting Time	42 min
4.	Final Setting Time	210 min

Table .2.1 Physical properties of cement

2.1.2 Fine Aggregate (Quarry Dust)

Quarry dust confirming to IS 383-1997 zone III is used in this study by fully replacing the river sand. Quarry dust was collected from local dealer and was initially dry in condition and IS 75µ sieve retaining. Some of physical properties of quarry dust are shown in following table3.2.

S.NO.	Property	Value
1.	Color	Grey
2.	Specific Gravity	2.4
3.	Fineness Modulus	2.72

Table No.2.2 Physical Properties of Fine aggregate (Quarry Dust)

Fig.2.1 Cement

Sieve Analysis of Fine Aggregate (Quarry Dust):

IS-Sieve	Weight Retained	% Weight Retained	%Pass	% Cumulative Retained
4.75mm	10gm	2	98	2
2.36mm	15gm	3	95	5
1.18mm	25gm	5	90	10
600µ	40gm	8	82	18
300 µ	140gm	28	54	46
150 µ	225gm	45	9	91
PAN	45gm	9	0	100
SUM	500gm			272

Table No.2.3 Sieve Analysis of Fine aggregate (Quarry Dust)

Fig.2.2 Quarry Dust

2.1.3 Coarse Aggregate

Coarse Aggregate Confirming the IS 383. Coarse aggregate of size 20-10 mm used in this project. The physical examination performed on the coarse aggregate results given in Table.3.4.

S.N	Property	Value
1.	Water Absorption	0.17%
2.	Crushing Value	15.7%
3.	Impact Value	6.03%
4.	Specific Gravity	2.62
5.	Fineness Modulus	7.16

Table .2.4 Physical properties of coarse aggregate

Sieve Analysis of Coarse Aggregate: 5000 gm sample of coarse aggregate is passed through the set of sieves given in the Table.3.5.

IS-Sieve	Weight Retained	%Retained	%Pass	% Cumulative Retained
80mm	0	0	100	0
40mm	150gm	3	97	3
20mm	530gm	10.6	86.4	13.6
10mm	4320gm	86.4	0	100
4.75mm	0	-	-	100
2.36mm	0	-	-	100
1.18mm	0	-	-	100
600µ	0	-	-	100
300µ	0	-	-	100
150µ	0	-	-	100
	SUM			716.6

Table 2.5 Sieve analysis of coarse aggregate

2.1.4 Cow Dung Ash

The Physical properties of cow dung ash examine in the laboratory is given in table 3.6.

S.NO.	Property	Value
1.	Color	Grey
2.	Specific Gravity	3.0

Table 2.6 Physical properties of cow dung ash

Fig.2.3 Cow Dung Ash

2.1.5 Fly Ash

The Physical properties of cow dung ash examine in the laboratory is given in table 3.7.

S.NO.	Property	Value
1.	Color	Dark Grey
2.	Specific Gravity	2.1

Table 2.7 Physical properties of Fly ash

Fig.2.4 Fly ash

2.2 Methodology

2.2.1 Mix Design

The M25 mix design for the proposed concrete mix was calculated. Quantities of coarse aggregate, fine aggregate (Quarry dust) and water were kept constant whereas the proportion of cement decreased with increasing proportion of fly ash and cow dung ash.

2.2.2 Mix Proportion

In this experiment 5 different mix of M 25 grade concrete are prepared. Which contain different proportion of Cement, Fly Ash and Cow Dung Ash.

Grade	Mix	Cement	Fly ash percentage	Cow Dung Ash percentage	W/C Ratio
M25	I	100%	0%	0%	0.5
	II	85%	10%	5%	0.5
	III	72%	20%	8%	0.5
	IV	60%	30%	10%	0.5
	V	42%	40%	12%	0.5

2.2.3 Compression Test

To determine the compressive strength for each five mix cubes are cast as per IS: 516-1959. Each set contains 9 cubes were cast to find the compressive strength of cube in 7 days, 14days and 28 days.

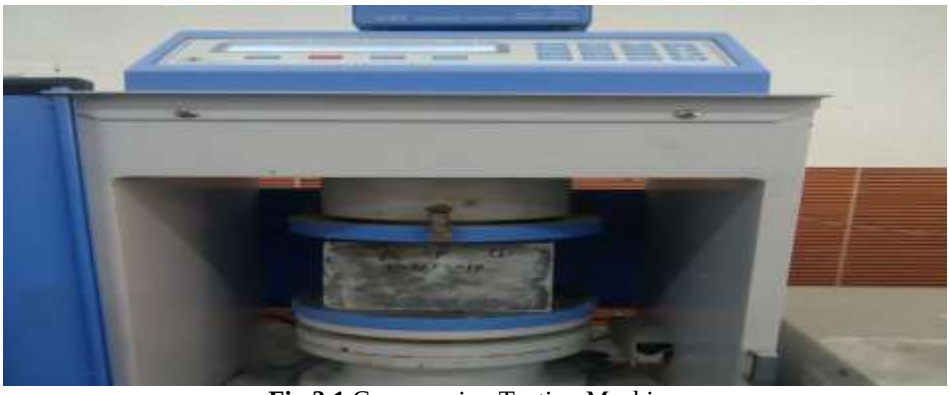

Fig.2.1 Compression Testing Machine

Procedure:

1. Cubes of size 15X15X15(cm^3) used for determination of compressive strength.
2. The concrete cube should be clean properly for lubrication.
3. Assemble the mould and tightly fix with bolt.
4. A thin layer of oil should be applying on all side of concrete cube.
5. The concrete sample filled in cube in 3 layers each layer should be compact by 25 number of stroke with the help of tampering rod.
6. Then cubes placed on vibration table for vibration.
7. The casted cubes remain in mould for 24 hours at the temperature 22^0C to 33^0C.
8. After 24 hours Specimen is taken out and placed in water for curing.
9. After curing cubes tested for compression in compression testing machine.

2.2.4 Slump Test

To determine the workability of concrete for each mix five mix as per IS: 1199-1959.The slump test is used to determine the workability of fresh concrete. This test measures the consistency of fresh concrete. It is generally used in sites for quick determination of workability because of its simplicity of apparatus and test procedure. It is not a suitable method for dry concrete

.

Fig.2.2 Slump Test

Procedure:

The test is carried out by using frustum cone known as slump cone having internal diameter 100mm at top, 200mm at bottom and height 305mm.It is open at both ends. The cone is fit on the hard surface plate and attach tightly with the help of bolts then cone is fill with the concrete in three layers and each layer should be compacted 25 times firmly with the help of tampering rod .After third layer the extra concrete removed with the help of trowel. At the end mould lifted up carefully and slump is measured from the top with the help of tape or tamper rod. The slump obtained can be of various shapes given below.

A.True slump

In a true slump concrete the concrete cone is decend mor or less to shape.

B. Zero slump

It is stiff or dry mix concrete ehich shows no measurable or zero slump after removal of mould.It shows very low water-cement ratio.This type of concrete generally used in road construction.

C. Collapse slump

A collapse slump shows that concrete is too wet dur to high water-cement ratio.it gives high workability.This is not consider in practices.

D. Shear slump

A shear slump shows that haslf collapse of concrete about side way of slump concrete. Shear slump occur in harsh concrete mix shear occur due to lack of cohession.

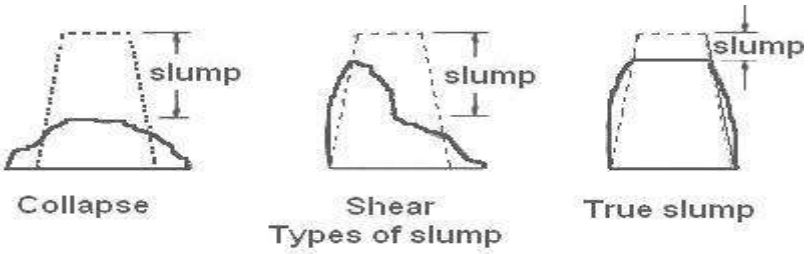

Fig.2.3 Types of Slump

2.2.5 Standard Consistency

Standard consistency is defined as the requirement of water for the normal consistency. To determine the standard consistency as per IS: (4031-Part 4-1988). VICAT apparatus confirming IS: 5513-1976 used to determine the initial and final setting time of cement. In this five sets of different proportion of cement fly ash, and cow dung is prepared.

Fig.2.4 Vicat Apparatus

Procedure:

1. Take 400gm of Ordinary Portland cement.
2. Now take the initial standard consistency of water 30%.
3. Now take the 30% water of a cement and mix in the cement.
4. Now mix it thoroughly for 4-5 minute and prepare cement paste.
5. Now fill the prepared cement paste in vicat apparatus mould.
6. Put the mould on apparatus and touch the plunger to the mould.
7. Release the plunger and allow it to go inside the cement paste.
8. Note down the penetration of plunger. Repeat the procedure till the plunger penetration is in between 5-7mm.

2.2.6 Initial and Final Setting Time

As per the IS: (4031-Part 5-1988) the initial and final setting time of cement is determined and the VICAT apparatus confirming IS: 5513-1976 used to determine the initial and final setting time of cement.

A. Initial Setting Time

As per the IS: (4031-Part 5-1988).The initial setting time of cement is defined as the minimum time requires to attain the mould shape with strength is known as initial setting time. The initial setting time for cement should not be less than 30 minutes. This is a time when cement paste gets harden and gain some strength.

Procedure:

1. Before determining the initial setting time the standard consistency test is performed to determine the amount of water needed for standard consistency (P).
2. 400 gm of Ordinary Portland cement is taken to prepare cement paste and add water according to the 0.85P.
3. Mix the paste thoroughly for 4-5 minutes.
4. Place the cement paste in the vicat apparatus.
5. Touch the needle (1mm circular) gently with the apparatus and all to fall the needle on the cement paste sample.
6. Note down the penetration of plunger. Repeat the procedure till the plunger penetration is in between 5-7mm.

B. Final Setting Time

As per the IS: (4031-Part 5-1988).The Final setting time of cement is defined as the time requires to attain full strength is known as final setting time. The final setting time for cement should not be more than 600 minutes. This is a time at which cement paste become hard and losses its plasticity.

Procedure:

1. In final setting time the 1 mm circular needle use in determination of initial setting time replaced by the 5mm hollow circular needle.
2. The final setting time of cement is a time at which needle doesn't penetrate in the sample it only makes a impression on hardened paste.

III. Result And Discussion

3.1 Compressive Strength

3.1.1 Compressive Strength in 7 days

Grade	Mix	Cement	Fly ash percentage	Cow Dung Ash percentage	W/C Ratio	Compressive Strength (N/mm^2)
M25	I	100%	0%	0%	0.5	25.3
	II	85%	10%	5%	0.5	25.4
	III	72%	20%	8%	0.5	19.4
	IV	60%	30%	10%	0.5	17.6
	V	42%	40%	12%	0.5	14.5

Table 3.1 Compressive strength in 7 DAYS

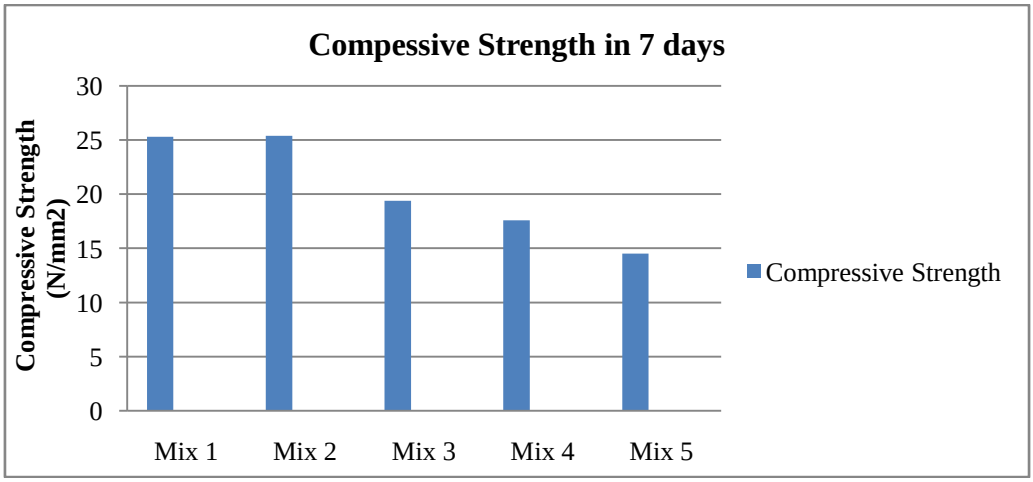

Fig.3.1 Compressive strength in 7 DAYS

3.1.2 Compressive Strength in 14 days

Grade	Mix	Cement	Fly ash	Cow Dung Ash	W/C Ratio	Compressive strength (N/mm^2)
M25	I	100%	0%	0%	0.5	26.7
	II	85%	10%	5%	0.5	32.6
	III	72%	20%	8%	0.5	25.9
	IV	60%	30%	10%	0.5	23.5
	V	42%	40%	12%	0.5	18.0

Table 3.2 Compressive strength in 14 DAYS

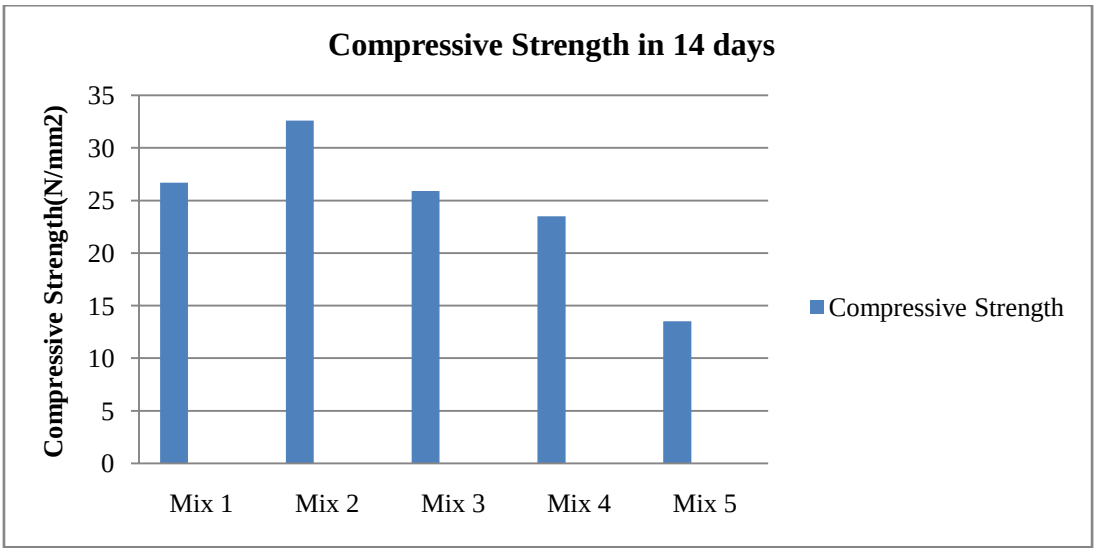

Fig.3.2 Compressive strength in 14 DAYS

3.1.3 Compressive Strength in 28 days

Grade	Mix	Cement	Fly ash	Cow Dung Ash	W/C Ratio	Compressive strength (N/mm^2)
M25	I	100%	0%	0%	0.5	36.8
	II	85%	10%	5%	0.5	40.2
	III	72%	20%	8%	0.5	33.0
	IV	60%	30%	10%	0.5	30.9
	V	42%	40%	12%	0.5	23.9

Table 3.3 Compressive strength in 28 DAYS

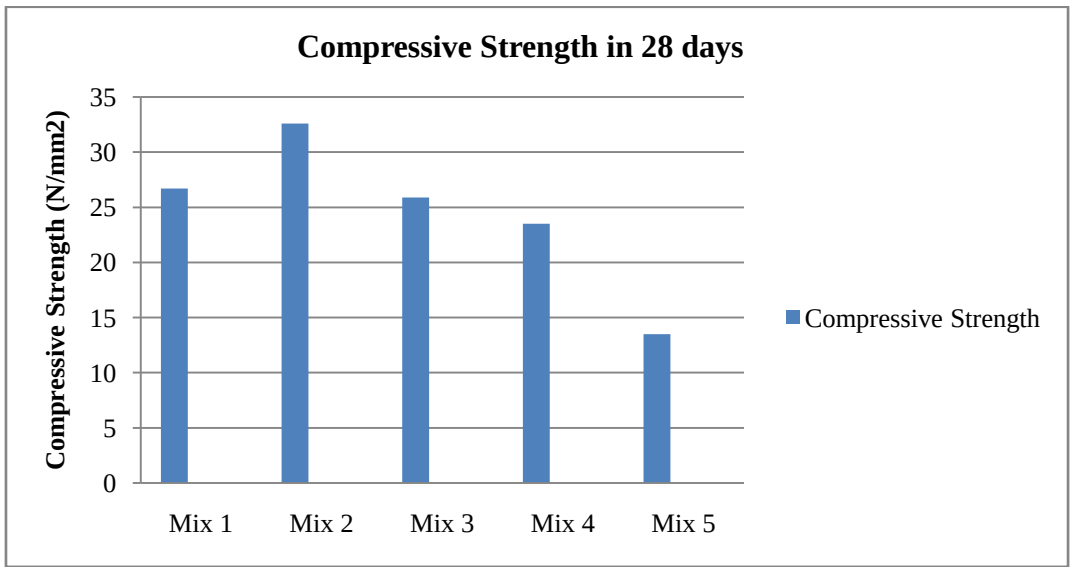

Fig.3.3 Compressive strength in 28 DAYS

3.2 SLUMP TEST

Grade	Mix	Cement	Fly ash	Cow Dung Ash	Slump	Degree of Workability
M25	I	100%	0%	0%	65mm	Medium
	II	85%	10%	5%	30mm	low
	III	72%	20%	8%	0mm	Very low
	IV	60%	30%	10%	0mm	Very low
	V	42%	40%	12%	0mm	Very low

Table 3.4 Slump Test

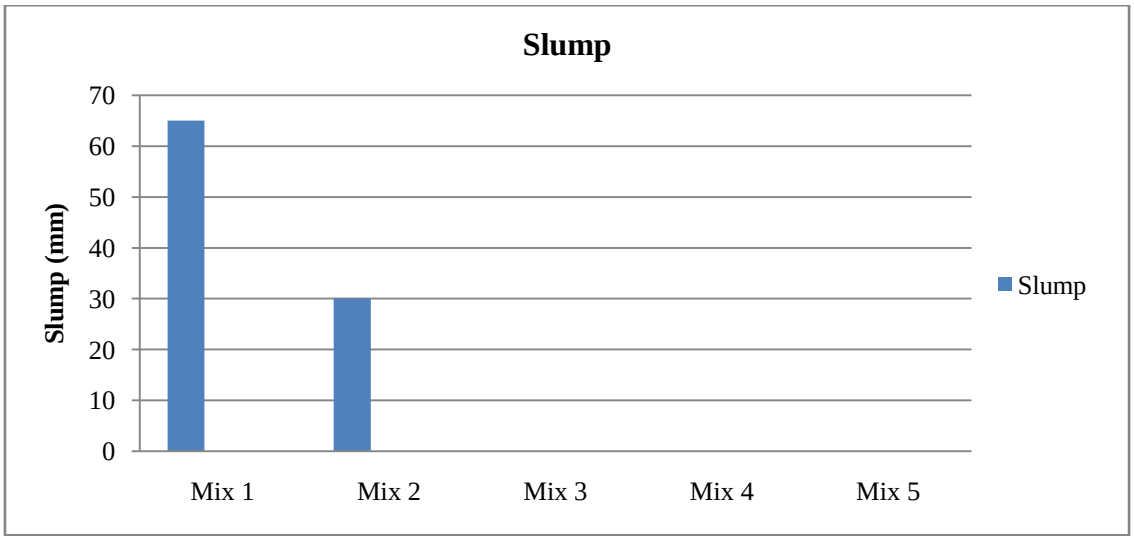

Fig. 3.4 Slump Test

3.3 Standard Consistency

Grade	Mix	Cement	Fly ash	Cow Dung Ash	Standard Consistency
	I	100%	0%	0%	30%
	II	85%	10%	5%	38%
	III	72%	20%	8%	45%
	IV	60%	30%	10%	62%
	V	42%	40%	12%	75%

Table 3.5 Standard Consistency

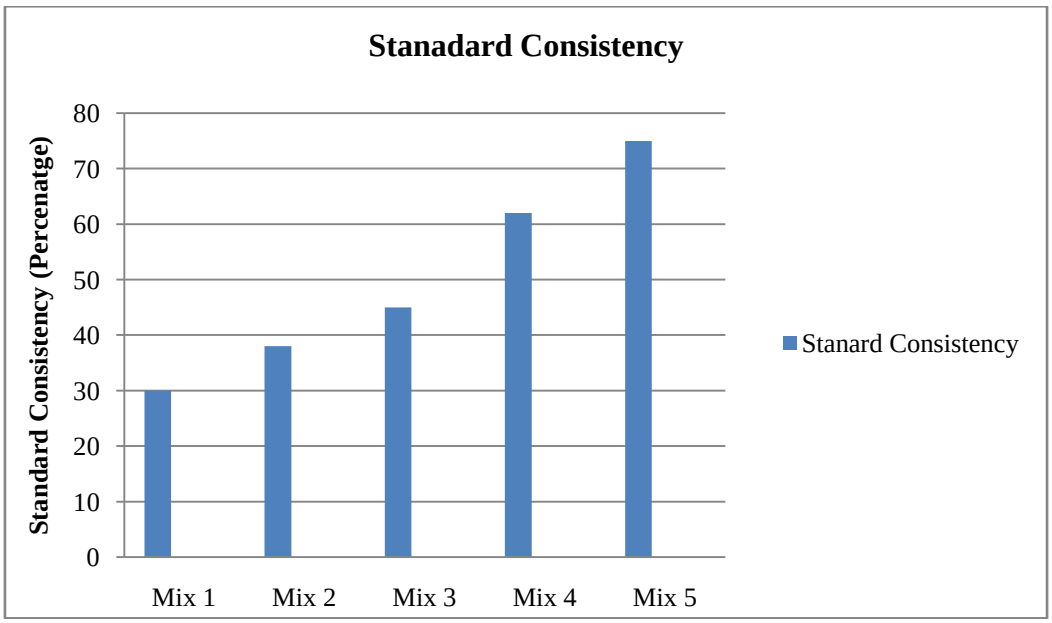

Fig.3.5 Standard Consistency

3.4 Initial Setting Time

Grade	Mix	Cement	Fly ash	Cow Dung Ash	Initial Setting Time
M25	I	100%	0%	0%	42min
	II	85%	10%	5%	45min
	III	72%	20%	8%	58min
	IV	60%	30%	10%	72min
	V	42%	40%	12%	90min

Table 3.6 Initial Setting Time

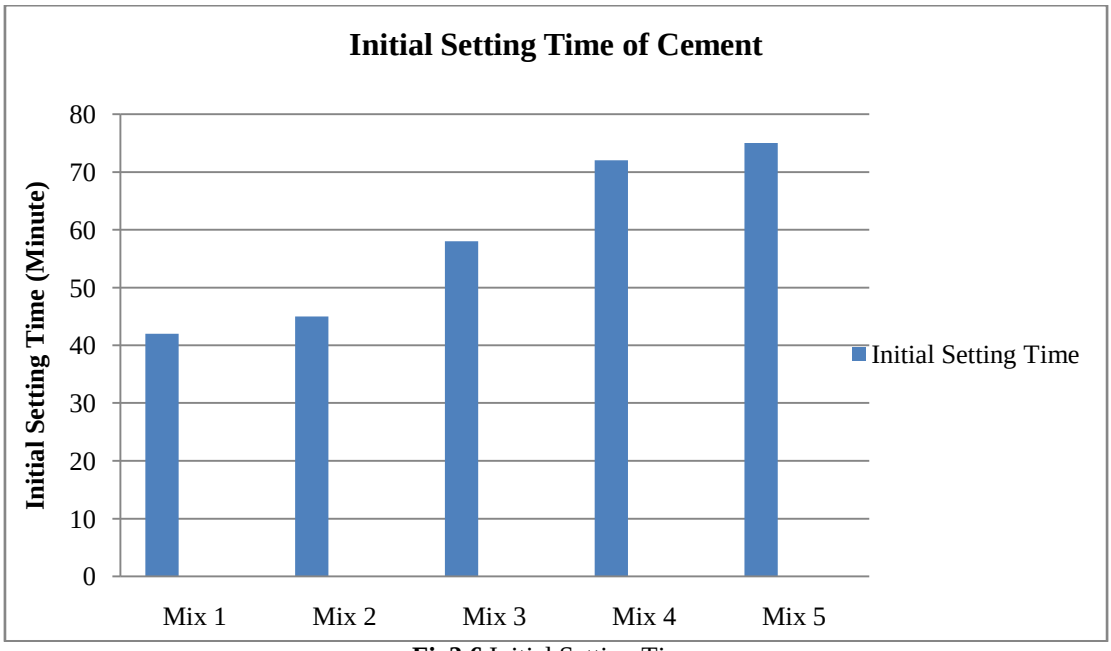

Fig3.6 Initial Setting Time

3.5 Final Setting Time

Grade	Mix	Cement	Fly ash	Cow Dung Ash	Final Setting Time
M25	I	100%	0%	0%	210min
	II	85%	10%	5%	380min
	III	72%	20%	8%	440min
	IV	60%	30%	10%	500min
	V	42%	40%	12%	540min

Table 3.7 Final Setting Time

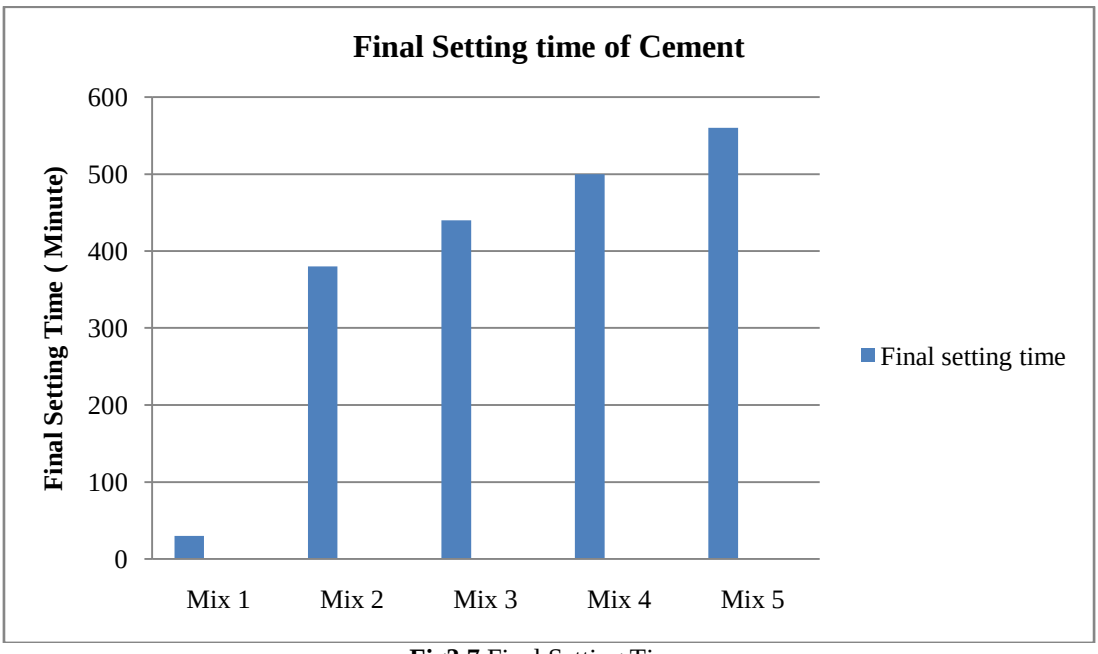

Fig3.7 Final Setting Time

IV. Conculusion

From the above examination it is concluded that.

- The partial replacement of cement by 10% fly ash and 5% cow dung ash the compressive strength of concrete increases after that the compressive strength gets decreased.
- The compressive strength was maximum in 28 days for replacement of cement by 10% fly ash and 5% cow dung ash.
- It is found that the workability of concrete gets decreased as the percentage of fly ash and cow dung ash increases.
- The Slump value for concrete having 10% fly and 5% cow dung ash of the weight of cement is 30mm. it falls in the low workability category. So this concrete can use in Concrete Road construction and Mass Concreting.
- The standard consistency increases as the percentage of fly ash and cow dung ash increases. Hence it requires more Quantity of water.
- The initial and final setting Time increases as the percentage of fly ash and cow dung ash increases.
- It is observed that by using environmental friendly material Fly ash and cow dung ash the environmental pollution can be reduce.
- The cost of a concrete gets decreased by using byproducts (Fly, cow dung ash and Quarry dust)

Acknowledgment

I would also like to thank the entire staff of Civil Engineering Department, **DIT University** and everyone involved in the completion of the project and their assistance for providing such a nice environment to work in.

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