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Optimum Strength Evaluation of Cement and Ordinary Concrete by Using Tandur Stone Slurry Powder

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Abstract:

Cement is a binder, a substance that sets and hardens independently, and can bind other materials together. Concrete is the one of the most important elements in civil engineering. The use of concrete as a construction material is been almost inevitable in today's construction industry. It is estimated that the present consumption of' concrete in the world is of the order of 10 billion tons every year. The ability of concrete to withstand the action of water without serious deterioration makes it an ideal material for building structures.

Tandur stone powder (TSP) is the powder that is being obtained by polishing these stones. While polishing these stones expels some fine particles in the form of slurry. Drying the disintegrated solid particles, nothing but slurry which is in the form of fine particles gives TSP. This Tandur Stone Powder is neglected as waste in several Tandur stone factories, which is available in plenty of quantity in Tandur, India. This Tandur stone powder is having lime stone qualities because Tandur stone itself is a lime stone.

In the present experiment investigations , the mechanical properties of cement, concrete of M25 at 7, 14, 28 days characteristic strength with different replacement of 12%, 16%, 24%, 28% evels of cement with Tandur stone slurry powder (TSP) is considered. Workability was also tested for the above levels of TSP using slump cone test. Standard cubes (150mm X 150mm X 50mm), standard cylinders (150mm dia X 300mm height) were considered in the investigation of concrete and standard cubes (70.6mm X 70,6mm X 70.6mm) is considered in the investigation of cement mortar. The mechanical properties viz., compressive strength , flexural strength and splitting tensile strength of concrete with replacement levels of Tandur stone slurry powder viz., 12%, 16%, 24%, and 28% has been considered.

INTRODUCTION

For a long time concrete was considered to be a very durable material requiring a little or no maintenance. The assumption is largely true, except when it is subjected to highly aggressive environments. We build concrete structures in highly polluted urban and industrial areas, aggressive marine environments,. Harmful sub-soil water in coastal areas and in many other hostile conditions, where other materials of construction are found to be non-durable. since, the use of concrete in recent years, has spread to highly harsh and hostile conditions, the earlier impression that concrete that concrete is a very durable material is being threatened, particularly on account of premature failures of number of structures in the recent past.

Strength of concrete is a pivotal aspect to be considered in the concrete mix design for attaining all favorable qualities including durability in the past. Durability parameters of concrete are to be considered in the revision of 1S456-2000.

TANDUR STONE POWDER (TSP)

TSP is produced from limestone. Limestone is a sedimentary rock composed largely of the minerals

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calcite and aragonite, which are different crystal forms of calcium carbonate. Much Limestone's are composed from skeletal fragments of marine organisms such as coral or foraminifera.

Limestone makes up about 10% of the total volume of all sedimentary rocks. The solubility of limestone in water and weak acid solutions leads to karst landscapes, in which water erodes the limestone over thousands to millions of years. Most cave systems are through limestone bedrock. Limestone has numerous uses: as a building material, as aggregate for the base of roads, as white pigment or filler in products such as toothpaste or paints, and as a chemical feedstock.
Limestone is very common in architecture, especially in Europe and North America. Many landmarks across the world, including the Great Pyramid and its associated complex in Giza, Egypt, are made of limestone. So many buildings in Kingston, Ontario, Canada were constructed from it that it is nicknamed the 'Limestone City'.[10] On the island of Malta, a variety of limestone called Globigerina limestone was, for a long time, the only building material available, and is still very frequently used on all types of buildings and sculptures. Limestone is readily available and relatively easy to cut into blocks or more elaborate carving. It is also long- lasting and stands up well to exposure: 1-lowever, it is a very heavy material, making it impractical for tall buildings, and relatively expensive as a building material.

M25 GRADE CONCRETE

Concrete is a composite material that consists of cement (commonly Portland cement), coarse aggregates (such as blasted rubble), fine aggregates (such as sand) and water .cement is the binder that binds the aggregates together. Coarse aggregates are mainly obtained from quarries; using advent blasting methods, whatever component bedrock deposits of aggregate quality exists. Fine.aggregate used is dry sand, which is available naturally or manufactured. M25 grade is the concrete which gets is 25 KN/mm2 for 28 days.

WORK DONE SO FAR

The physical properties like Specific Gravity, Consistency, Initial setting time, Final setting time; Fineness, Compressive strength, Soundness are determined, tested and analysed for PURE TANDUR STONE SLURRY POWDER (TSP).

When compared to Cement the properties of TSP are more or less relevant. The Compressive strength is failed due to the absence of binding property by which the specimen cannot be obtained. As there is less percentage of calcium oxide in TSP there the failure occurs in Soundness property. As to overcome these failures further research has to be done on the Chemical properties of TSP.

The physical properties like Specific Gravity, Consistency, Initial setting time, Final setting time, Fineness, Compressive strength, Soundness arc determined, tested and analysed for TANDUR STONE SLURRY. POWDERED CEMENT (TSPC), where TSPC means cement is replaced with 20%, 40%& 60% Tandur stone slurry powder.

Specific Gravity of TSPC got decreased at 40% and again increased at 60%.When the percentage of TSP added is increased the Consistency of TSPC also gets increased. When the percentage of TSP added is increased the Initial Setting Time of TSPC also gets increased, which is not good. The Final Setting Time of TSPC is greater than 15 hrs which is also not good. The soundness value remains constant for all the percentages of TSP added. The Fineness of TSPC got increased with increase in the percentage of TSP added.

The mechanical properties of cement, concrete of.M25 at 7, 14, 28 days characteristic strength with different replacement levels of cement with Tandur stone slurry powder is considered. Workability was also tested for the above% levels of TSP using slump cone test. Sairbes (l50mmX .50mm xl 5Qrnm), standard cylinders (150mm dia X 300mm height) and standard prisms (100mm X 100mm 500m) were considered the

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investigation for concrete. The rechanica1 properties viz., compressive strength, flexural strength and splitting tensile strength of concrete with various replacement levels of Tandur stone slurry powder viz., 25%, 50% ,75% and 80% has been considered.

a) When 20% TSP was used, cement compressive strength has been increased to some extent when compared to 0%STSP.
b) After 20% TSP, for the remaining percentages of TSP i.e. 40% and 60%, cement compressive strength has been decreased linearly.
c) Similarly, when 20% TSP was used in concrete, the compressive strength of concrete has been increased to some extent when compared to 0% TSP.
d)But, after 20% TSP, for the remaining percentages of TSP i.e. 40% and 60%, concrete compressive strength has been decreased linearly.
e) The split tensile strength of concrete has also been increased when 20% TSP was used when compared to 0% TSP.
f) The split tensile strength of concrete has been decreased linearly when 40% and 60% TSP was used.
g) For all the replacement percentage levels of TSP i.e. 20%, 40% and 60%, th workability has been decreased linearly when compared to 0% TSP.
h) Further research has to be carried on the reasons for decreased workability, increased compressive strength and tensile strength up to 20% TSP and decreased compressive strength and tensile strength beyond 20% TSP.

LITERATURE REVIEW

GENERAL

Limestone is a sedimentary rock composed largely of the minerals calcite and aragonite, which are different crystal forms of calcium carbonate. Many limestones are composed from skeletal fragments of marine organisms such as coral or foraminifera.

Limestone makes up about 10% of the total volume of all sedimentary rocks. The solubility of limestone in water and weak acid solutions leads to karst landscapes, in which water erodes the limestone over thousands to millions of years. Most cave systems are through limestone bedrock.

Limestone has numerous uses: as a building material, as aggregate for the base of roads, as white pigment or filler in products such as toothpaste or paints, and as a chemical feedstock.

Limestone is very common in. architecture, especially in Europe and North America. Many landmarks across the world, including the Great Pyramid and its associated complex in Giza, Egypt, are made of limestone. So many buildings in Kingston, Ontario, Canada were constructed from it that it is nicknamed the ‘Limestone City’.[lO] On the island of Malta, a variety of limestone called Globigerina limestone was, for a long time, the only building material available, and is still very frequently used on all types of buildings and sculptures. Limestone is readily available and relatively easy to cut into blocks or more elaborate carving. It is also long-lasting and stands up well to exposure. However, it is a very heavy material, making it impractical for tall buildings, and relatively expensive as a building material.

Some lirnestones do not consist of grains at all, and are formed completely by the chemical precipitation of calcite or aragonite, i.e. travertine. Secondary calcite may be deposited by supersaturated meteoric waters (groundwater that precipitates the material in caves). This produces speleothems, such as stalagmites and stalactites. Another form taken by calcite is oolitic limestone, which can be recognized by its granular (oolite) appearance.

The primary source of the calcite in limestone is most commonly marine organisms. Some of these organisms can construct mounds of rock known as reefs, building upon past generations. Below about 3,000 meters, water pressure and temperature conditions cause the dissolution of calcite to increase nonlinearly, so limestone typically does not form in deeper waters (seelysocline). Limestone’s may also

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form in both lacustrine and evaporite depositional environments.

Because of impurities, such as clay, sand, organic remains, iron oxide and other materials, many limestone's exhibit different colors, especially on weathered surfaces. Because of impurities, such as clay, sand, organic remains, iron oxide and other materials, many limestone's exhibit different colors, especially on weathered surfaces.

TSP at Tandur site

Polishing Of Tandur Stone

Collected TSP sample at SITECH

Now due to industrialization there is greater increase in the polishing activity in at around Rangareddy district, mainly in case of Tandur area. There is huge amount of TSP is produced every day and dumped on the ground it is threat environment. This waste is used for dumping for filling the low lying areas.

Causing the environment in deterioration in long run, so this mix should be used for the construction activity it will reduce the problem of environmental pollution at the same time it reduces the cost of the construction.

This waste was collected from site then it is crushed by using ball mill machine (this machine is used to crush the large solid into small fine powder) then it is used in experiments and before dumping of this wastage it is stored in a tank called as TSP slurry storage tank which are located nearer to polishing machine this polishing machine run with the help of electrical power and water pumping as shown in below figure.

First the stones are collected from quarry and transported to the polishing unit. The stones sent from the quarry are cut by a machine and then polished by a polishing machine.

Polishing Machine

TANDUR STONE SLURRY TANK

TSP Powder Slurry Storage Tank

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Up on polishing Tandur stone, a milky white coloured out wet slurry will be produced and is fed in to a tank as shown in the figure.

TANDURSTONE POWDER (TSP)

This Tandur stone slurry will be plumped off and disposed off at the Tandur town out skirts. When this slurry dries off, it is becoming a white powder called TSP. This TSP is available in plenty and is lying as a waste all over the out skirts of Tandur town,

TSP

CHEMICAL COMPOSITION OF TSP

Table 2.1 Chemical Composition of Tsp

NAME OF CHEMICAL	% OF THE CHEMICAL
Co_3 (Total Carbonate)	85.22
Mg Co_3 (Magnesium Carbonate)	3.36
LOI (loss on ignition)	36.98
SiO_2 (Silicon Dioxide)	10.84
$A1_2O_3$ (aluminum trioxide)	1.14
Fe_2O_3 (ferrous trioxide)	1.60
Cao (calcium oxide)	48.23
Total	98.79

OBJECTIVE AND SCOPE OF THE WORK

The objective of the present study is to investigate about workability and mechanical Characteristics of ordinary concrete of M25 and cement motor using Tandur stone powder. The specific objectives of the present work are listed below:

a) To study the workability in terms of' slump.
b) To study the strength of cement motor cubes.
c) To study the strength characteristic in terms of compressive and split tensile strength of concrete. Standards cubes of 150 X 150 X 150 mm have been cast and tested for obtaining compressive strength 7 days, 14 days, and 28 days. Standard cylinders of 150 mm diameter and 300 mm height were cast and tested for split tensile strength for 7 days, 14 days, and 28 days.

MATERIALS AND METHODS

GENERAL

In the present experimental investigation, properties like compressive strength and split tensiles trength of ordinary concrete and TSP replacement in concrete of 12%, 16%, 24% and 28% weights of cement mixers have been studied for M25 grade concrete.

MATERIALS

Materials used for the experiments are locally available cement, sand and aggregate. Tandur stone powder is taken from Tandur town.

ORDINARY PORTLAND CEMENT

Cement is a fine, grey powder. It is mixed with water and materials such as sand, gravel, and crushed stone to make concrete. The cement and water form a paste that binds the other materials together as the concrete hardens. The ordinary cement contains two basic ingredients namely argillaceous and calcareous. In argillaceous, materials clay predominates and in calcareous materials calcium carbonate predominates. Basic compositions of cement are shown in Table 3.1.
Grade 53 Sagar cement was used for casting cubes for all concrete mixes. The cement was of uniform colour i.e. grey with a light greenish shade and was free from any hard lumps.
Summary of the various tests conducted on cement are as under given below in Table 3.2.

FINE AGGREGATES

The sand used for the experimental programme was locally procured and conformed to Indian Standard

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Specifications IS: 383-1970. The sand was first sieved through 4.75 mm sieve to remove any particles greater than 2.4 mm and then was washed to remove the dust. Properties of the fine aggregate used in the experimental work are tabulated in Table 3.3. The aggregates were sieved through a set of sieves as shown in Fig. 3.1 to obtain sieve analysis and the same is presented in Table 3.4. The fine aggregated belonged to grading zone II.

Coarse aggregate

The crushed coarse aggregate of 12.5 mm maximum size rounded obtained from the local crushing plant, Robo silicon, Keeseragutta; Hyderabad is used in the present study. The physical properties of coarse aggregate like specific gravity, bulk density, gradation and fineness modulus are tested in accordance with IS 2386.

WATER

Generally, water that is suitable for drinking is satisfactory for use in concrete. Water from lakes and streams that contain marine life also usually is suitable. When water is obtained from sources mentioned above, no sampling, is necessary. When it is suspected that water may contain sewage, mine water, or wastes from industrial plants or canneries, it should not be used in concrete unless tests indicate that it is satisfactory. Water from such sources should be avoided since the quality of the water could change due to low water or by intermittent discharge of harmful wastes into the stream. In the present experimental programme, potable tap water is used for casting and curing.

TSP

This Tandur stone slurry will be plumped off and disposed off at the Tandur town out skirts. When this slurry dries off, it is becoming a white powder called TSP. This TSP is available in plenty and is lying as a waste all over the out skirts of Tandur town.

TSP Sample

BATCHING AND MIXING

This clause specifies the procedure for making and curing compression test specimens of concrete in the laboratory where accurate control of the quantities of materials and test conditions are possible and where the maximum nominal size of aggregate does not exceed 38mm. the method is especially applicable to the making of preliminary compression tests to ascertain the suitability of the available or to determine suitable mix proportions.

SAMPLING OF MATERIALS

Representative samples of the materials of concrete for use in the particular concrete construction work shall be obtained by careful sampling. Test samples of cement shall be made up of a small portion taken from each of a number of bags on the site, test samples of aggregate shall be taken larger lots by quartering.

PREPARATION OF MATERIALS

All materials shall be brought to room temperature preferably 27+_3 before commencing thee test .the cement samples, on arrival at the laboratory, shall be thoroughly mixed dry either by hand or in a suitable mixer in such manner as to ensure the greatest to avoid the instruction of foreign matter, the cement shall then be stored in a dry place, preferably in air-tight containers.

Samples of aggregates for. each batch of concrete shall be of the desired grading and shall be in air

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dried condition. In general, the aggregate shall be separated in to fine and coarse fractions and recommended for each concrete batch in such a manner as to produce the desired grading. IS sieve 480 shall be normally used for separated in to different sizes.

PROPORTIONING

The proportions of the materials, including water, in concrete mixes used for determining the suitability of the materials available, shall be similar in all respects to those to be employed in the work. Where the proportions of the ingredients of the concrete as used on the proportions by weight used in the test cubes and the unit weights of the materials.

WEIGHING

The quantities of cement, each size of aggregate, and water for each batch shall be determined by weight, to an accuracy of 0.1 percent of the total weight of the batch

MIXING CONCRETE

The concrete shall be mixed by hand, on preferably in a laboratory batch mixer, in such a manner as to avoid loss of water or other materials. Each batch of concrete shall take about 10 percent excess after the desired number of test specimens.

MACHINE MIXING

Mixing of concrete was carried out by machine. Machine mixing is not only efficient but also economical. Before the materials are loaded in to drum about 25 percent of the total quantity of water required for mixing is poured in to the mixer drum and to prevent any sticking of cement on the bodies or at the bottom of the drum.

Then discharging all the materials i.e. coarse aggregate and cement in to the drum. Immediately after discharging the dry material in to the drum the remaining 75 percent of water is added to the drum .The time is counted from the moment all the materials are placed particularly the complete quantity of water is fed in to the drum.

Fig: 4.2 Concrete Pan Mixers

The proportioning of cement, aggregate, TSP and water is done by mass as per the mix deign. All the measuring equipments are maintained in a clean serviceable condition with their accuracy periodically checked.

The mixing process is carried out in electrically operated concrete pan mixer. the materials are laid down in uniform layers, one on the other in the order-coarse aggregate, fine aggregate and cement. Dry mixing is done to obtain a uniform colour. The workability tests are carried out immediately after mixing of concrete using the slump test.

EXPERIMENTAL RESULTSAND DISCUSSION

PHYSICAL PROPERTIES OF CEMENT

In the present investigation ordinary Portland cement IS type cement of 53 Grade is used. Care is taken that it is freshly produced and from a single producer. The cement thus produced was tested for physical properties in accordance with IS 4031.

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Table-6.1 - Physical Properties of Cement

S.No	Characteristics	Values obtained	Standard values
1	Normal Consistency	31%	-
2	Initial Setting time	48min	Not be less than 30 minutes
3	Final Setting time	240min	Not be greater than 600 minutes
4	Fineness	4.80%	less than 10
5	Specific gravity	3.08	-

Compressive strength:- Cement: Sand (1:3)

1	7 days	24.5 N/mm2	27N/mm2
2	l4days	35N/mm2	41 N/mm2
3	28 days	53.5N/mm2	53 N/mm2

CHEMICAL PROPERTIES OF CEMENT

Table-602-Chemical Composition as per Manufactures Teas Report

S.No,	Chemical Property	Result	Limits as per IS
1	Lime Saturation Factor(%)	0.82	066 min to 1.06 max
2	Alumina iron ratio (%)	1.2	Min0.665
3	Insoluble residue (%)	0.95	Max 2%
4	Magnesia (%)	2.4	Max 6%
5	Sulphuric anhydride (%)	1.1	2.5% to 35
6	Loss on ignition (%)	2.2	Max 5%

PROPERTIES OF FINE AGGREGATE

The sand used for the experimental programme was locally procured and conformed to Indian Standard Specifications IS: 383-1970. The sand was first sieved through 4.75 mm sieve to remove any particles greater than 2.4 mm and then was washed to remove the dust.

Properties of the fine aggregate used in the experimental work are tabulated in Table 6.3. The aggregates were sieved through a set of sieves as shown in Fig. 6.1 to obtain sieve analysis and the same is presented in Table 6.4. The fine aggregated belonged to grading zone II.

TABLE 6.3 PROPERTIES OF FINE AGGREGATES

S.No.	Characteristics	value
1	Type	Uncrushed (natural)
2	Specification gravity	2.54
3	Total water absorption	1.08%
4	Fineness modulus	2.372
5	Grading zone	II

Table 6.4 Sieve Analysis of Fine Aggregate

S. No.	Sieve No.	Mass Retained (gms)	% of weight Retained	Cumulative % of weight Retained	% Passing
1	4.75	0	0	0	0
2	2.36	0	0	0	0
3	1.18	4.6	0.46	24.8	99.54
4	600pm	57.2	5.72	6.18	93.82
5	425pm	548	54.8	60.98	39.02
6	300pm	347.6	34.7	95.68	4.32
7	150pm	35	3.5	99.18	0.18
8	75 pm	5.0	0.50	99.68	0.32
9	Pan	3.0	0.30	99.98	0.02
∑F=237.20					

Fineness Modulus of fine aggregate **=∑F/100=237.2/100=2.372**

Fig:6.3 Fine Aggregates

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PROPERTIES OF COARSE AGGREGATE

The crushed coarse aggregate of 20 mm maximum size obtained from the local crushing plant, Hyderabad is used in the present study.

Fig:6.4 Coarse Aggregates

Table 6.5 Fineness Modulus of coarse aggregate

I.S.Sieve Size	Weight of aggregate retained in gms	Cumulative weight retained in gms	Cumulative % of weight retained in gms	% of passing
40 mm	0	0	0	100
20 mm	0	0	0	100
10 mm	270	750	15	85
4.75 mm	4250	5000	100	0
2.36 mm	0	5000	100	0
1.18 mm	0	5000	100	0
600 nu	0	5000	100	0
300 nu	0	5000	100	0
150 nu	0	5000	100	0

Fineness modulus of coarse aggregate = 615/100=6.15

Table 6.6 Physical properties of coarse aggregate

Property	result
Fineness mouulus	6.15
Specific gravity	2.67
Bulk density(kg/m3) Loose compact	1475 1690

TSP

This Tandur stone slurry will be plumped off and disposed off at the Tandur town out skirts. When this slurry dries off, it is becoming a white powder called TSP. This TSP is available in plenty and is lying as a waste all over the outskirts of Tandur town, Telangana, India.

CHEMICAL COMPOSITION OF TSP

But in the case of Tandur area crushed and polished limestone remains as a white coloured powder, which is waste powder produced from polishing industries. Which consist following chemicals.

Below shown chemical analysis was done with the help of Sagar cements which is located in Nalgonda district, Telangana, India.

Table 6.7 Chemical Composition of TSP

NAME OF CHEMICAL	% OF THE CHEMICAL
CO3 (total carbonate)	85.22
MgCo3 (Magnesium carbonate)	3.36
LOT (loss on ignition)	36.98
Si02 (silicon dioxide)	10.84
A1203 (aluminum trioxide)	1.14
Fe203 (ferrous trioxide)	1 .60
Cao (Calcium oxide)	48.23
Total	98.79

WATER

This is the least expensive but most important ingredient in concrete. The water, which is used for making concrete, should be clean and free from harmfijl impurities such as oil, alkali, and acid etc., in general, the water is fit for drinking, should be used for making concrete.

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Table 6.8 Permissible Limits for Solids (clause 5.4 of IS 456-2000)

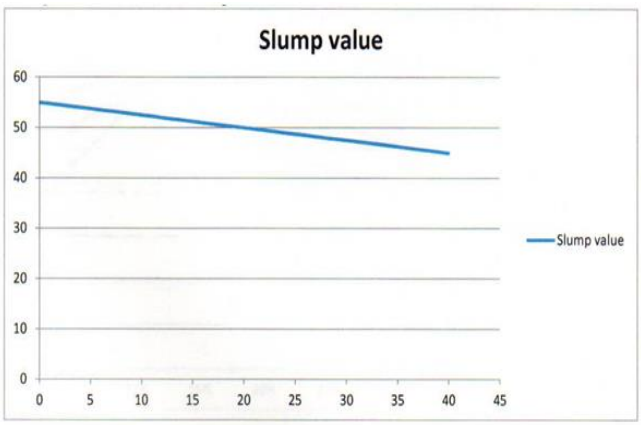
S.No	Impurity	Tested as per	Permissible limits
1	Organic	IS3025(part 18)	200 mg/lit
2	Inorganic	1S3025(part 18)	3000 mg/lit
3	Sulphates (as So3)	1S3025(part 24)	400 mg/lit
4	Chlorides	1S3025(part 32)	2000 mg/lit
5	S.S	1S3025(part 17)	2000 mg/lit

STUDIES ON MIX PROPORTIONS AND WORKABLITY OF M25 GRADE CONCRETE

Table 6.9 Mix Proportion and Workability

S.No	Mix details	% of TSP	W/C Ratio	Slump value (cm)
1	1:1.59 : 2.72	0	0.49	55
2	1:1.59 : 2.72	12	0.49	52
3	1:1.59 : 2.72	16	0.49	51
4	1:1.59 : 2.72	20	0.49	50
5	1:1.59 : 2.72	24	0.49	49
6	1:1.59 : 2.72	28	0.49	48
7	1:1.59 : 2.72	40	0.49	48

Graph 6.1 % TSP VS Slump value

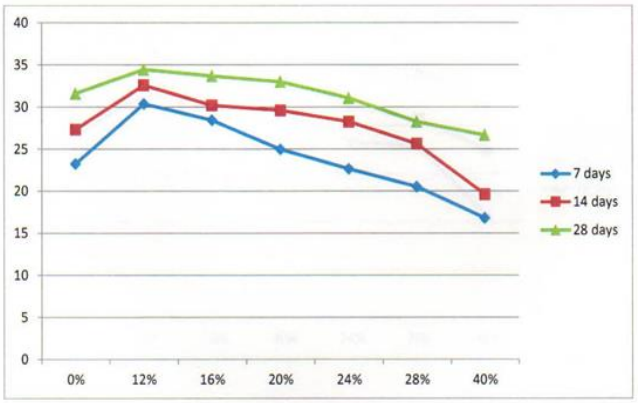


STUDIES ON STRENGTH OF M25 GRADE CONCRETE

Table 6.10 Compression Strength of M25 Grade Concrete

S.No	% of TSP	Compression Strength (Mpa)		
		7 Days	14 Days	28 Days
1	0	23.25	27.30	31.60
2	12	30.37	32.59	34.44
3	16	28.44	30.20	33.69
4	20	25.00	29.60	33.0
5	24	22.67	28.22	31.06
6	28	20.55	25.63	28.25
7	40	16.80	19.60	26.66

Graph 6.2 Compression Strength VS Percentage of TSP



Split Tenslie Strength Of M25 Grade Concrete

S.No	% of TSP	Split Tenslie Strength (Mpa)		
		7 Days	14 Days	28 Days
1	0	1.94	2.30	2.78
2	12	2.35	2.77	2.99
3	16	2.17	2.69	2.88
4	20	2.15	2.54	2.80
5	24	1.83	2.19	2.65
6	28	1.79	2.07	2.58
7	40	1.05	1.35	2.25

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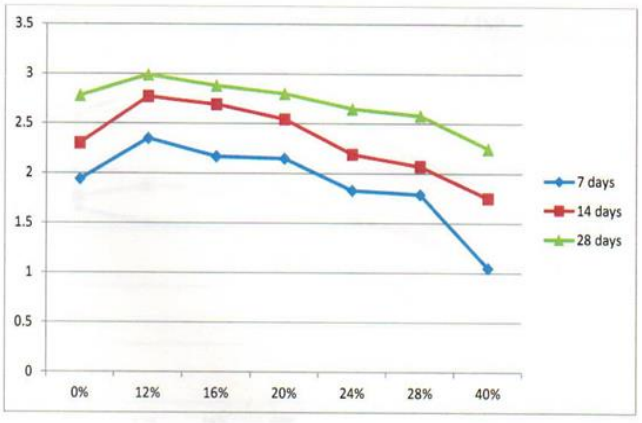
Graph 6.3 Split Tenslie Strength VS Percentage of TSP

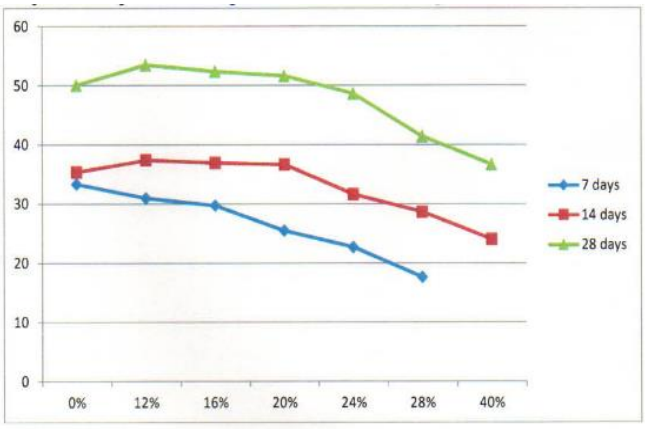


Studies on Strength of Cement

Table 6.12 Compression Strength of Cement

S.No	% of TSP	Compression Strength (Mpa)		
		7 Days	14 Days	28 Days
1	0	31.30	35.35	50.05
2	12	33.36	37.39	53.49
3	16	31.01	36.92	52.38
4	20	29.75	36.65	51.65
5	24	25.30	31.59	48.64
6	28	22.39	28.63	41.39
7	40	17.65	24.00	36.66

Graph 6.4 Compression Strength of Cement VS Percentage of TSP



CONCLUSION

a) When 12% TSP was used, cement compressive strength has been increased to some extent when compared to 0% TSP.

b) After 12% TSP, for the remaining percentages of TSP i.e. 16%, 24% and 28%, cement compressive strength has been decreased linearly.

c) Similarly, when 12% TSP was used in Concrete,, the compressive strength of concrete has been increased to some extent when compared to 0% TSP.

d) After 12% TSP, for the remaining percentages of TSP i.e. 16%, 24% and 28%, Concrete compressive strength has been decreased linearly.

e) The split tensile strength of concrete has also been increased when 12% TSP was used when compared to 0% TSP.

The split tensile strength of concrete has been decreased linearly when 16%, 24% and 28% TSP was used.

g) For all the replacement percentage levels of TSP i.e. 12%, 16%, 24% and 28%, the workability has been decreased linearly when compared to 0% TSP.

h) Further research has to be carried on the reasons for decreased workability, increased compressive strength and tensile strength up to 12% TSP and decreased compressive strength and tensile strength beyond 12% TSP.

i) In our project the optimum strength evaluated at 12% TSP, when l2%TSp added to Ordinary Concrete.

SCOPE FOR FUTURE RESEARCH

The following experimental studies can be conducted in future with respect to ordinary concrete

1. Further research has to be carried out on the reasons for decreased workability, increased compressive strength and tensile strength up to 12% TSP and decreased compressive strength and tensile strength beyond 12% TSP.

2. Further research has to be carried out on the durability characteristics of ordinary concrete, when 12%TSP added to Ordinary Concrete.

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3. Further research has to be carried out on the ordinary Concrete due to effect of high temperature, when 12%TSp added to Ordinary Concrete.

4. Further research has to be carried out on the shrinkage and the creep properties of ordinary concrete, when I 2%TSP added to Ordinary Concrete.

5. Reduction of Cost & Quantity of cement, when 12%TSp added to Ordinary Concrete.

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