International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 17
July 2018

Behavior of Carbide Waste Concrete at Elevated Temperature

B.Rambabu[1], C.Manikanta Reddy[2], V.Bhavani[3],
[1](Project guide, Assistant Professor, Anurag Engineering College)
[2](HOD, Assistant Professor, Anurag Engineering College)
[3](Structural Engineering, Anurag Engineering College)

ABSTRACT:
Concrete is a combination of construction material composed of cement and water combined with fine aggregate, coarse aggregate in proper proportions. The investigation is carried out mainly in two phases. The first phase of investigation is carried out to study the compressive strength of carbide waste concrete for one standard grade (M40) and one high grade (M60) by maintaining the water cement ratio constant and by replacing cement with carbide waste in varying proportions by using absolute volume method. The design mixes were prepared by adopting the IS code, IS: 10262-2009 for M40 and Erntroy and shaklock method for M60 high grade. To know the performance of the carbide waste concrete when compared with the conventional concrete totally 170 cubes are casted which are of 150x150x150 mm size in which 85 cubes are for each grade of concrete. samples with and without carbide at different proportions of 0%,5%,15%,20% were casted. In second phase the compressive strength is found out for each specimen after heated to different elevated temperatures from 2000 c to 8000 c for 2 hours and cooled to room temperature. The experimental results showsfor M-40 grade at 10% of carbide waste there is a 11 % of increase of compressive strength when compares to normal concrete, after furnace test there is a 6% of more compressive strength at 200o c,28% more compressive strength at 5000 c and 31% more compressive strength at 8000 c. For M-60 grade concrete at 5% of carbide waste there is an 10% increase of compressive strength when compared to normal concrete, after furnace test there is 8% of more compressive strength at 2000 c, 12% of more compressive strength at 4000 c and 44% of more compressive strength at 8000 c.

KEYWORDS: *compressive strength, concrete cubes, carbide waste, elevated temperature*

Introduction

General

Concrete is a construction material composed of Portland cement and water combined with sand, gravel, crushed stone, or other inert material such as expanded slag or vermiculite. The major constituent of concrete is aggregate which may be natural (gravel or crushed rock with sand) or artificial (blast furnace slag, broken brick and steel shot) another constituent is binder which serves to hold together the particles of aggregate to form concrete. Commonly used binder is the product of hydration of cement, which is the chemical reaction between cement and water.

During the past 20 years, concrete mix design and manufacturing have been progressed quite rapidly and the concrete ingredients have been tailored to provide better performance those suites different types of environments. This has been carried out by selecting the concrete mix ingredients that produce concrete suitable for certain exposure conditions. The change occurred in the concrete mix design includes reducing the w/c ratio, using high range water reducers(super-plasticizers), optimizing the grain size distribution of concrete constituent materials, employing cement replacement materials with pozzolanicactivity, incorporation of certain types of fibers, etc. Since human safety in case of fire is one of the major considerations in the design of buildings, it is extremely necessary to have a complete knowledge about the behavior of all construction materials before using them in the structural elements.

Properties Influencing Fire Resistance

General

The fire response of reinforced concrete (RC) members is influenced by the characteristics of constituent materials, namely, concrete and reinforcing steel. These include (a) thermal properties, (b) mechanical properties, (c) deformation properties, and (d) material specific characteristics such as spalling in concrete. The thermal properties determine the extent of heat transfer to the structural member, whereas the mechanical properties of constituent materials determine the extent of strength loss and stiffness deterioration of the member. The deformation properties, in conjunction with mechanical properties, determine the extent of deformations and strains in the structural member. In addition, fire induced spalling of concrete can play a significant role in the fire performance of RC members. All these properties vary as a function of temperature and depend on the composition and characteristics of concrete as well as those of the reinforcing steel. The temperature induced variation in properties in concrete is much more complex than that in reinforcing steel due to moisture migration as well as significant variation of ingredients in different types of concrete. Thus, the primary focus of this chapter is on the effect of temperature on properties of concrete.

Thermal Properties

The thermal properties that influence temperature rise and distribution in a concrete structural member are thermal conductivity, specific heat, thermal diffusivity, and mass loss. Thermal conductivity is the property of a material to conduct heat. Concrete contains moisture in different forms, and the type and the amount of moisture have a significant influence on thermal conductivity. Thermal conductivity is usually measured by means of "steady state" or "transient" test methods.

Transient methods are preferred to measure thermal conductivity of moist concrete over steady-state methods, as physiochemical changes of concrete at higher temperatures cause intermittent direction of heat flow Specific heat is the amount of heat per unit mass, required to change the temperature of a material by one degree and is often expressed in terms of thermal (heat) capacity which is the product of specific heat and density. Specific heat is highly influenced by moisture content, aggregate type, and density of concrete. The variation of specific heat with temperature used to be determined through adiabatic calorimeter.

Mechanical Properties

The mechanical properties that determine the fire performance of RC members are compressive and tensile strength, modulus of elasticity, and stress-strain response of constituent materials at elevated temperatures. Compressive strength of concrete at an elevated temperature is of primary interest in fire resistance design. Compressive strength of concrete at ambient temperature depends upon water-cement ratio, aggregate-paste interface transition zone, curing conditions, aggregated type and size, admixture types, and type of stress. At high temperature, compressive strength is highly influenced by room temperature strength, rate of heating, and binders in batch mix (such as silica fume, fly ash, and slag). Unlike thermal properties at high temperature, the mechanical properties of concrete are well researched.

Deformation Properties

The deformation properties that determine the fire performance of reinforced concrete members are thermal expansion and creep of the concrete and reinforcement at elevated temperatures. In addition, transient strain that occurs at elevated temperatures in concrete can enhance deformations in fire exposed concrete structural member.

1.2.5 Thermal Expansion

Thermal expansion characterizes the expansion (or shrinkage) of a material caused by heating and is defined as the expansion (shrinkage) of unit length of a material when the temperature of concrete is raised by one degree. The coefficient of thermal expansion is defined as the percentage change in length of a specimen per degree temperature rise. The expansion is considered to be positive when the material elongates and is considered negative (shrinkage) when it shortens.

Creep

Creep, often referred to as creep strain, is defined as the time-dependent plastic deformation of the material. At normal stresses and ambient temperatures, deformations due to creep are not significant. At higher stress levels and at elevated temperatures, however, the rate of deformation caused by creep can be substantial. Hence, the main factors that influence creep are the temperature, the stress level, and their duration. The creep of concrete is due to the presence of water in its microstructure. There is no satisfactory explanation for the creep of concrete at elevated temperature.

Transient Strain

Transient strain occurs during the first time heating of concrete and is independent of time. It is essentially caused by thermal incompatibilities between the aggregate and the cement paste. Transient strain of concrete, similar to that of high temperature creep, is a complex phenomenon and is influenced by factors such as temperature, strength, moisture content, loading, and mix proportions.

Spalling

In addition to thermal, mechanical, and deformation properties, another property that has a significant influence on the fire performance of a concrete structural member is spalling. This property is unique to concrete and can be a governing factor in determining the fire resistance of an RC structural member. Spalling is defined as the breaking up of layers (pieces) of concrete from the surface of a concrete member when it is exposed to high and rapidly rising temperatures such as those encountered in fires.

Fig 1.1 Spalling of wal

Carbide waste

Calcium carbide (CaC_2) is usually used in industrial acetylene production for welding tools and in chemical synthesis. It is also used in caving fuel acetylene, large spent carbide is usually left by some cavers anywhere in caves where the recharging of gas generators takes place and over the year this can result in substantial accumulation of such wastes such as carbide dumps. The effect of fire or high temperature on concrete containing Carbide Waste (CW) has not been fully investigated. CW is the remnant of oxy-acetylene gas used in welding industries to join pieces of metal by road side panel beater sand it is whitish in colour.

Calcium carbide

The reaction of calcium carbide with water creates acetylene: $CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2$

That commonly-held view was substantiated by the fact that the waste's main chemical compound is calcium hydroxide – $Ca(OH)_2$, which reacts over time with atmospheric carbon dioxide to form non-toxic calcium carbonate**.** In the past studies it was investigated the strength properties of concrete using CW as partial replacement of OPC and observed that the compressive strength of concrete increased in CW content of an amount up to 10% replacement and decreased with further percentage increase.

Materials and Methods

CW was grinded by grinding machine and then sieved with 75μm BS sieve. Only those that passed through 75μm sieve were used for the research. Sieved with 10 mm and 20 mm sieve sizes to get rid of the suspended and organic impurities were used for the research. Physical property of CW was determined to confirm its suitability as partial replacement of cement in concrete production. Properties such as specific gravity, bulk density, moisture content and absorption capacity of CW and sand were investigated.

Experimental Work and Methodology

General

The present investigation is aimed at arriving the compressive strength of the CARBIDE WASTE by considering M-40 grade and M-60 grade after thoroughly understanding the parameters influencing the strength improvement which are designed with the help of IS: 10262-2009 and Erontroi and shaklock method. The experimental programme is divided in to five phases.

Phase I: Laboratory setup and procurement of materials.

Phase II: Mix design, mixing of cement mortar, moulding and curing of cement mortar specimens.

Phase III: It is about the mixing of cement concrete, testing procedure for evaluating the strength parameters of cement mortar & Concrete specimens moulding and curing of cement concrete specimens.

Phase IV: Finding out the maximum compressive strength and minimum compressive strength for both M-40 and M-60 grade concrete under normal room temperature.

Phase V: Finding out the maximum compressive strength and minimum compressive strength for both M-40 and M-60 grade concrete which are cooled to normal room temperature after heated to different elevated temperature.

Phase VI: Evaluating the results

Fig 3.1 Furnace

Procurement of Materials

The materials used for the investigative study of carbide waste Concrete are given below.

- Cement
- Fine Aggregate
- Coarse Aggregate
- Water
- Carbide waste

Cement

Ordinary Portland cement of 53 grade confirming to IS: 12269 were used. Physical properties of cement as per IS : 12269-1999 were tested at the concrete testing laboratory, Anuragcollege of Engg. & Tech., JNTU University, Hyderabad and are presented in Table 3.1. and 3.2. The normal consistency and specific gravity of the cement used are 33.70% and 3.15 respectively.

Table 3.1 Properties of Portland cement (53Grade) for M-40

Sl. No.	Property	Value
1.	Specific gravity of OPC Cement	3.15
2.	Initial Setting Time	60 minutes
3.	Final Setting Time	150Minutes
4.	Normal Consistency	33.70%
5.	Compressive strength of cement for 7 days	36.50 Mpa
6.	Compressive Strength of Cement for 14 days	44.50 Mpa
7.	Compressive Strength of Cement for 28 days	49.00 Mpa

Table 3.2 Properties of Portland cement (53Grade) for M-60

Sl. No.	Property	Value
1.	Specific gravity of OPC Cement	3.15
2.	Initial Setting Time	96Minutes
3.	Final Setting Time	210Minutes
4.	Consistency	28%
5.	Compressive strength of cement for 7 days	37.66 MPa
6.	Compressive Strength of Cement for 14 days	54.50 MPa
7.	Compressive Strength of Cement for 28 days	72.33 MPa

Fine aggregate

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 17
July 2018

Fine Aggregate used was natural sand obtained from local market. The Physical properties of fine aggregate like specific gravity and fineness modulus were found to be 2.65 and 2.47 respectively. The details of sieve analysis are given in Table 3.3. It could be noted that the sand confirms to Zone-III as per IS: 383-1970. The physical properties of the fine aggregate are given in Table 3.2.

Table 3.3 Properties of Fine Aggregate

Sl. No.	Property	Value
1.	Specific gravity of Fine Aggregate	2.70
2.	Dry Unit Weight	1.74 kg/m3
3.	Fineness Modules	3.47

Table 3.4 Sieve Analysis of Fine Aggregate

SI. No.	Sieve Size	Weight retained in (Gm)	% weight Retained	Cumulative % weight Retained	% of Passing in each sieve	Remarks
1	4.75 mm	4	0.40	0.40	99.60	
2	2.36 mm	10	1.00	1.40	98.60	Fine
3	1.18 mm	144	14.40	15.80	84.20	Aggregate is
4	600 micron	200	20.00	35.80	64.20	Pertaining to Zone-III as
5	300 micron	582	58.20	94.00	6.00	Per Table-4
6	150 micron	56	5.60	99.60	0.40	Of IS:383,1970
7	Tray	4	0.40	100.00	0.00	

Total = 247.00

Fineness Modulus= 2.47

Coarse aggregate

Coarse Aggregate used was with maximum size aggregate of 20 mm obtained from local market. The physical properties of coarse aggregate like specific gravity and fineness modulus were found to be 2.63 and 7.30 respectively. The details of sieve analysis are given in Table 3.4

Table 3.5 Sieve Analysis of Coarse Aggregate

SI. No.	Sieve Size	Weight retained in gm	% weight retained	Cumulative % weight Retained	% of passing in each sieve	Remark
1	80 mm	0	0	0	100	
2	40 mm	0	0	0	100	
3	20	1598	31.96	31.96	84.20	

	mm					
4	10 mm	3310	66.20	98.16	64.20	
5	4.75 mm	92	1.84	100.00	6.00	Reference
6	2.36 mm	0	0	100.00	0.40	Codes IS:383,
7	1.18 mm	0	0	100.00	0.00	1970
8	0.60 mm	0	0	100.00	0.00	
9	0.30 mm	0	0	100.00	0.00	
10	0.15 mm	0	0	100.00	0.00	

Water

The least expensive but the most important ingredient of concrete is water. The water which is used for mixing concrete should be clean and free from harmful impurities such as oil, alkali, acid etc. Potable water was used for the mixing and curing work in the project.

Carbide waste

CW is the remnant of oxy-acetylene gas used in welding industries to join pieces of metal by road side panel. It is whitish in color. The whitish color material which was regarded as waste and ordinarily posed environmental nuisance in terms of its unpleasant and unsightly appearance in open-dump sites located at strategic places within the societies is now considered as binder in partial replacement for expensive. This material is dried in the sun in an open field for a period of one week, grinded and then sieved to cement fineness.

Fig 3.2 Carbide waste material

Table 3.6 Physical properties of carbide waste

Properties	Sample type and description		
	Carbide waste	Sand	OPC
Specific gravity	2.35	2.70	3.15
Uncompacted bulk density (kg/m^3)	670	1600	1440
Compacted bulk density(kg/m^3)	540	1490	1270

Table 3.7 Chemical properties of carbide waste.

Constituents	CW (%)	OPC (%)
Calcium Oxide (CaO)	64.79	72.70

International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 17
July 2018

Aluminum Oxide (Al2O3)	4.40	3.20
Ferrous Oxide (Fe2O3)	3.49	3.87
Magnesium Oxide (MgO)	1.19	2.05
Potassium Oxide (K2O)	0.13	0.73

PHASEII

PHASE II is about the mixing of cement mortar, moulding and curing of cement mortar specimens.

Mixing of Cement Mortar

The following mix cases have been considered or both normal cement mortar and Carbide waste cement mortar for both M-40 and M-60 grade concrete

- Normal cement mortar mix case with 0% replacement of c/w.
- Cement Mortar mix case with 5% replacement of c/w.
- Cement Mortar mix case with 10% replacement of c/w.
- Cement Mortar mix case with 15% replacement of c/w.
- Cement Mortar mix case with 20% replacement of c/w.

Moulding and Demoulding of Specimens

A total of 170 specimens were casted during the project work, 85 specimens of M-40 grade and 85 specimens M-60 grade concrete are casted for each of the five mix cases considered. The specimens of cube size 150mm X 150mm X 150mm were casted. After curing the moulded specimens were stored in the laboratory at the room temperature for 24hours.After this period, the specimens were demoulded and submerged in clean, fresh water of the curing tank.

Ages of Curing

The specimens were cured for 28days.A total of specimens for each period of curing for each of five mix cases were tested and the recorded details of the testing procedure and the results are given in following sections.

Phase III

Phase III is about the mixing of cement concrete, testing procedure for evaluating the strength parameters of cement mortar & Concrete specimens. Moulding and curing of cement concrete specimens.

Mixing of Cement Concrete

Three mix cases with M-40 grade and M-60 grade of concrete have been considered for both normal concrete and carbide waste concrete. The mix design is adopted as per IS: 10262-2009 for M-40 and Erontroi and shacklok method for M-60 mixes as follows.

Test on Fresh Concrete

Slump test

The slump test is perhaps the most widely used because of the simplicity of the apparatus required and the test procedure. The slump test indicates the behaviour of the compacted concrete cone under the action of gravitational forces. The test is carried out with a mould called the slump cone.

Compaction factor test

This test is also used to assess the workability of the concrete mix. The degree of compaction called the Compaction factor is measured by the density ratio, i.e., the ratio of the density actually achieved in the test to the density of the same concrete fully compacted. Based on the compaction factor the workability of the mix is evaluated. This test was also performed for all the mixes. A slump of 75mm to 150mm, 50mm to 75mm, 25mm to 50mm and 0mm to 25mm with compaction factor of more than 0.92,0.85 to 0.92,0.80 to 0.85 and 0.75 to 0.80 shows degree of workability of high, medium, low and very low respectively.

Table.3.8 Workability, Slump and Compaction factor of Carbide waste Concrete for M-40 grade

% of carbide waste	Slump in 'mm'	Percentage of Compaction	Degree of Workability
0%	85	0.95	High
5%	80	0.93	High
10%	74	0.88	Medium
15%	69	0.87	Medium
20%	64	0.85	Medium

Table.3.9 Workability, Slump and Compaction factor of Carbide waste Concrete for M-60 grade

% of carbide waste	Slump in 'mm'	Percentage of Compaction	Degree of Workability
0%	35	0.84	Low
5%	32	0.82	Low
10%	28	0.8	Low
15%	22	0.77	Very Low
20%	17	0.75	Very Low

Moulding and Demoulding of Specimens

A total of 170 specimens were casted during the project work which includes casting of 85 cubes specimens of M-40 and 85 cubes specimen of M-60 grade. The details of dimensions of specimens are specified below. After curing the moulded specimens were stored in the laboratory at the room temperature for 24hours. After this period, the specimens were demoulded and submerged in clean, fresh water of the curing tank.

Specimens Moulded

Cubes specimens

- Cube size: cube moulds of 150x150x150mm size.
- Number of cubes :17 cubes at 0% c/w+17 cubes at 5% c/w+17 cubes at 10% c/w +17 cubes at 15% c/w+17 cubes at 20% c/w
- Total number of cubes cast:85for M-40 and 85 for M-60 =170 cubes

Fig 3.3 Cubes casted

Ages of Curing

- The cubes specimens were cured for 28days for normal and carbide waste concrete samples.
- After curing, the cube specimens were tested and the recorded details of the testing procedure and the results are given in the following sections.

Phase IV

Phase IV is about the testing procedure for evaluating the strength parameters of cement mortar & concrete specimens.

Testing Procedure

The concrete specimens considered in this investigation programme have been subjected to the following tests.

Compression Test

Compression test has been conducted confirming to IS 516-1959(5), on the concrete specimens in the universal testing 200MT. In this test, cube is placed with the cast faces not in contact with the platens of testing machine i.e., the position of the cube when tested is at right angles to that cast. Load has been applied at a constant rate of stress equal to 15 MPa/min according to relevant IS code and the load at which the specimens failed has been recorded. Thus from the results, compressive strengths of the specimens have been obtained. After obtaining the results of samples, they have been presented.

Furnace test

In this test each cube of varying proportions of carbide waste is heated at different elevated temperature i.e. from 200^{o}c to 800^{o}c. At each temperature two cubes of same percentage of carbide waste concrete cubes are heated for equal intervals of one hour time and each cube is cooled to normal room temperature. Once the cubes are cooled to normal room temperature each cube is tested under compression.

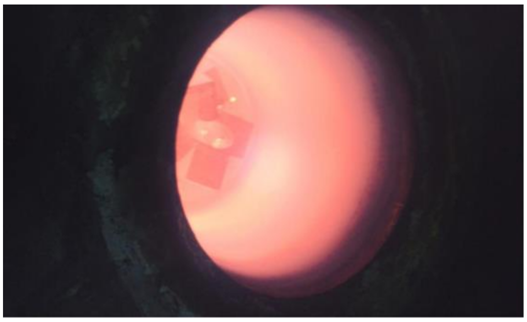

Fig 3.4 Cubes are under heating

Fig 3.5 Cubes after heating.

Fig 3.6 Heated cubes cooled at room temperature

Results and Discussions

Strength Characteristics

Preliminary remarks

This chapter deals with the experimental observation of tests conducted on normal concrete specimens, and carbide waste concrete specimens, after curing for 28 days. The results have been precisely and systematically compiled and presented. They are also represented in line charts and Bar charts for its critical analysis and interpretations.

Properties of Mortar

Weight of cubes

Before conducting the different test on the specimen the weight of each specimen is weighed and noted so that all the specimens are within same range.

Table 4.1 Weight of the cubes for M40 grade

Sl. No.	% of carbide waste replaced	Weigh of the cubes in Kg's			Average weight of cubes
1	0%	8.4	8.5	8.4	8.4
2	5%	8.6	8.5	8.5	8.5
3	10%	8.5	8.6	8.6	8.5
4	15%	8.5	8.6	8.6	8.5
5	20%	8.3	8.3	8.5	8.4

Table 4.2 Weight of the cubes for M60 grade

Sl. No.	% of carbide waste replaced	Weigh of the cubes in Kg's			Average weight of cubes
1	0%	9	9	9	8.6
2	5%	9	8	9	8.5
3	10%	8	9	9	8.5
4	15%	8	8	8	8.25
5	20%	8	8	8	8.4

Compressive strength

The most common of all the parameters is the compressive strength because it is a desirable characteristic of concrete and also quantitatively related to compressive strength.

Table 4.3 Compressive strength for M40 grade (28 days)

Sl. No.	Loading values obtained after 28 days of curing in KN					Average compressive strength in
	% c/w	Sample 1	Sample 2	Sample 3	Average	N/mm^2
1	0%	1110	1090	1140	1113.33	49
2	5%	1150	1090	1125	1121.66	50.8
3	10%	1205	1210	1205	1206.66	53.6
4	15%	1190	1120	1265	1191.66	52.33

5	20%	1020	1010	1025	1018.33	44.66

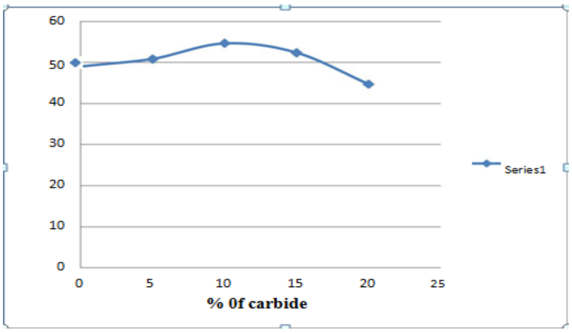

Fig 4.1 Compressive strength values for various proportions of carbide waste for M40 grade

Table 4.4 Compressive strength values for M60 grade (28 days)

Sl. No.	**loading values obtained after 28 days of curing in KN**					**Average compressive strength in n/mm2**
	c/w	**Sample1**	**Sample2**	**Sample3**	**Average**	
1	0%	1650	1620	1640	1636.66	72.27
2	5%	1775	1805	1795	1791.66	79.6
3	10%	1725	1715	1700	1713.33	76.1
4	15%	1550	1560	1565	1558.33	69.25
5	20%	1430	1390	1420	1413.33	62.8

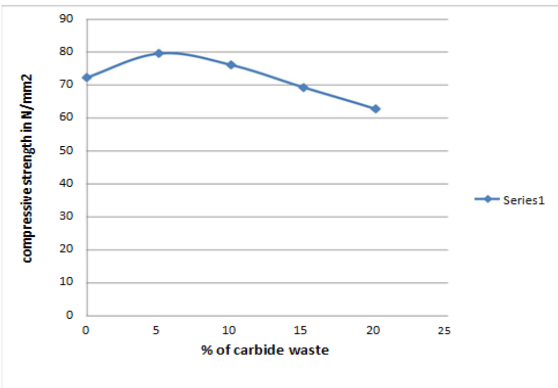

Fig 4.2 Compressive strength values for various proportions of carbide waste for M-60 grad

Table 4.5 M-40 grade loading values after heated to different temperatures which were cooled to room temperature

Sl.No.	**Loading values obtained after heating the cubes to different temperatures in KN**					
	C/W	0%	5%	10%	15%	20%
1	200^{c}c	1150	1153	1218	1215	1002.5
2	300 ^{c}c	1153	1180	1218	1203	1002.5
3	400 ^{c}c	1060	1210	1245	1098	900
4	500^{o}c	997.5	1215	1280	987.5	785
5	600^{o}c	927.5	1170	1233	897.5	720
6	700^{o}c	857.5	1093	1158	842.5	635
7	800^{o}c	810	1008	1063	755	632.5

Table 4.6 Compressive strength values of M40 grade after heated to elevated temperatures

Sl. No.	**Compressive strength values in N/mm^2 for various**					
	C/W	0%	5%	10%	15%	20%
1	200oc	51.11	51.22	54.11	54	44.55
2	300oc	51.22	52.44	54.11	53.4	44.55
3	400oc	52	53.77	55.33	48.8	40
4	500oc	44.33	54	56.88	43.9	34.8
5	600oc	41.22	52	54.77	39.9	32
6	700oc	38.11	48.77	51.44	37.4	28.22
7	800oc	36	44.77	47.22	33.6	28

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 17
July 2018

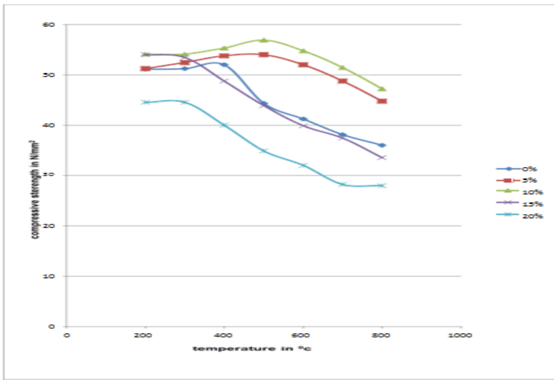

Fig 4.3 M-40 Grade Specimens Compressive Strength at Varying Temperatures

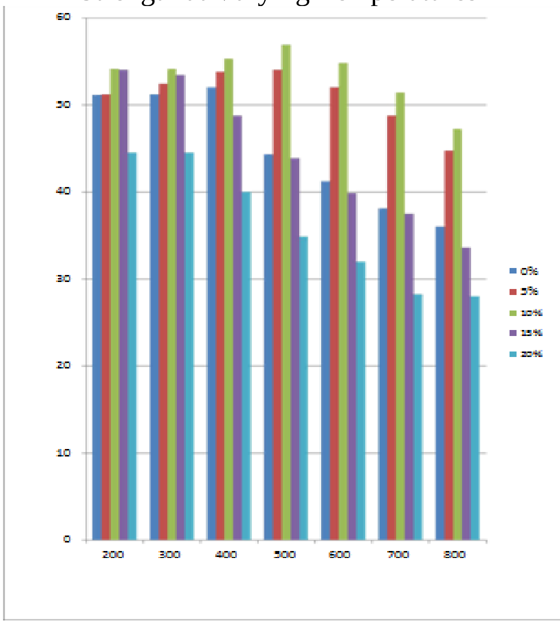

Fig 4.4 M-40 Specimens Compressive Strength at Varying Temperatures

Table 4.7 Loading values obtained after heating the cubes to different temperatures in KN for M-60 grade

Sl. No.	Loading values obtained after heating the cubes to different temperatures					
	C/W	0%	5%	10%	15%	20%
1	200^{o} c	1650	1792	1708	1515	1403
2	300^{o} c	1625	1810	1685	1525	1403
3	400^{o} c	1620	1810	1665	1518	1283
4	500^{o} c	1463	1733	1525	1370	1175
5	600^{o} c	1310	1643	1418	1350	1035
6	700^{o} c	1170	1583	1350	1298	972.5
7	800^{o} c	990	1440	1335	1125	855

Table 4.8 Compressive strength values of M-60 grade concrete

Sl. No.	Compressive strength values in N/mm^2 for various					
	C/W	0%	5%	10%	15%	20%
1	200^{o} c	73.33	79.66	75.88	67.33	62.33
2	300^{o} c	72.22	80.44	74.88	67.77	62.33
3	400^{o} c	72	80.44	74	67.44	57
4	500^{o} c	65	77	67.77	60.88	52.22
5	600^{o} c	58.22	73	63	60	46
6	700^{o} c	52	70.33	60	57.44	43.22
7	800^{o} c	44	64	59.33	50	38

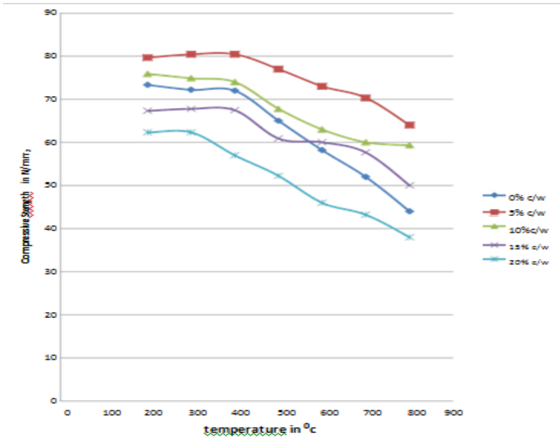

Fig 4.5 M-60 Line Graph of Specimen Compressive Strength at Varying Temperatures

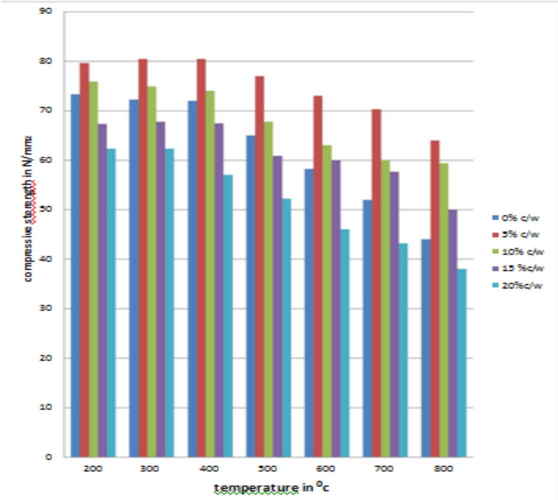

Fig 4.6 M-60 Specimens Compressive Strength at Varying Temperatures

Conclusions

- For M-40 at 10% of Carbide waste has high compressive strength of 53.60 N/mm^2 when compared to remaining.
- After heated to different elevated temperatures only 5% to 10% replacement of carbide waste has shown good results
- For M-40 at 10% replacement the compressive strength gradually increased to 56.88N/mm^2 at 500^{0}c and decreased to 47.22N/mm^2 at 800^{0}c.
- For M-40 grade at 10% of carbide waste there is a 9.38% of increase of compressive strength when compares to normal concrete.
- After furnace test there is a 10.42% of more compressive strength at 200^{0}c when compared to normal concrete, 16.08% more compressive strength at 500^{0}c and there is an reduction of compressive strength of 3.63% when compared to normal concrete at 800^{0}c.
- For M-60 grade concrete 5% replacement of carbide waste has shown good results.
- For M-60 at 5% of carbide waste replacement has an high compressive strength of 79.6 N/mm^2 when compared to remaining.
- After heated to different elevated temperatures only 5% replacement carbide waste has shown good results.
- For 5% replacement compressive strength gradually increased to 80.44 N/mm^2 at 300^{0}c and 400^{0}c and decreased to 64N/mm^2 at 800^{0}c.
- For M-60 grade concrete at 5% of carbide waste there is an 10.14% increase of compressive strength when compared to normal concrete.
- After furnace test there is 10.22% of more compressive strength at 2000c and 11.3% of more compressive strength at 4000c , 6.45% of more compressive strength that 5000c and there is an 11.4% of decrease in the compressive strength at 8000c when compared to normal concrete.
- The most befit in using the carbide waste is, it is an waste material.
- Carbide waste is of completely cost free
- 5-10% replacement of Carbide waste is advisable

Reference

1. Aka AdefemiUsman Muhammad: “Effect of Admixture on Fire Resistance of Ordinary Portland Cement Concrete”. Civil and Environmental Research ISSN2222-1719 (Paper) ISSN 2222-2863 (Online) Vol 3, No.1, 2013.
2. AkhtarHossainRajshahi, Mohammad Nurul Islam, Rajshahi, Md.RajibulKarim,31st Conference on OUR WORLD IN CONCRETE & STRUCTURES:16 - 17 August 2006,SingaporeArticle Online Id: 100031022
3. Amad, A.H &Abdulkareem,O.M (2009) “EFFECT OF HIGH TEMPERATURE ON MECHANICAL PROPERTIES OF CONCRETE CONTAINING ADMIXTURES” ISSN2222-1729 VOL 3,NO 1,2013.
4. Balakrishnaiah.D, Balaji.K.V.G.D, and SrinivasaRao.P “Study Of Mechanical Properties Of Concrete At Elevated Temperatures - A Review” internationaljournal of research and technology, Essin: 231921163.
5. SelinRavikumar, C and Thandavamoorthy T.S “Investigation on Strength and Fire Resistant Properties” (2013)IOSR Journal of Mechanical and Civil

Engineering(IOSR-JMCE) e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 9, Issue 3 (Sep. - Oct. 2013)