A Comparative Study of Normal Concrete using High Performance Concrete Incorporated with Carbide Waste

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ABSTRACT

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. Commonly used binder is the product of hydration of cement, which is the chemical reaction between cement and water. The Ordinary Portland Cement concrete deteriorates considerably when exposed to aggressive environment such as fire or elevated temperature. 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: 10262-2019 for M40 and Erntroy and Shak lock 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 200^0c to 800^0c for 2 hours and cooled to room temperature.

Key words: compressive strength, concrete cubes, carbide waste, elevated temperature.

OBJCTIVES OF THE EXPERIMENT

- To study the compressive strength of the carbide waste concrete under constant water cement ratio.
- To investigate the compressive strength of carbide waste concrete.
- To study the compressive strength of the carbide waste concrete for one normal grade (M40) and one high grade(M60) concrete at elevated temperatures (200,300,400,600,700 and 800^0c)

EXPERIMENTAL WORK AND METHODOLOGY

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: 10262-2019. The experimental programme is divided in to six 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: 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.

Phase IV: Finding out the maximum stress and minimum stress at maximum load for both M-40 and M-60 grade concrete through analysis by using ansys software.

Phase V: Evaluating test results.

Properties of Portland cement (53Grade) for M-40: The Portland cement is shown the specific gravity value as 3.15, the initial and final setting time of cement is 65,180min. The normal consistency of cement is 33.70%. The compressive strength values for 7,14,28 days were 36.50,44.50,49.00 MPA.

Properties of Portland cement (53Grade) for M-60: The Portland cement is shown the specific gravity value as 3.15, the initial and final setting time of cement is 120,185min. The compressive strength values for 7,14,28 days were 37.66,54.50,73.33 MPA

Specimens moulded: Cubes specimens

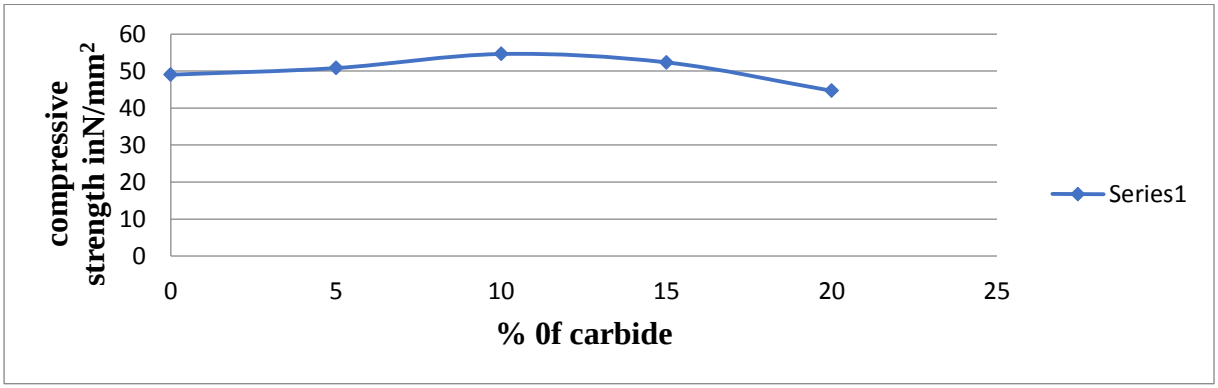
- Cube size: cube moulds of 150x150x150mm size
- Number of cubes :17 cubes at 0% c/w+17 cubes at 5% c/w+17 cubes at 10% c/w +17 cubes at 15% c/w+17 cubes at 20% c/w

Total number of cubes cast:85for M-40 and 85 for M-60 =170 cubes

Compressive strength for M40 grade(28 days)

Serial no	loading values obtained after 28 days of curing in kn					average compressive strength in N/mm^2
	% c/w	Sample 1	Sample 2	Sample 3	Average	
1	0%	1110	1090	1140	1113.33	49
2	5%	1150	1090	1125	1121.66	50.80
3	10%	1230	1230	1225	1228.66	54.60
4	15%	1190	1120	1265	1191.66	52.33
5	20%	10 20	1010	1025	1018.33	44.66

Graph showing the compressive strength values for various proportions of carbide waste for M40 grade



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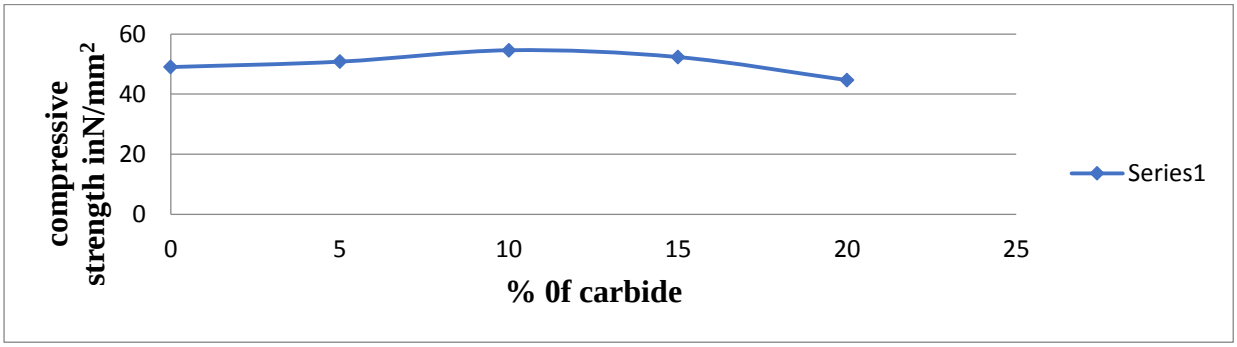
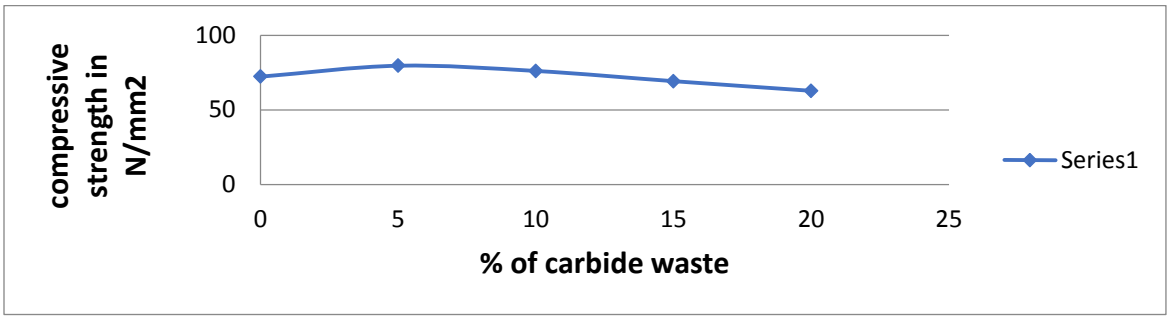


Compressive strength values for M60 grade(28 days)

Serial no	loading values obtained after 28 days of curing in kn					Average compressive strength in n/mm^2
	c/w	Sample1	Sample 2	Sample 3	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

Graph showing the compressive strength values for various proportions of carbide waste for M60 grade



M40 grade loading values after heated to different temperatures which were cooled to room temperature

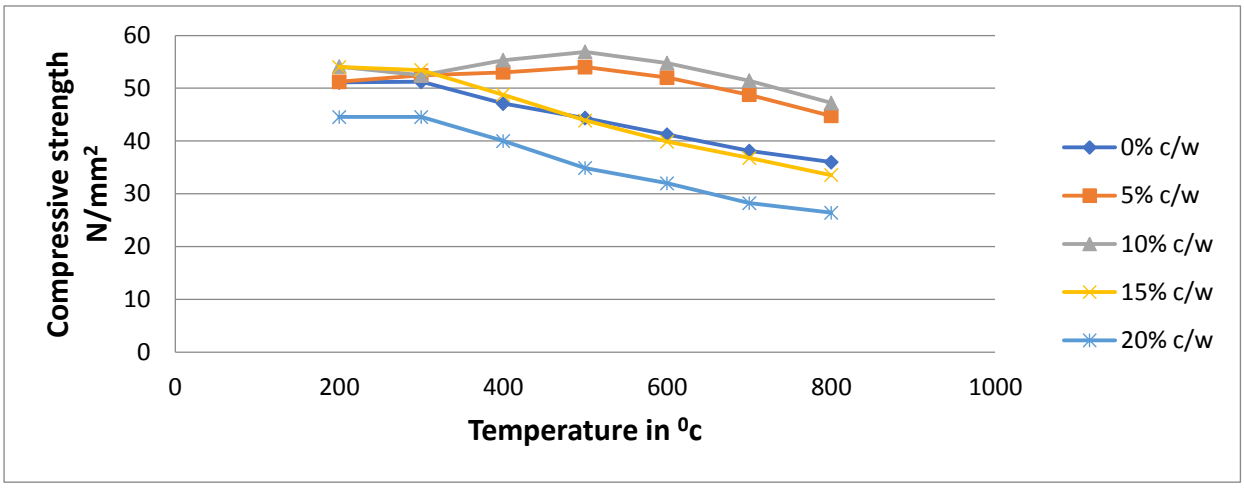
Serial .no	Loading values obtained after heating the cubes to different temperatures in kn											
	C/W	0%		5%		10%		15%		20%		
1	Temp	1140	1160	1140	1165	1245	1190	1205	1225	995	1010	
	200^{c}c											
	Avg	1150		1152.5		1217.5		1215		1002.5		
2	300^{o}c	1175	1130	1190	1170	1115	1245	1220	1185	1010	995	
	Avg	1152.5		1180		1180		1202.5		1002.5		
3	400^{o}c	1090	1030	1215	1205	1215	1275	1120	1075	905	895	
	Avg	1060		1210		1245		1097.5		900		
4	500^{o}c	1025	970	1195	1235	1280	1280	1000	975	780	790	
	Avg	997.5		1215		1280		987.5		785		
5	600^{o}c	930	925	1150	1190	1210	1255	880	915	700	740	
	Avg	927.5		1170		1232.5		897.5		720		

6	700°c	845	870	1080	1105	1140	1175	830	855	645	625
	Avg	857.5		1092.5		1157.5		842.5		635	
7	800°c	780	840	990	1025	1055	1070	740	770	640	625
	Avg	810		1007.5		1062.5		755		632.5	

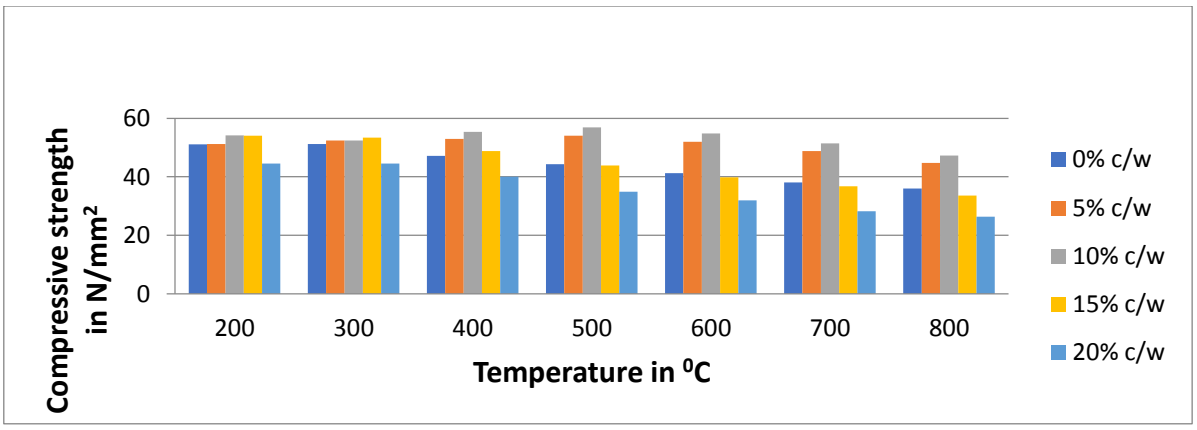
Compressive strength values of M40 grade after heated to elevated temperatures.

Serial No	Compressive strength values in N/mm² for various					
	C/W	0%	5%	10%	15%	20%
	Temperature					
1	200°c	51.11	51.22	54.11	54	44.55
2	300°c	51.22	52.44	52.11	53.44	44.55
3	400°c	52.00	53.77	55.33	48.77	40.00
4	500°c	44.33	54.00	56.88	43.88	34.88
5	600°c	41.22	52.00	54.77	39.88	32.00
6	700°c	38.11	48.77	51.44	37.44	28.22
7	800°c	36.00	44.77	47.22	33.55	28.00

M40 Line Graph of Specimen Compressive Strength at Varying Temperatures



M40 Bar Graph of Specimens Compressive Strength at Varying Temperatures



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

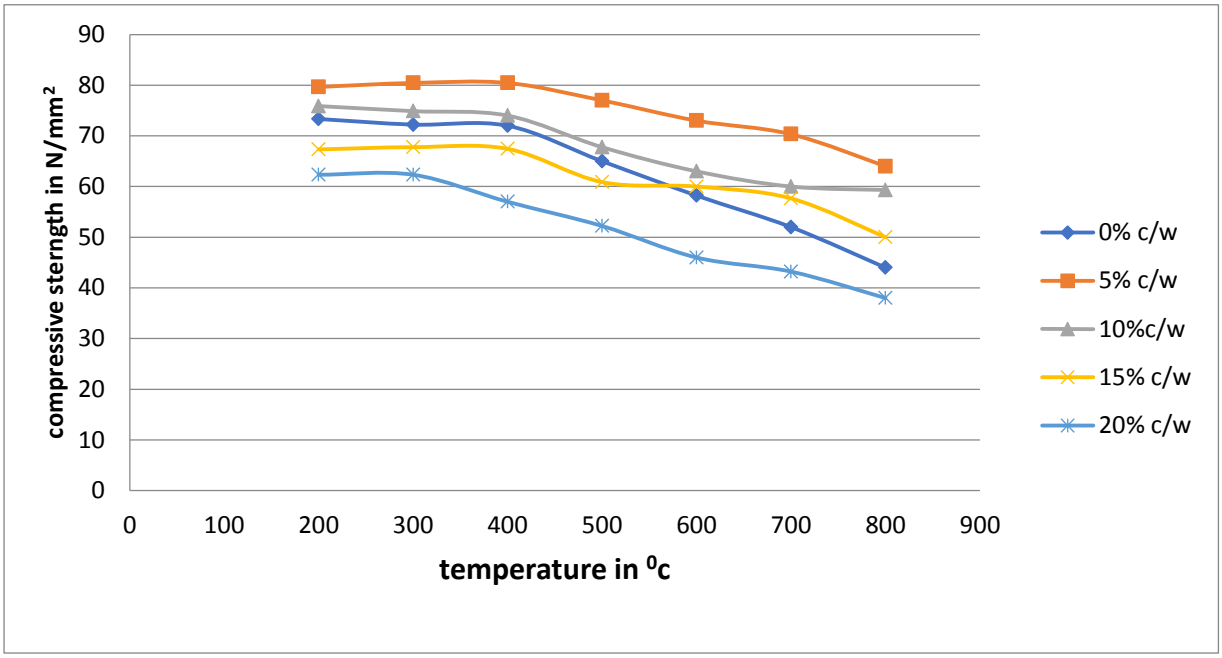
S.no	Loading values obtained after heating the cubes to different temperatures										
	C/W	0%		5%		10%		15%		20%	
1	Temp 200°c	1640	1660	1780	1805	1705	1710	1508	1522	1405	1400
	Avg	1650		1792.4		1707.5		1515		1402.5	
2	300°c	1630	1620	1804	1816	1690	1680	1530	1520	1405	1400
	Avg	1625		1810		1685		1525		1402.5	
	400°c	1620	1620	1815	1805	1670	1660	1820	1515	1280	1285

3	Avg	1620		1810		1665		1517.5		1282.5	
4	500°c	1450	1475	1745	1720	1515	1535	1360	1380	1170	1180
	Avg	1462.5		1732.5		1525		1370		1175	
5	600°c	1300	1320	1650	1635	1405	1430	1360	1340	1020	1050
	Avg	1310		1642.5		1417.5		1350		1035	
6	700°c	1170	1170	1570	1595	1340	1360	1305	1290	980	965
	Avg	1170		1582.5		1350		1297.5		972.5	
7	800°c	980	1000	1455	1425	1340	1330	1115	1135	870	840
	Avg	990		1440		1335		1125		855	

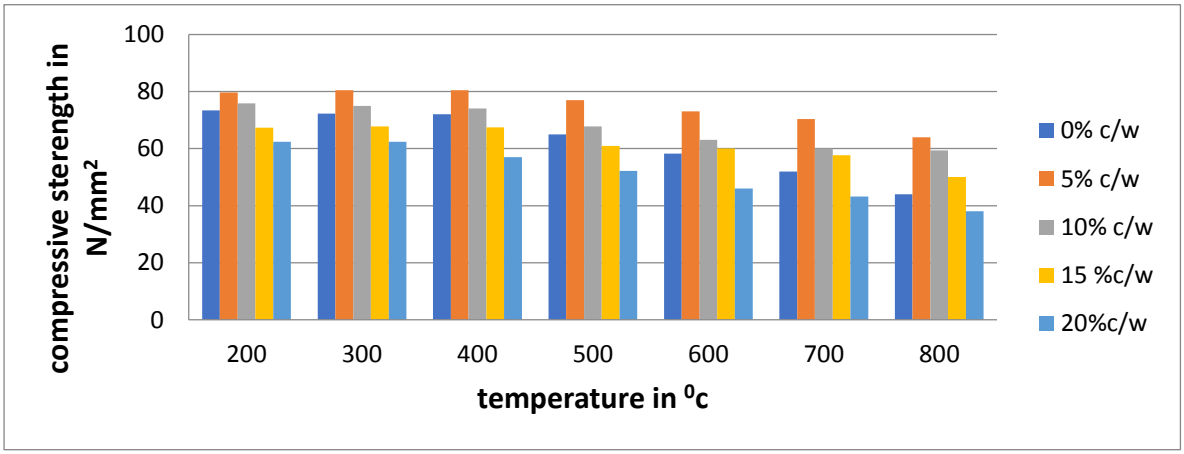
Compressive strength values of M-60 grade concrete.

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

M60 Line Graph of Specimen Compressive Strength at Varying Temperatures



M60 Bar Graph of Specimens Compressive Strength at Varying Temperatures



CONCLUSIONS

Based on the present experimental investigation the following conclusions are drawn.

- Addition of carbide waste powder has an effect on workability aspects of concrete or it can be concluded that there is a change in the workability aspects of carbide waste concrete when compared with respect to normal (or) control concrete.
- When the percentage of addition of carbide waste is replaced in the cement increases the workability of the concrete goes on decreasing.
- The partial replacement of carbide waste with 5% ,10%,15% and 20% has shown the medium workability for M-40 grade.

- The partial replacement of carbide waste with 5% ,10%,15% and 20% has shown the low workability for M-60 grade.

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