Chapter Five

Presentation and discussion of results

5.1 slump test results:

- Mix design (1) Grade 30 without additives (slump test) = 13 cm
- Mix design (2) Grade 40 with additives (slump test) = 14.2 cm

5.2 compressive strength results:

The compressive strength of specimens at different ranges of temperature are presented in tables (5.1), (5.3) and (5.5) it can be noticed that the average residual compressive strength value of specimen have been decrease slightly at 100^0C, 200^0C, and 300^0C by about (28% to 34%) of the average compressive strength for mix design without additives at room temperature and about (45% to 53%) of the average compressive strength for mix design with additives, but in case of increasing the exposure ` temperature up to 200^0C a reduction occurs in compressive strength value by about (34% to 37%) of the average compressive strength for mix design without additives and dramatic a reduction occurs in compressive strength value by about (53% to 65%) of the average compressive strength for mix design with additives at room temperature. It should be note that; the detailed results of tests were attached in (Chapter four).

It is observed that during the compressive strength test, there is a clear different between failures mode for samples at room temperature and samples exposed to elevated temperature, collapse occurs to the outer cover of specimen exposed to heat (approximately about 20mm) as soon as the load applied by the machine , this could be attributed to the fact of the thermal gradient at surface is different than the core of concrete, that lead to the fact of

the damage in concrete micro-structure is more severe at the outer part than the core.

Table (5.1): Results of concrete compressive strength with const the degree of temperature and time variable.

Temp Degree 100^0c	**Compressive strength fcu (N/mm^2)**		**Time 45 mint.**		**Time1.5 hour**	
	strength	**average**	**strength**	**average**	**strength**	**average**
Cube 1	41.1		39.1		28.9	
Cube 2	50.2	46.1	40.4	39.8	35.8	33.1
Cube 3	46.6		40		34.7	

Table (5.2): losses in strength at difference time and constant (100^0c) degree of temperature.

Time	**Losses in strength**
45 min	**13.7%**
1.5 hour	**28.2%**

Table (5.3) Results of concrete compressive strength for mix (1) of constant time and degree of temperature variables.

Time 1.5 hour	**Compressive strength fcu (N/mm^2)**		**Degree of temp (200^{0}c)**		**Degree of temp (300^{0}c)**	
	strength	**average**	**strength**	**average**	**strength**	**average**
Cube 1	41.1		31.6		29.8	
Cube 2	50.2	46.1	30.2	30.1	30	29
Cube 3	46.6		28.4		27.1	

Table (5.4) :losses of strength at difference degree of temperature and constant time for mix (1)

Degree of temp	**Losses in strength**
100^{0}c	**28.2%**
200^{0}c	**34.7%**
300^{0}c	**37.1%**

Table (5.5) results of concrete compressive strength with additives with constant the degree of temperature and time variables.

Degree of (100^{0}c)	**Fcu (N/mm^2)**		**Time 45 min**		**Time1.5 hour**	
	strength	**average**	**strength**	**average**	**strength**	**average**
Cube 1	49.3		34.4		27.1	
Cube 2	43.6	47.7	29.1	32	24.9	25.9
Cube 3	50.2		32.4		25.9	

Table (5.6) the losses of strength in difference time and degree of temperature its constant in concrete without additives

Time	Losses of strength
45 min	**32.9%**
1.5 hour	**45.7%**

Table (5.7) results of concrete compressive strength with additives in constant time and degree of temperature variables.

Degree of temp	Losses of strength
100^0c	45.7%
200^0c	53.7%
300^0c	65.4%

the observation from the statistical analysis as shown in figures (5.1), (5.2), (5.3), (5.4) , (5.5) and (5.6) indicates that; this reduction in compressive strength follows a linear pattern at room temperature and up to 300^0C, beyond 300^0C which pattern follow is non-linear. So that leads to notice that the correlation and relation between compressive strength and elevated temperature up to 300^0C in general is not linear relation.

the compressive strength value for concrete mixes with (additives) is lowers than those without (additives), mainly because of the high denser structure of concrete with (additives). It should note that; the results of compressive strength tests at room temperature are presented in the chapter four.

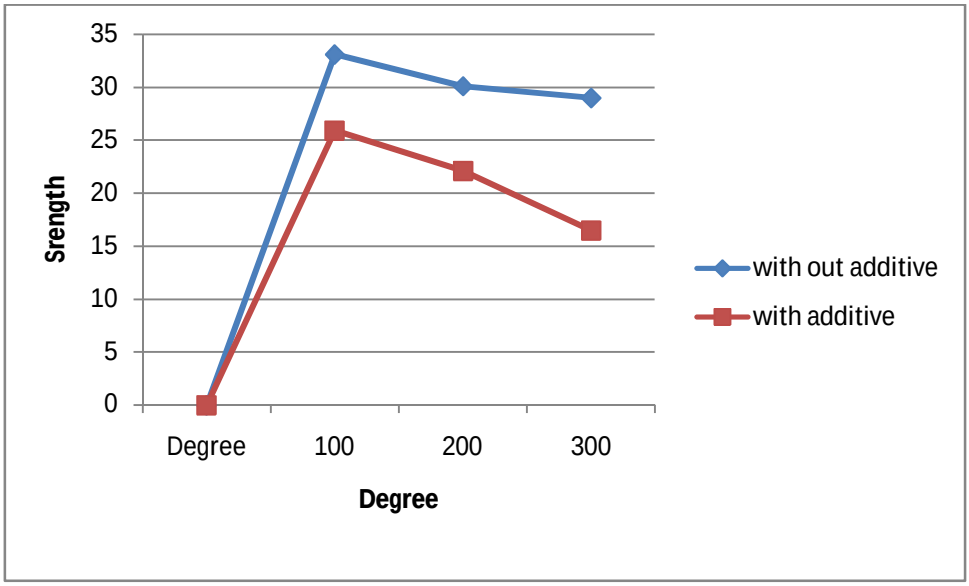

Figure (5.1): Shown the relationship between degree of temperature and compressive strength in time 1.5 hour

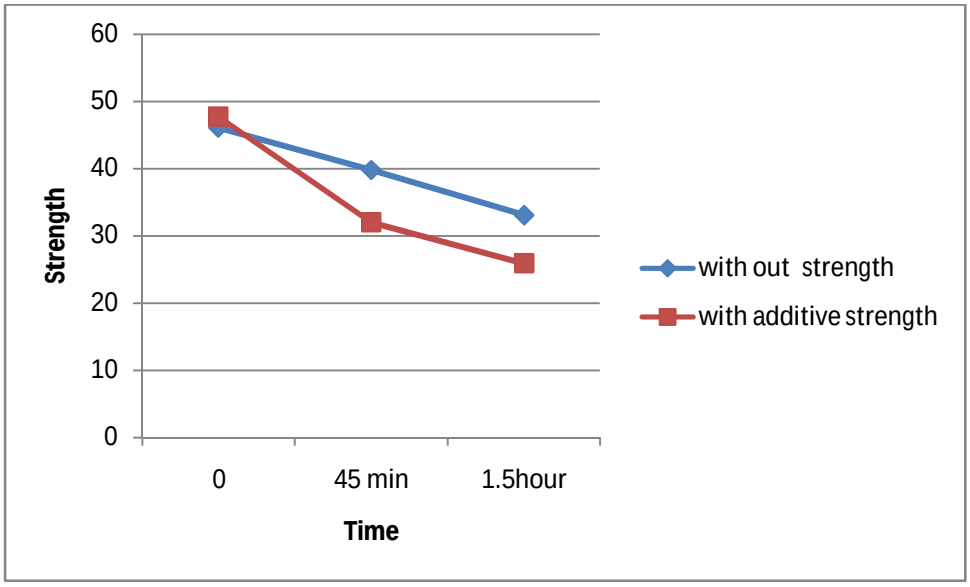

Figure (5.2): Shown the relationship between time and compressive strength in degree of temperature 100^0c

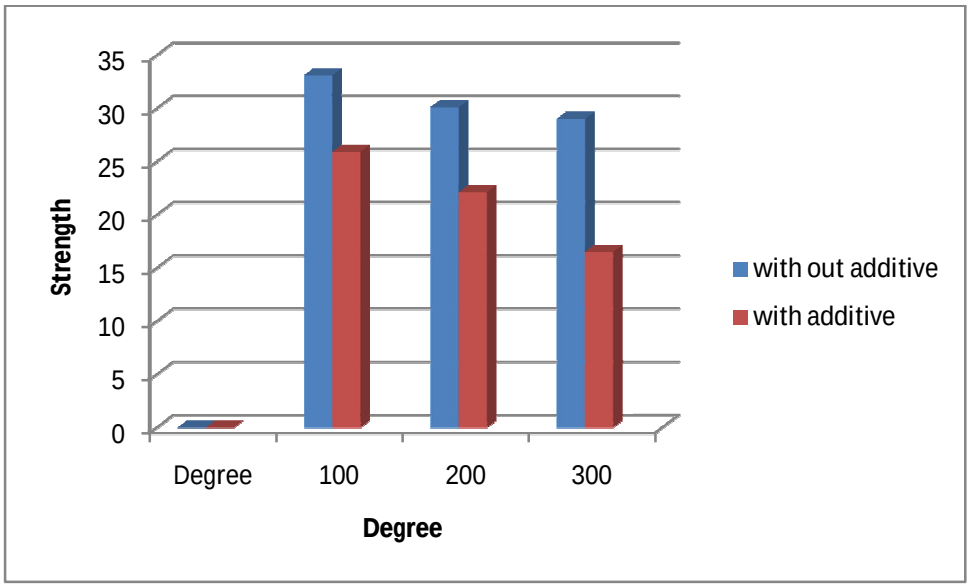

Figure (5.3): Shown the relationship between degree of temperature and compressive strength in time 1.5 hour with columns diagram

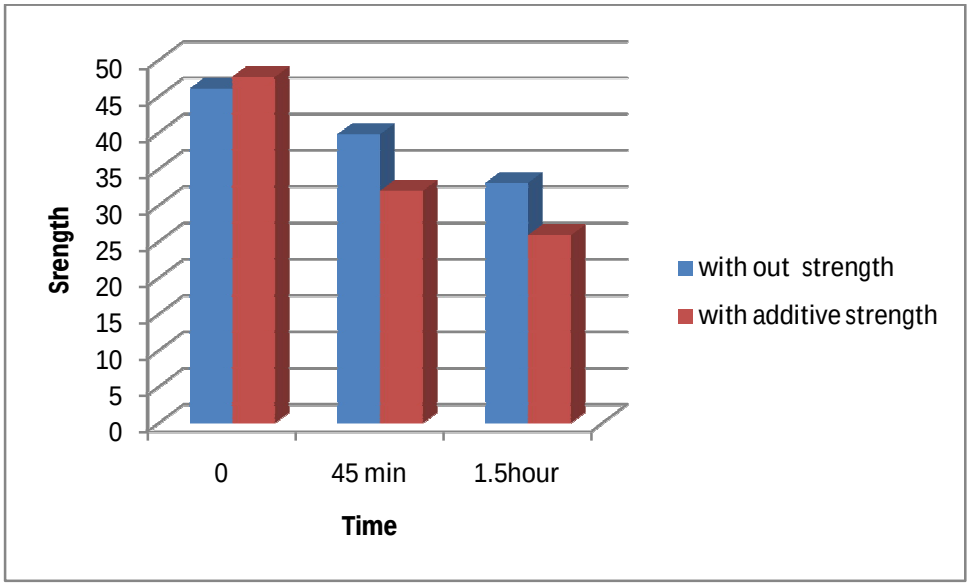

Figure (5.4): Shown the relationship between time and compressive strength in degree of temperature 100^0c with columns diagrams

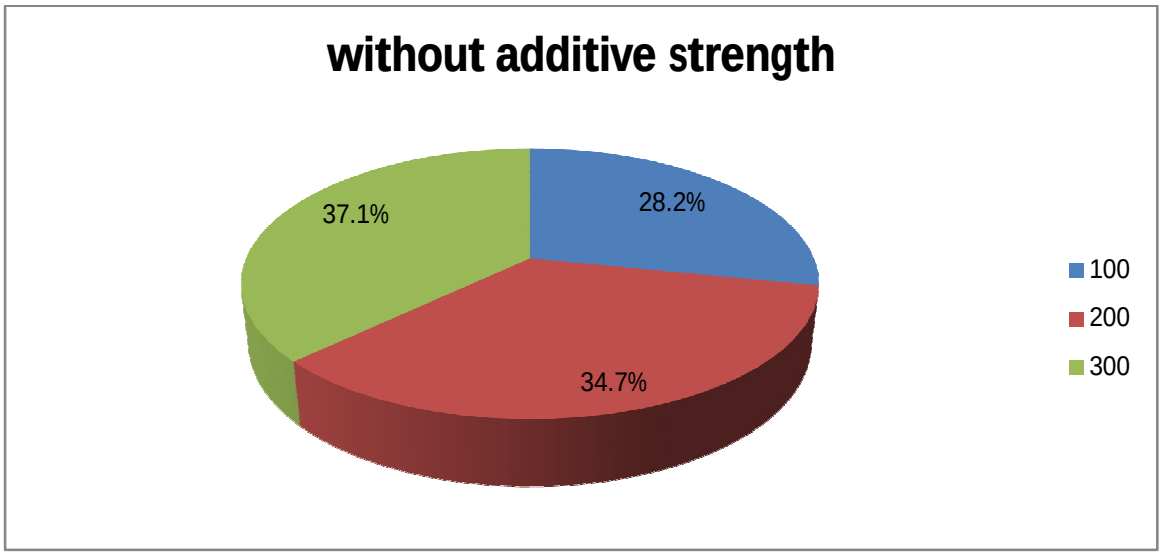

Figure (5.5): Shown the losses of strength in degree of temperature in concrete without additives

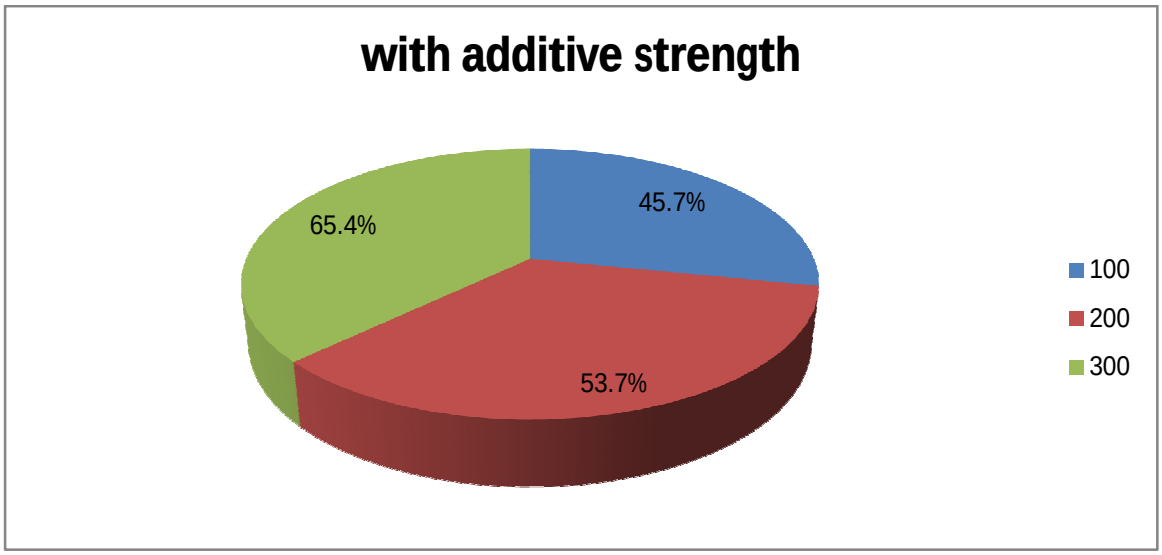

Figure (5.6): Shown the losses of strength in degree of temperature in concrete with additives

Figure (5.1) presented relationship between degrees of temperature and compressive strength at constant time (1.5 hour), the reducing in compressive strength is decreasing for degree of temperature, and the losses of compressive strength in concrete without additives shown by blue line its small compare for concrete with additives (superplastisize) shown by red line because the additives its chemical materials its helping to flammable.

Within the range of the original compressive strength (without additives and with additives) shown in figures (5.1) ,(5.2) , (5.3) and (5.4) which examined in this study under the impact of elevated temperature, it was found that: grade with additives have less reduction in compressive strength than this with Additives.

Figures (5.5) and (5.6) shown The both grades of concrete that investigated in this study in the ranges of temperature from room temperature (39^0C) up to (100^0C) show a loss in compressive strength, in fact the physical properties has changed due to elevated temperature and these changes are clear in the appearance of surface cracks and the failure mode of specimens during tests.