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COMPRESSIVE STRENGTH CALIBRATION OF WASHED AND UNWASHED LOCALLY OCCURRING 3/8 GRAVEL FROM VARIOUS WATER CEMENT RATIOS AND CURING AGE

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Abstract- The compressive strength of locally occurring 3/8 gravel applying different water cement ratios has been evaluated, these were done through experimental techniques by characterizing the sorted locally occurring 3/8 gravel in washed and unwashed sample for analysis, these two conditions were applied to monitor the compressive strength of locally occurring 3/8 gravel for higher performances of concrete formations. Several results were generated from different water cement ratios for washed and washed gravel including its curing age, these results were subjected to calibration, these concept generated several mathematical equations, the equation represents developed values for unwashed and washed concrete compressive strength at different water cement ratios and curing time, from the graphical representation, it has express the rate of compressive strength at different curing time thus different water cement ratios. The results have express the effect that influences some concrete that developed very low compressive strength. These can be attributed to variations from mix proportion and rate of compaction in various samples, impurities may also cause degradations of concrete compressive strength, calibrating these values has definitely express mathematical equations that will be resolved to predict compressive strength of locally sorted 3/8 gravel at different water cement ratios and curing age.

Key words- compressive strength, calibration, local 3/8 gravel, water cement ratio, and time

1. Introduction

The compressive strength of concrete depends on the water to cement ratio, degree of compaction, ratio of cement to aggregate, bond between mortar and aggregate, and grading, shape, strength and size of the aggregate (Roccoand and Elices, 2009; Elices and Rocco, 2008, Abdullahi.2012). Concrete can be visualized as a multi-phase composite material made up of three phases; namely the mortar, mortar/aggregate interface, and the coarse aggregate phase, (Olanipekun, Olusola, and Ata, 2006 Meddah, M.S., Zitouni and Belâabes, 2010),. The coarse aggregate in normal concrete are mainly from rock fragments characterised by high strength. Therefore, the aggregate interface is not a limiting factor governing the strength requirement (Beshr, Almusallam, and Maslehuddin 2003 Abdullahi.2012, Eluozo and Ode 2015a, Eluozo and Ode 2015b, Eluozo and Ode 2015c). The effect of using crushed quartzite, crushed granite, limestone, and marble as coarse aggregate on the on the mechanical properties of high-performance concrete was investigated (Wu, Chen, Yao, and Zhang, 1997 Montgomery, Peck, and Vining.2001). The outcome of the study revealed that the strength, stiffness, and fracture energy of concrete for a given water/cement ratio depend on the type of aggregate. Basalt, limestone and gravel have been used as coarse aggregate to produce normal and high-performance concrete (Özturan, and Çeçen, 1997 Ephraim and Ode, 2006). Normal strength concrete made with basalt and gravel gave similar compressive strength while the concrete containing limestone attained higher strength. The effects of content and particle size distribution of coarse aggregate on the compressive strength of concrete have been investigated (Meddah, Zitouni, and Belâabes 2010).

2. Materials and Method

ELE England made concrete compressive machine was used. It consists of a measuring gauge with two indicator or pointer (black and red). The indicator must be set to zero mark before testing. Load is applied to test specimen through two steel loading platforms, with a fixed upper platform and an upward moving lower platform. The lower platform has marking which help in centralizing a test specimen to receive the concentric load. At failure, the black pointer drops back to zero and red pointer remains in position to give the reading of the failure load, after the reading has been taken, a knob is adjusted to release the lower platform to former position.

3. Results and Discussion

Results and discussion are presented in tables including graphical representation of compressive strength of concrete.

Table: 1 compressive strength of unwashed Mix at [0.45 at Different Curing Days

Water Cement Ratio Curing Age Mix U-0.45	Compressive Strength N/mm^2
7	6
14	7.71
21	7.78
28	10.82
60	9.33
90	5.56

Table: 2 compressive strength of unwashed Mix at [0.50] at Different Curing Days

Water Cement Ratio Curing Age Mix U-0.50	Compressive Strength N/mm^2
7	5.03
14	4.74
21	5.78
28	11.26
60	9.33
90	9.11

Table: 3 compressive strength of unwashed Mix at [0.55] at Different Curing Days

Water Cement Ratio Curing Age Mix U-0.55	Compressive Strength N/mm^2
7	6.82
14	10.22
21	9.04
28	11.85
60	8.93
90	9.56

Table: 6 compressive strength of unwashed Mix at [0.60] at Different Curing Days

Water Cement Ratio Curing Age Mix U-0.60	Compressive Strength N/mm^2
7	10.5
14	11.26

21	**16**
28	**11.52**
60	**8.93**
90	**12.89**

Table: 7 compressive strength of unwashed Mix at [0.65] at Different Curing Days

Water Cement Ratio Curing Age Mix U-0.65	**Compressive Strength N/mm^2**
7	**8.89**
14	**8.89**
21	**11.85**
28	**12.45**
60	**17.78**
90	**10.67**

Table: 8 compressive strength of unwashed Mix at [0.70] at Different Curing Days

Water Cement Ratio Curing Age Mix U-0.70	**Compressive Strength N/mm^2**
7	**10.69**
14	**11.26**
21	**14.56**
28	**13.63**
60	**17.33**
90	**10.22**

Table: 9 compressive strength of unwashed Mix at [0.75] at Different Curing Days

Water Cement Ratio Curing Age Mix U-0.75	**Compressive Strength N/mm^2**
7	**6.67**
14	**9.19**
21	**11.41**
28	**9.93**
60	**11.11**
90	**10.67**

Table: 10 compressive strength of unwashed Mix at [0.80] at Different Curing Days

Water Cement Ratio Curing Age Mix U-0.80	**Compressive Strength N/mm^2**

7	5.78
14	8.3
21	9.78
28	10.81
60	11.11
90	11.78

Table: 11 compressive strength of unwashed Mix at [0.85] at Different Curing Days

Water Cement Ratio Curing Age Mix U-0.85	Compressive Strength N/mm^2
7	5.33
14	9.63
21	9.93
28	10.52
60	10.67
90	11.12

Table: 12 compressive strength of unwashed Mix at [0.90] at Different Curing Days

Water Cement Ratio Curing Age Mix U-0.90	Compressive Strength
7	7.11
14	10.37
21	9.63
28	12.15
60	9.78
90	13.12

Table: 13 compressive strength of unwashed Mix at [0.95] at Different Curing Days

Water Cement Ratio Curing Age Mix U-0.95	Compressive Strength N/mm^2
7	4.4
14	4.89
21	5.11
28	6.22
60	7.56
90	7.34

Table: 14 compressive strength of unwashed Mix at [1.00] at Different Curing Days

Water Cement Ratio Curing Age Mix U-1.00	Compressive Strength N/mm^2
7	4
14	4.44
21	5.78
28	6
60	5.78
90	6

Table: 15 compressive strength of unwashed Mix at [1.05] at Different Curing Days

Water Cement Ratio Curing Age Mix U-1.05	Compressive Strength N/mm^2
7	2.8
14	4.44
21	4.59
28	5.04
60	3.56
90	4.44

Table: 16 compressive strength of unwashed Mix at [1.10] at Different Curing Days

Water Cement Ratio Curing Age Mix U-1.10	Compressive Strength N/mm^2
7	3.11
14	5.33
21	6.08
28	5.18
60	7.11
90	5.34

Table: 17 compressive strength of washed Mix at [0.35] at Different Curing Days

Water Cement Ratio Curing Age Mix W-035	Compressive Strength N/mm^2
7	2.82
14	3.56
21	4.15
28	6.97
60	3.98
90	4.4

Table: 18 compressive strength of washed Mix at [0.45] at Different Curing Days

Water Cement Ratio Curing Age Mix W-0.45	Compressive Strength N/mm^2
7	19.34
14	18.29
21	23.56
28	23.11
60	20.89
90	34.67

Table: 19 compressive strength of washed Mix at [0.50] at Different Curing Days

Water Cement Ratio Curing Age Mix W-0.50	Compressive Strength N/mm^2
7	16.23
14	17.33
21	22.22
28	23.81
60	22.67
90	26.67

Table: 20 compressive strength of washed Mix at [0.55] at Different Curing Days

Water Cement Ratio Curing Age Mix W-0.55	Compressive Strength N/mm^2
7	13.55
14	17.04
21	14.96
28	22.67
60	17.78
90	26.89

Table: 21 compressive strength of washed Mix at [0.60] at Different Curing Days

Water Cement Ratio Curing Age Mix W-0.60	Compressive Strength N/mm^2
7	12.89
14	18.08
21	16.3
28	20.59

60	**19.56**
90	**22.89**

Table: 22 compressive strength of washed Mix at [0.\65] at Different Curing Days

Water Cement Ratio Curing Age Mix W-0.65	**Compressive Strength N/mm^2**
7	**11.11**
14	**13.63**
21	**13.56**
28	**16.15**
60	**18.89**
90	**24**

Table: 23 compressive strength of washed Mix at [0.70] at Different Curing Days

Water Cement Ratio Curing Age Mix W-0.70	**Compressive Strength N/mm^2**
7	**10.37**
14	**12.29**
21	**13.48**
28	**14.22**
60	**10.22**
90	**16.89**

Table: 24 compressive strength of washed Mix at [0.75] at Different Curing Days

Water Cement Ratio Curing Age Mix W-0.75	**Compressive Strength N/mm^2**
7	**9.78**
14	**12.59**
21	**14.67**
28	**11.56**
60	**15.56**
90	**20**

Table: 25 compressive strength of washed Mix at [0.80] at Different Curing Days

Water Cement Ratio Curing Age Mix W-0.80	**Compressive Strength N/mm^2**
7	**12.29**
14	**11.41**

21	**12.44**
28	**9.93**
60	**13.33**
90	**13.33**

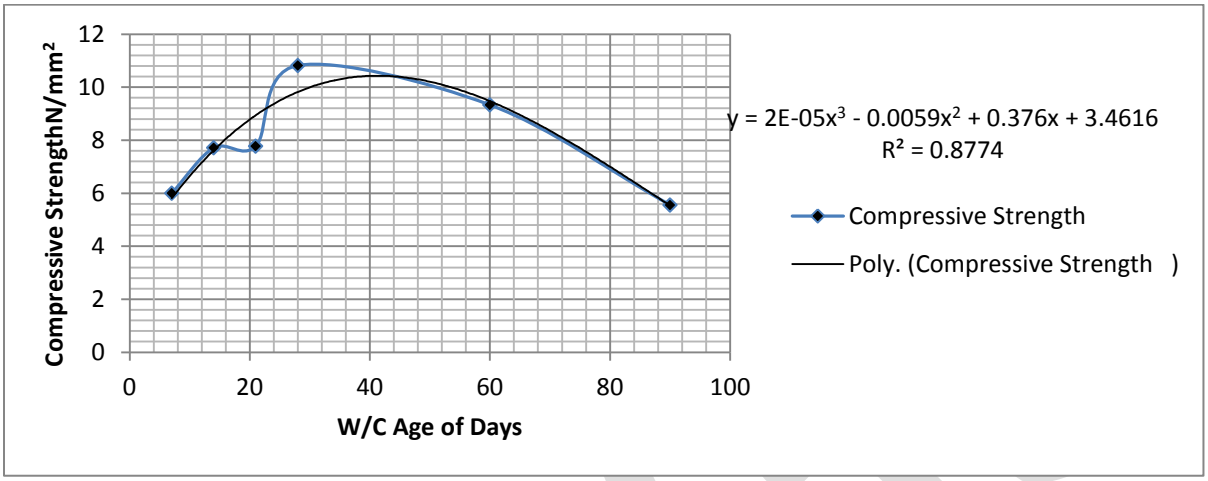

Figure: 1 compressive strength of unwashed Mix at [0.45 at Different Curing Days

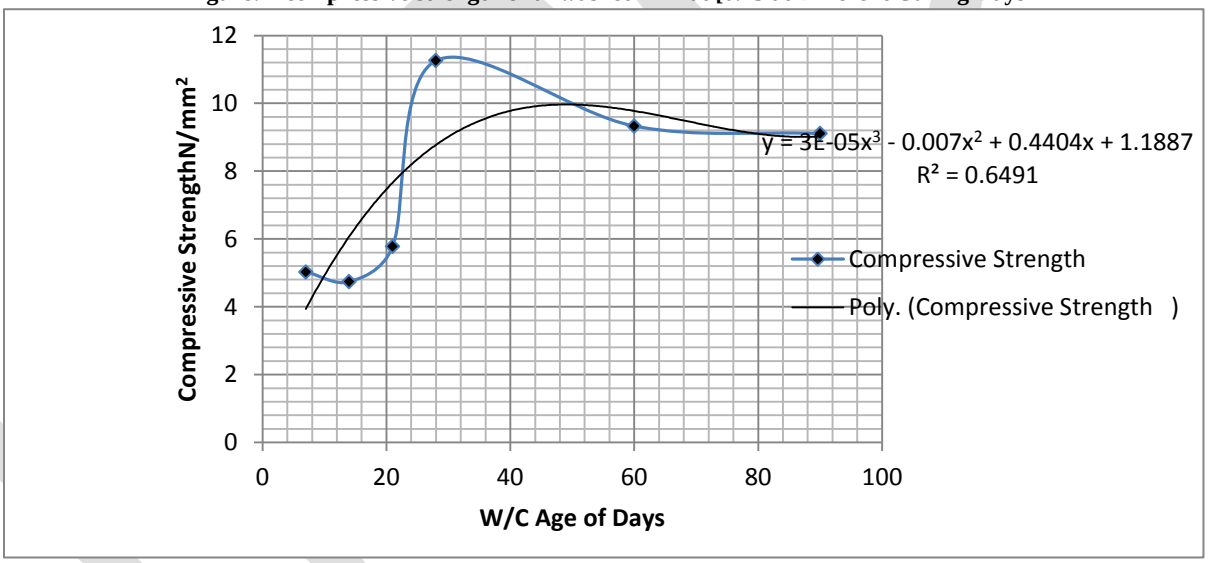

Figure: 2 compressive strength of unwashed Mix at [0.50] at Different Curing Days

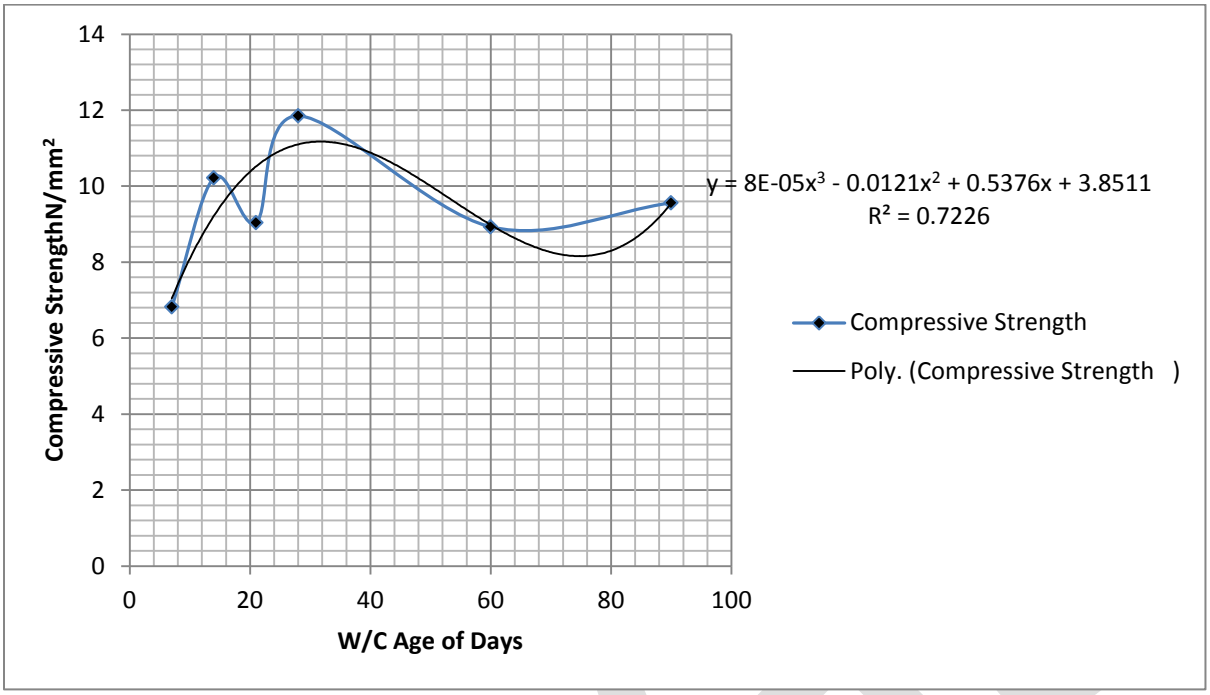

Figure: 3 compressive strength of unwashed Mix at [0.55] at Different Curing Days

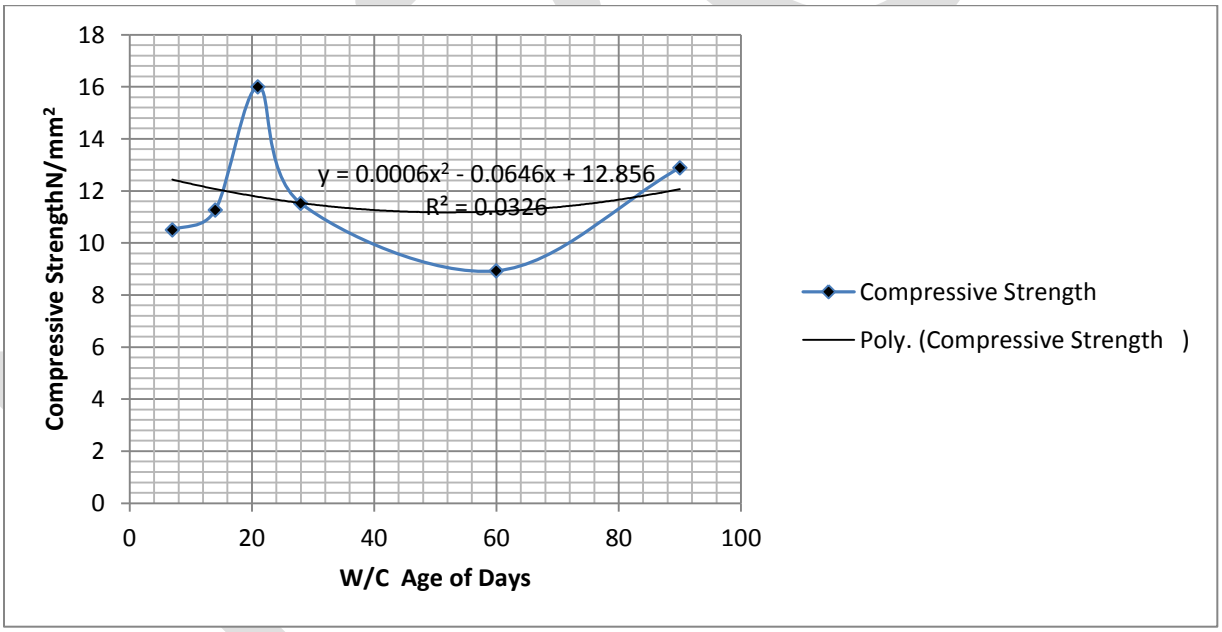

Figure: 4 compressive strength of unwashed Mix at [0.50] at Different Curing Days

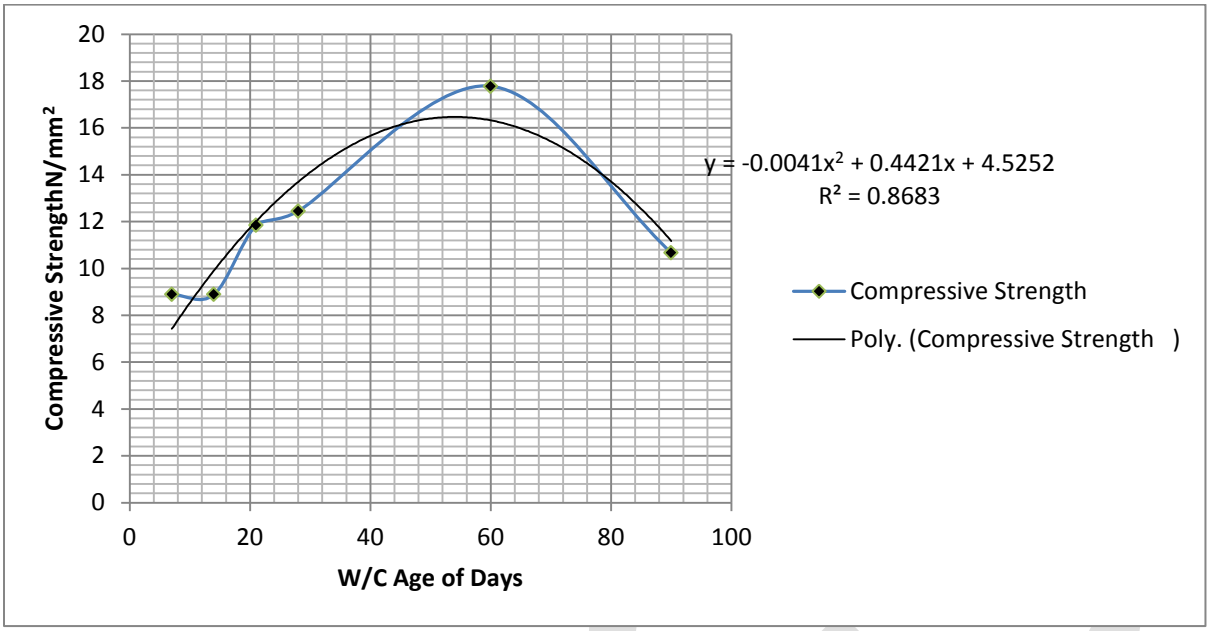

Figure : 5 compressive strength of unwashed Mix at [0.55] at Different Curing Days

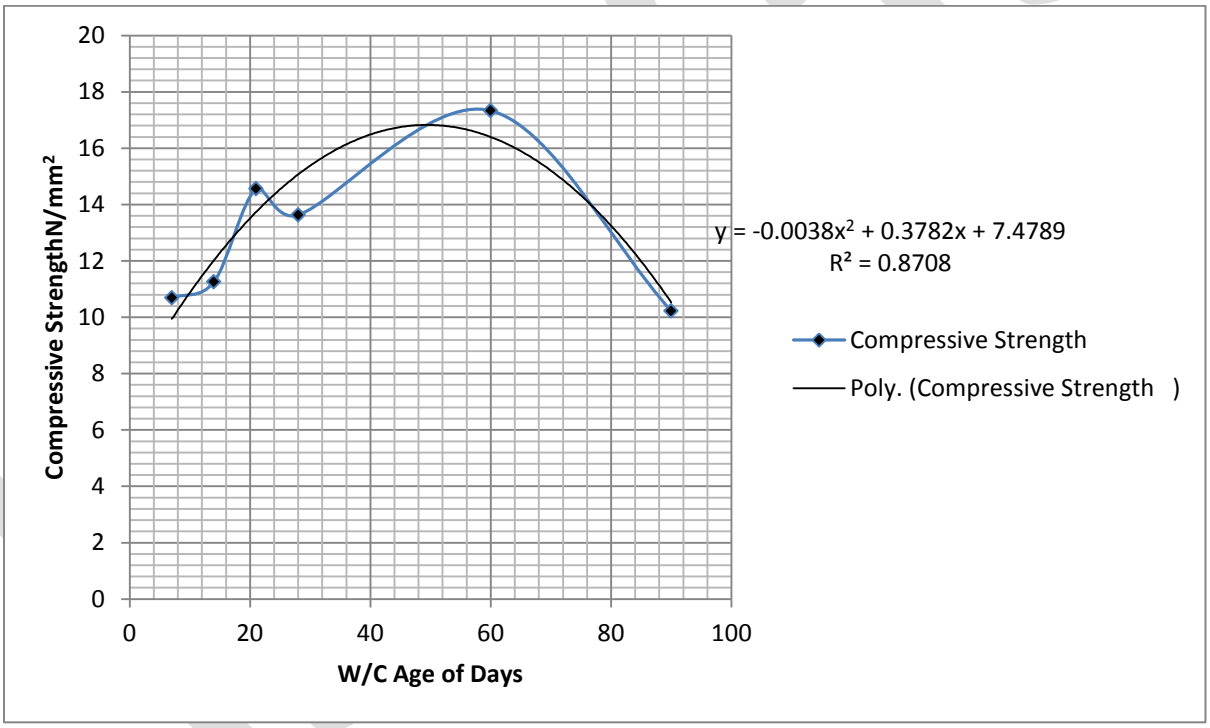

Figure: 6 compressive strength of unwashed Mix at [0.60] at Different Curing Days

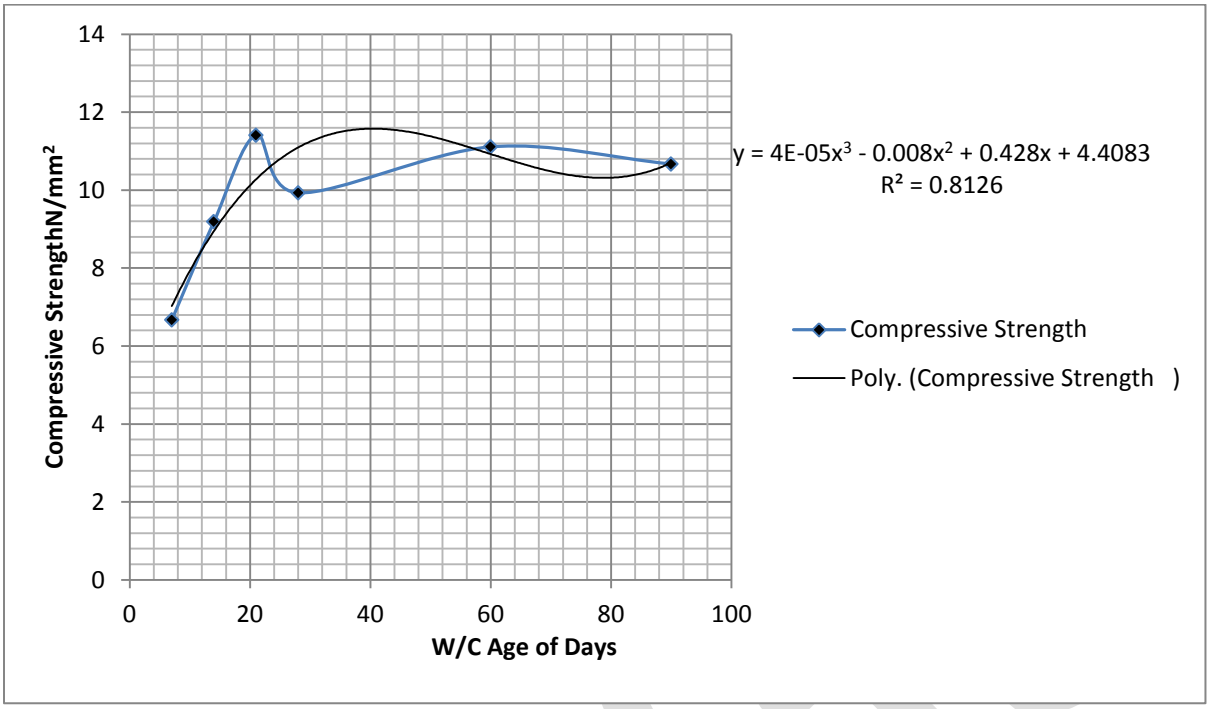

Figure: 7 compressive strength of unwashed Mix at [0.65] at Different Curing Days

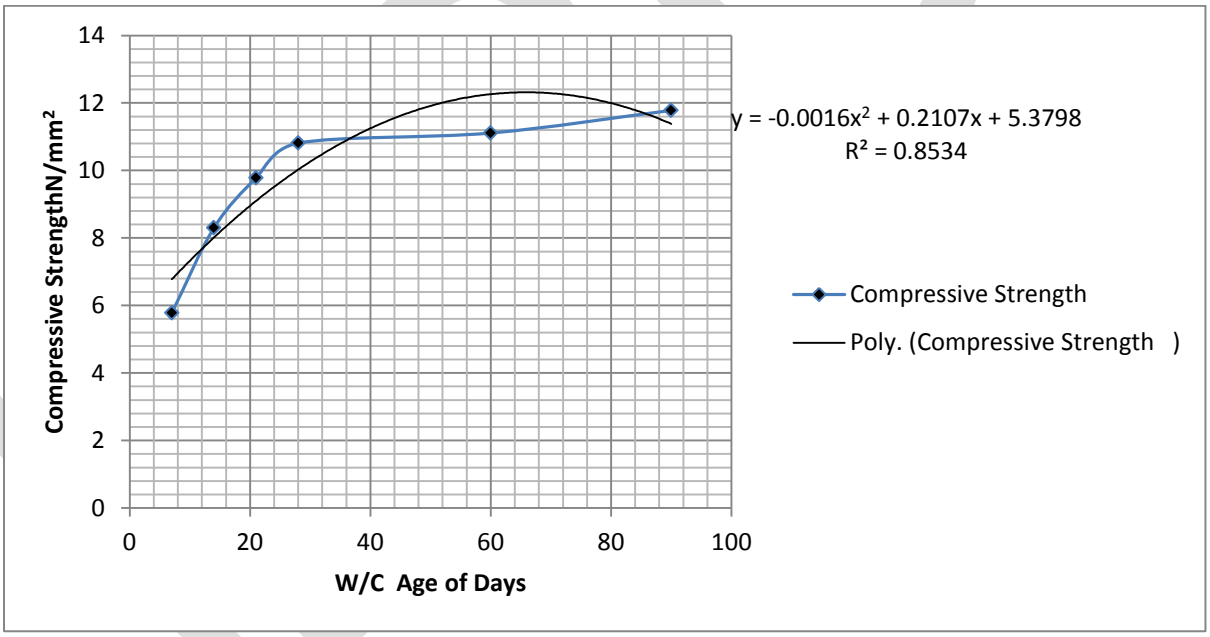

Figure : 8 compressive strength of unwashed Mix at [0.70] at Different Curing Days

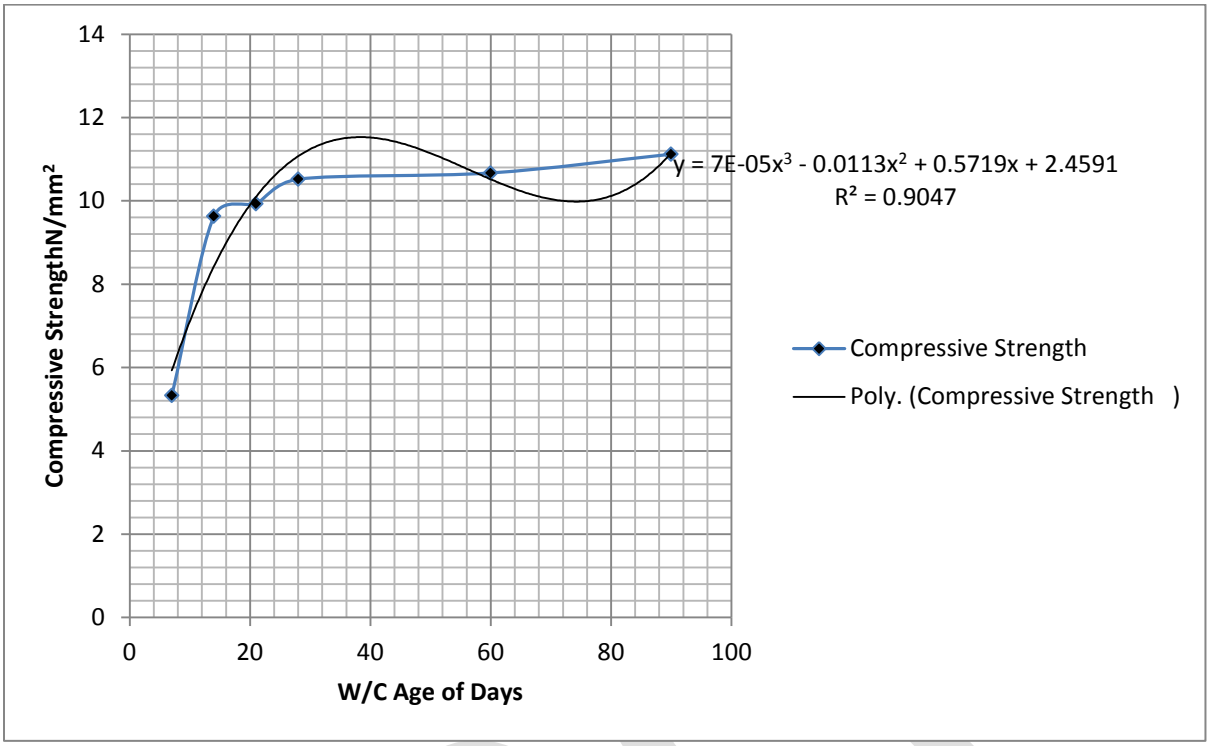

Figure: 9 compressive strength of unwashed Mix at [0.75] at Different Curing Days

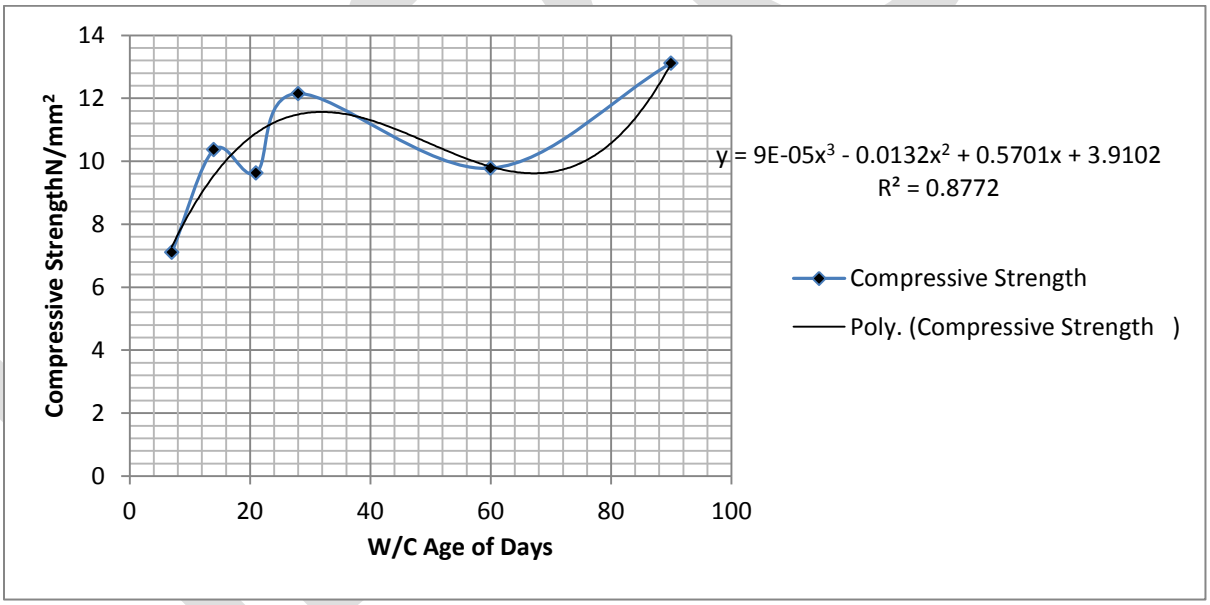

Figure: 10 compressive strength of unwashed Mix at [0.80] at Different Curing Days

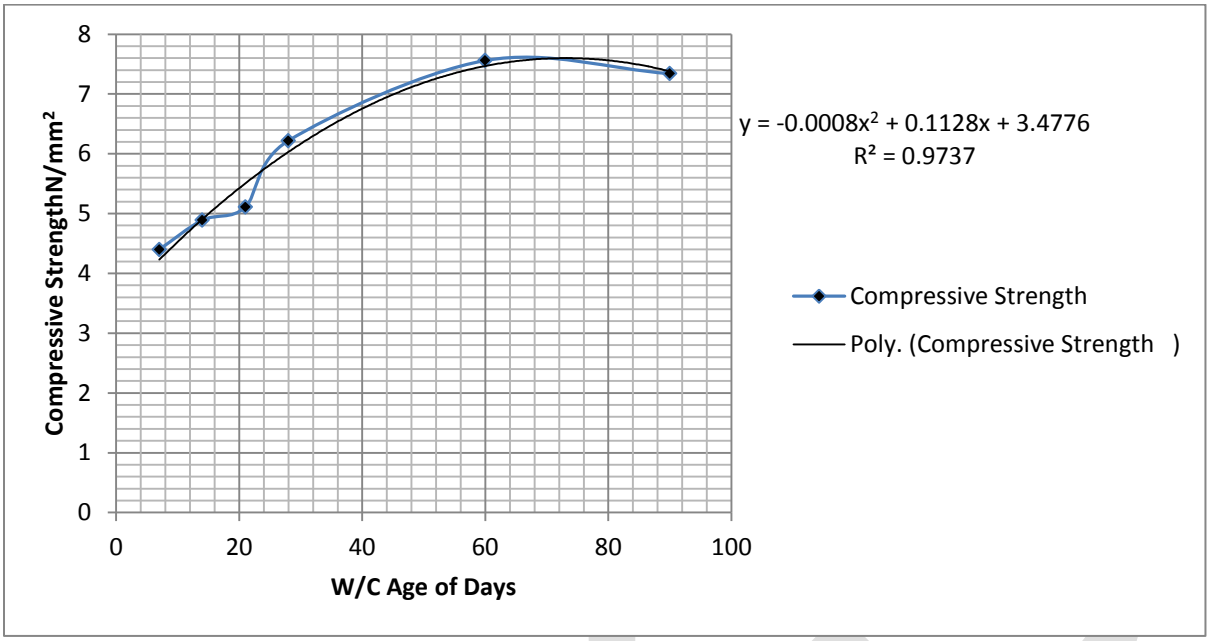

Figure: 11 compressive strength of unwashed Mix at [0.85] at Different Curing Days

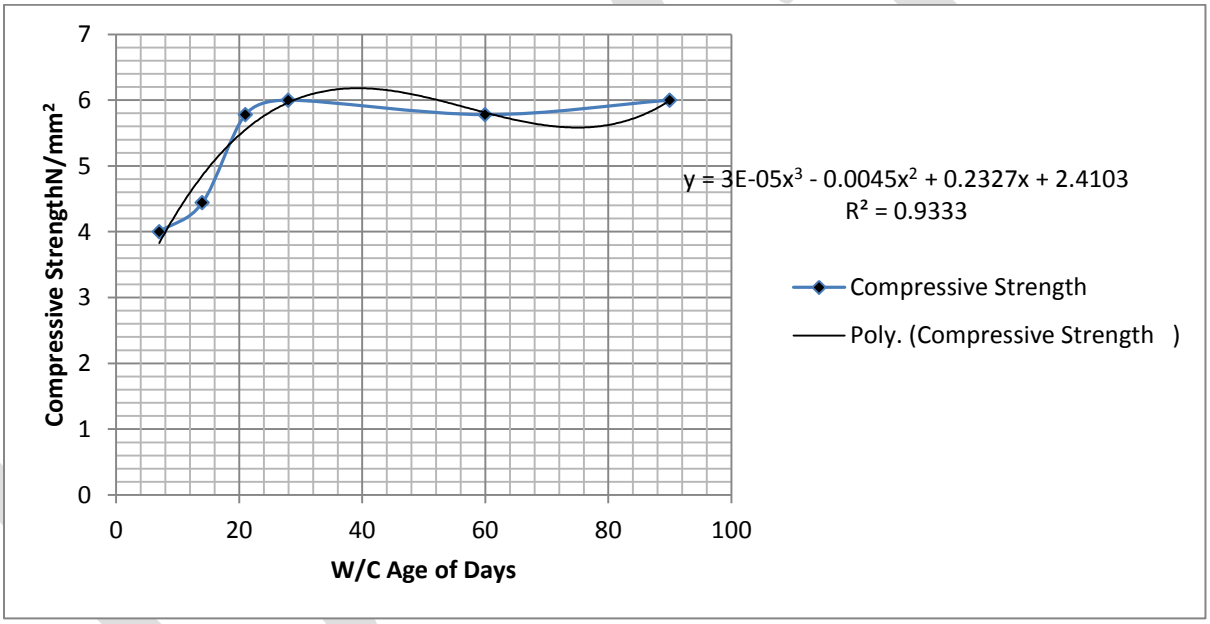

Figure: 12 compressive strength of unwashed Mix at [0.90] at Different Curing Days

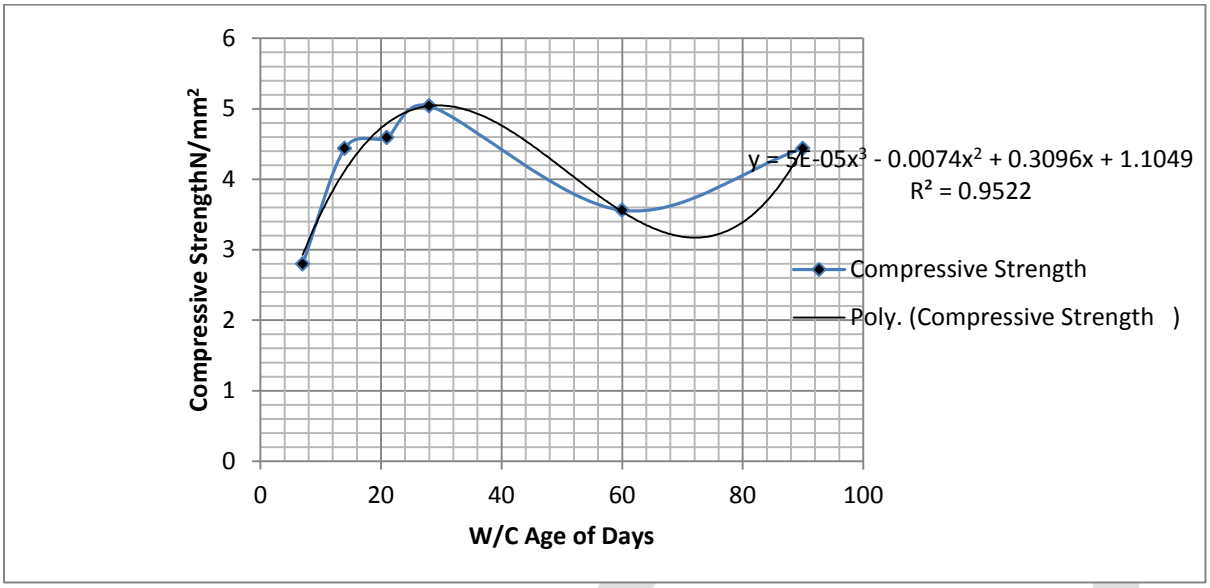

Figure: 13 compressive strength of unwashed Mix at [0.95] at Different Curing Days

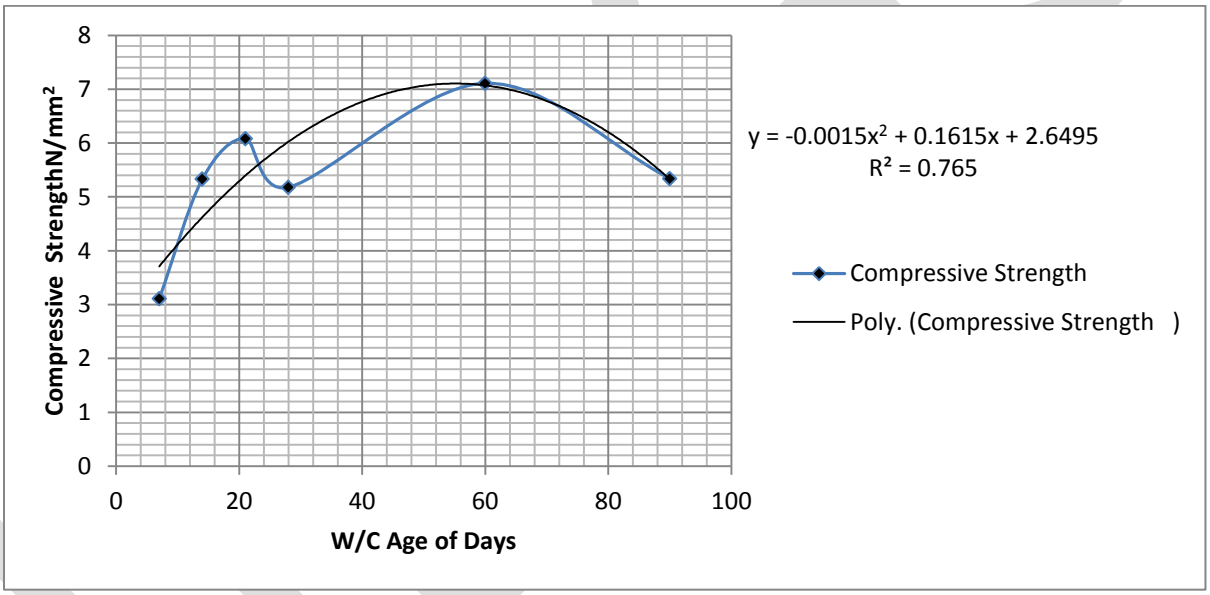

Figure: 14 compressive strength of unwashed Mix at [1.00] at Different Curing Days

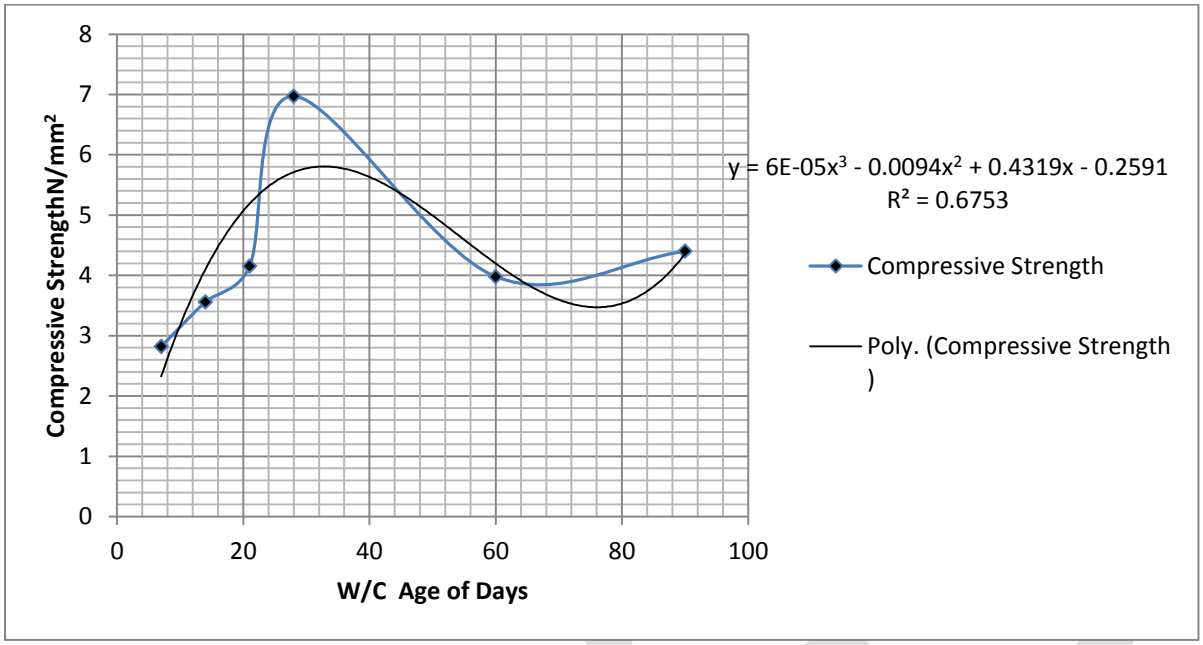

Figure: 15 compressive strength of unwashed Mix at [1.05] at Different Curing Days

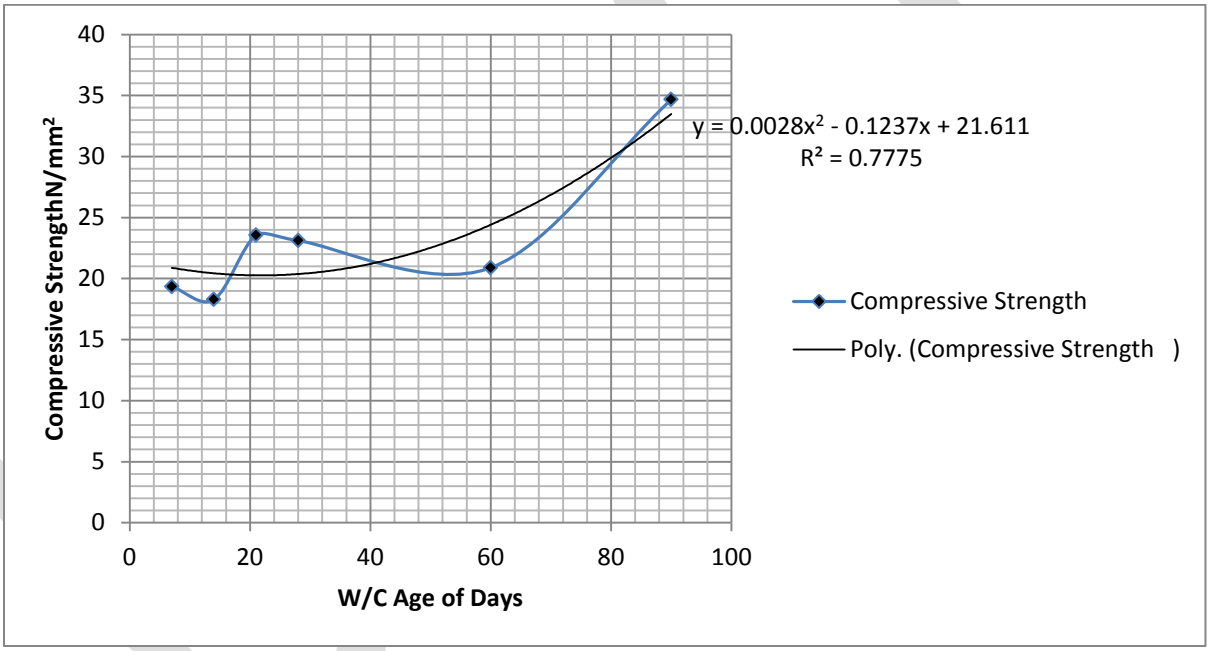

Figure: 16 compressive strength of unwashed Mix at [1.10] at Different Curing Days

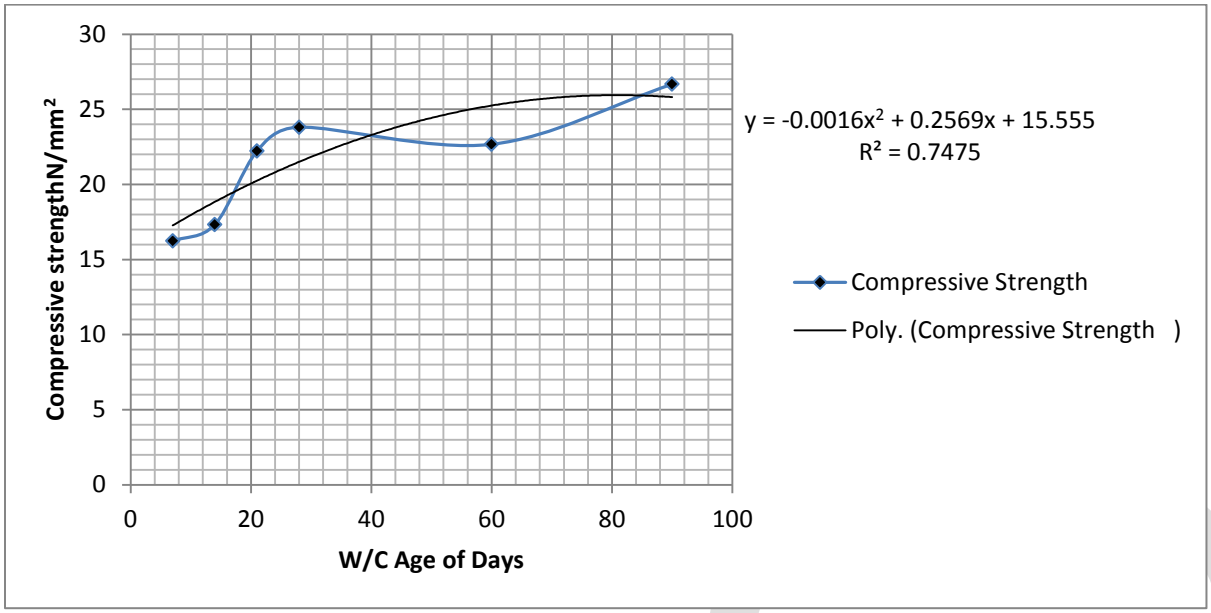

Figure: 17 compressive strength of washed Mix at [0.0.35] at Different Curing Days

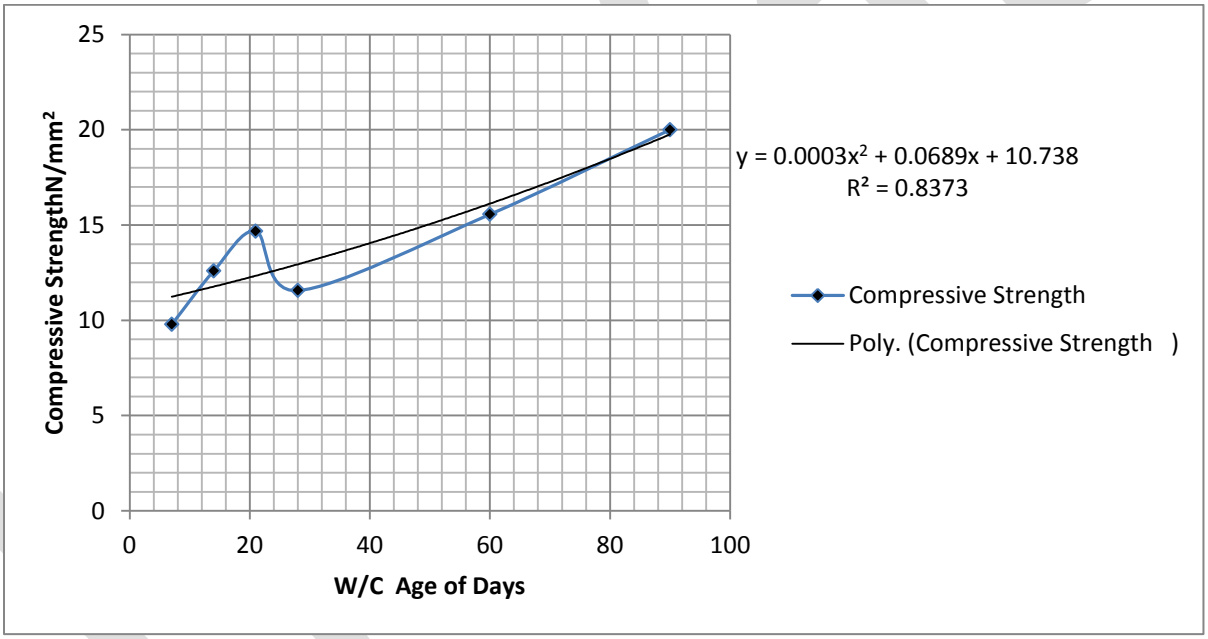

Figure: 18 compressive strength of washed Mix at [0.50] at Different Curing Days

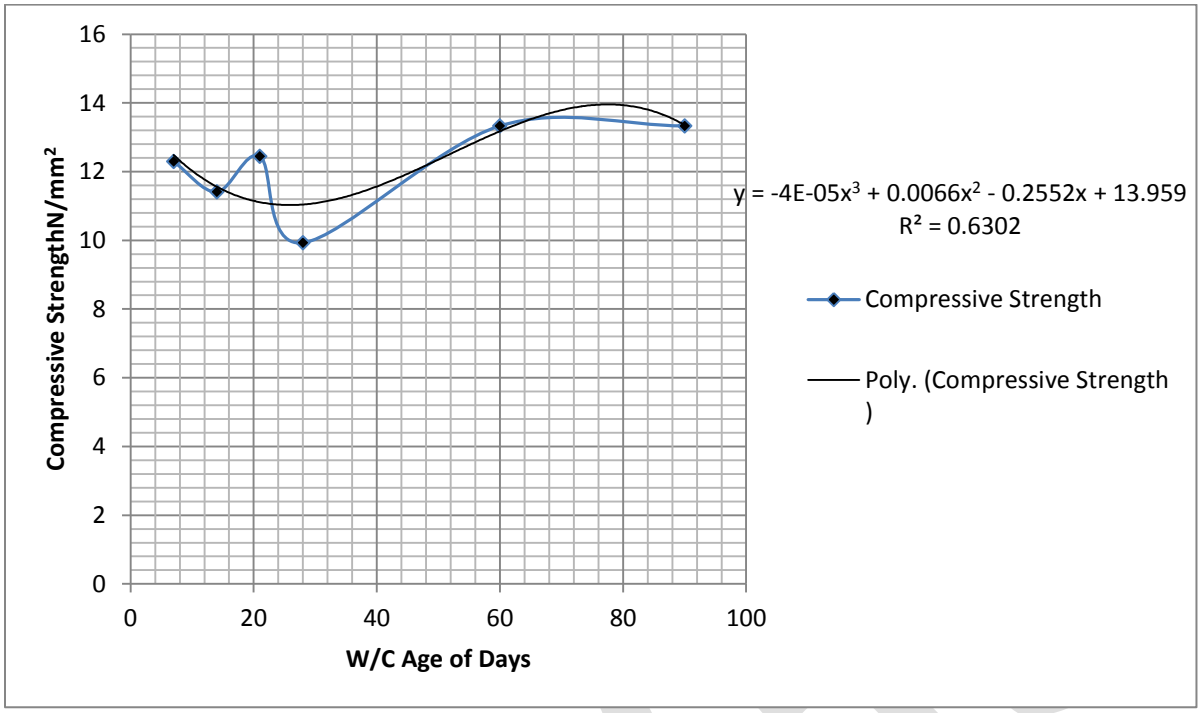

Figure: 19 compressive strength of washed Mix at [0.55] at Different Curing Days

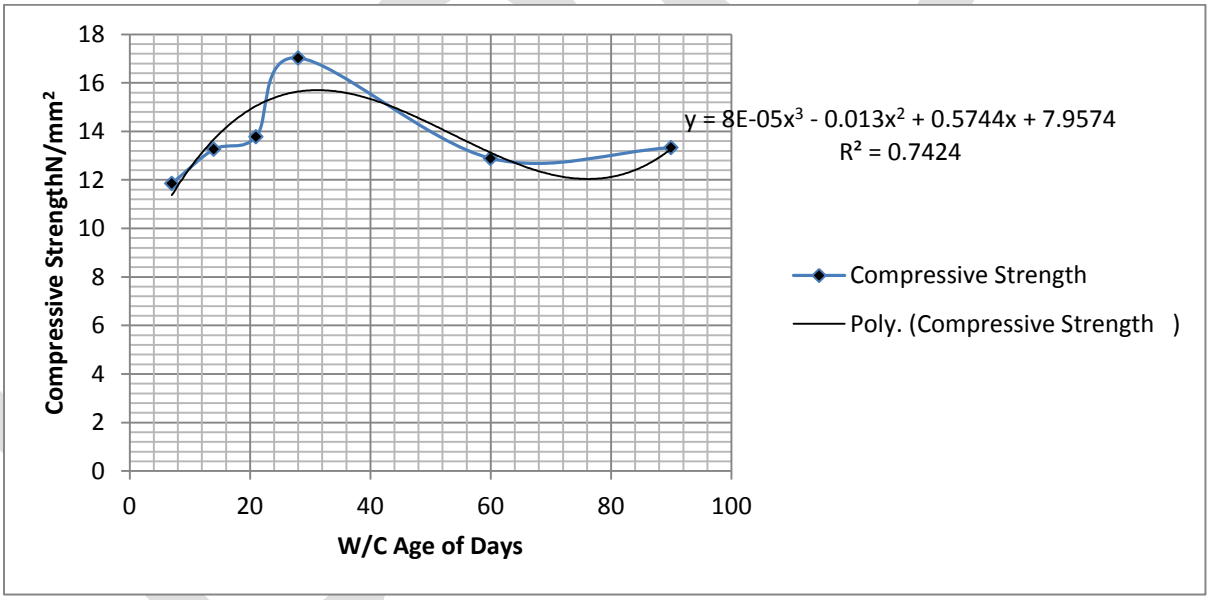

Figure: 20 compressive strength of washed Mix at [0.60] at Different Curing Days

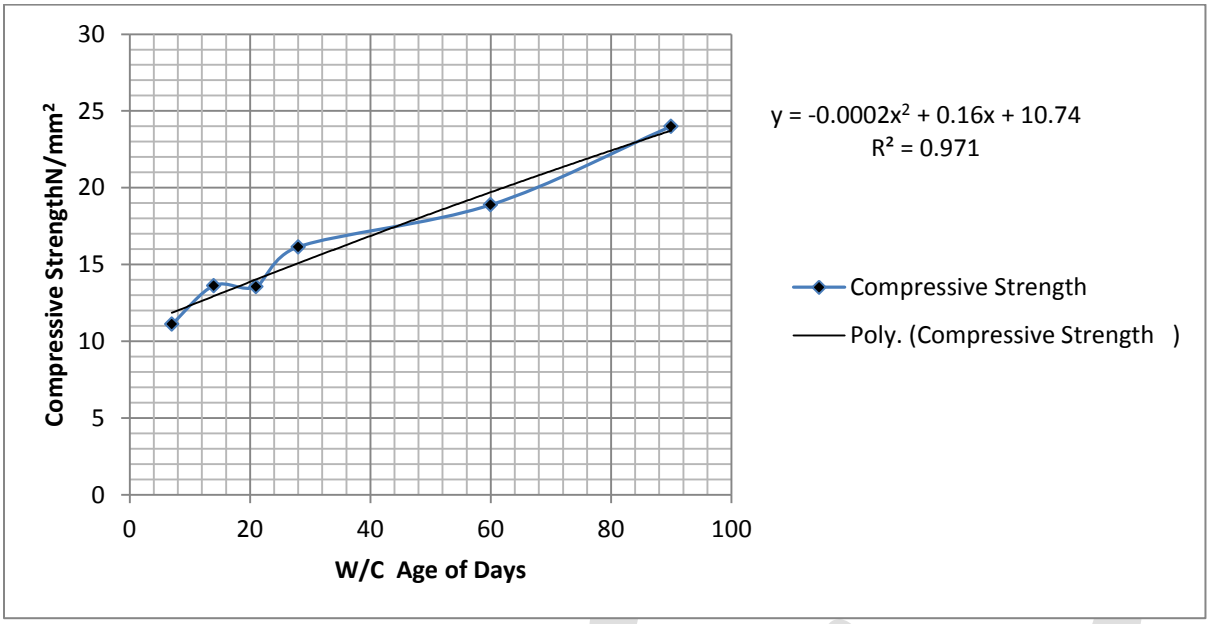

Figure: 21 compressive strength of washed Mix at [0.65] at Different Curing Days

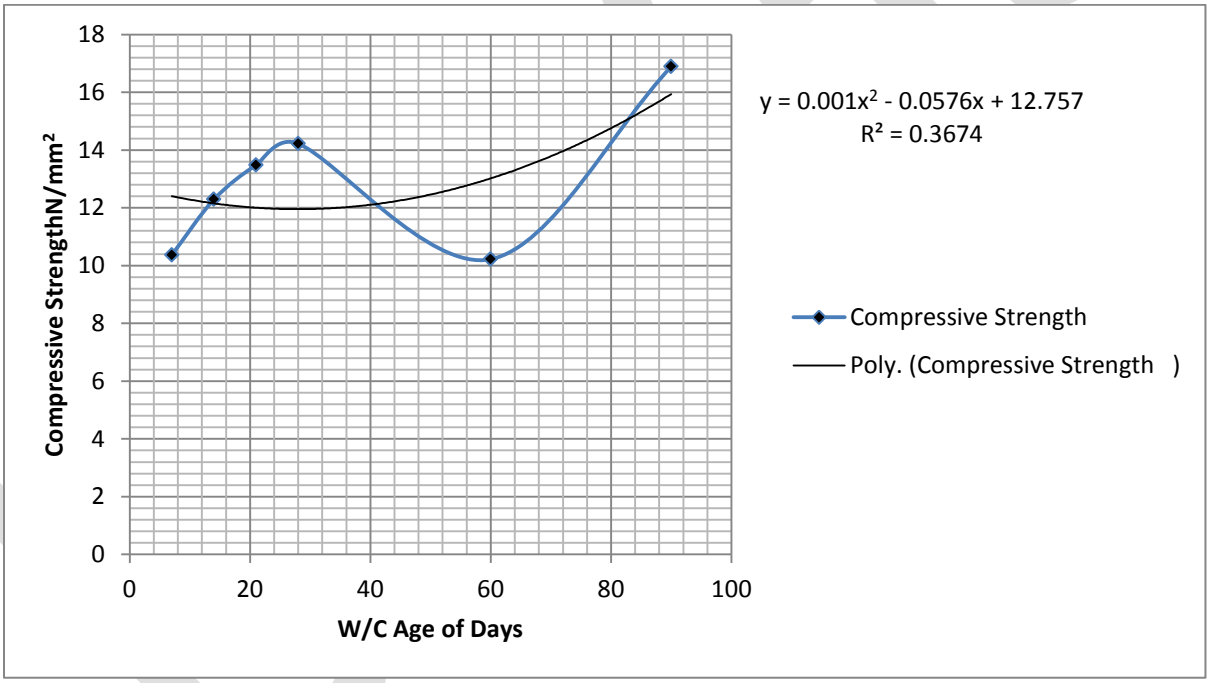

Figure: 22 compressive strength of washed Mix at [0.70] at Different Curing Days

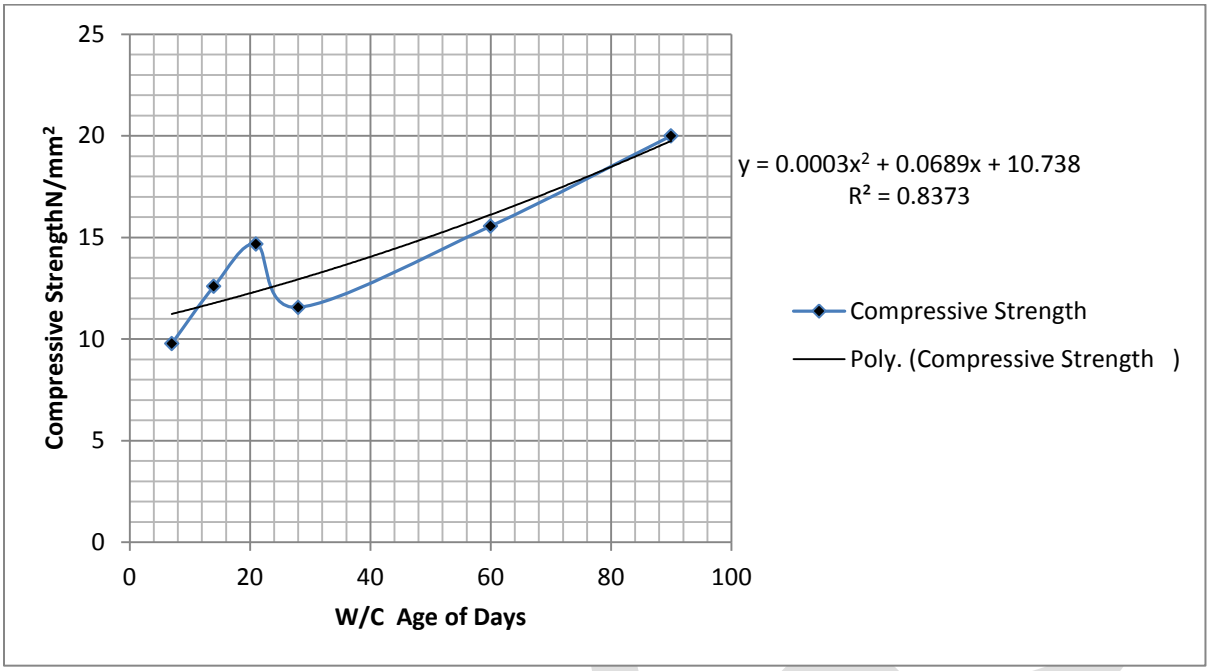

Figure: 23 compressive strength of washed Mix at [0.75] at Different Curing Days

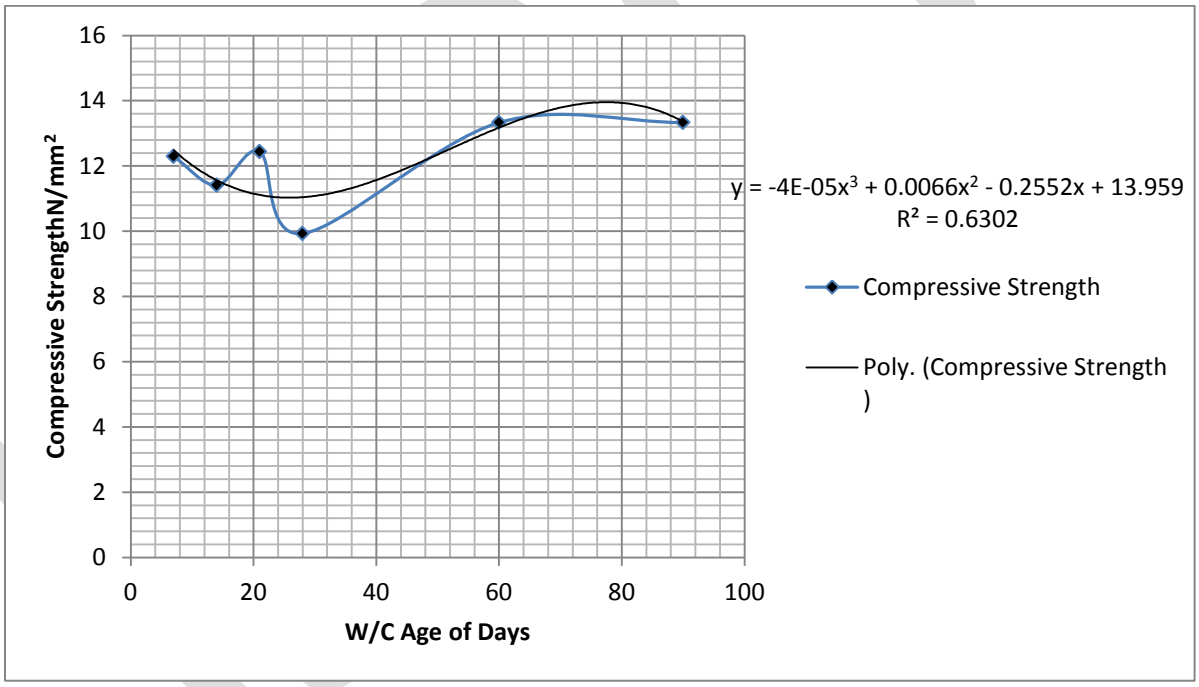

Figure: 24 compressive strength of washed Mix at [0.80] at Different Curing Days

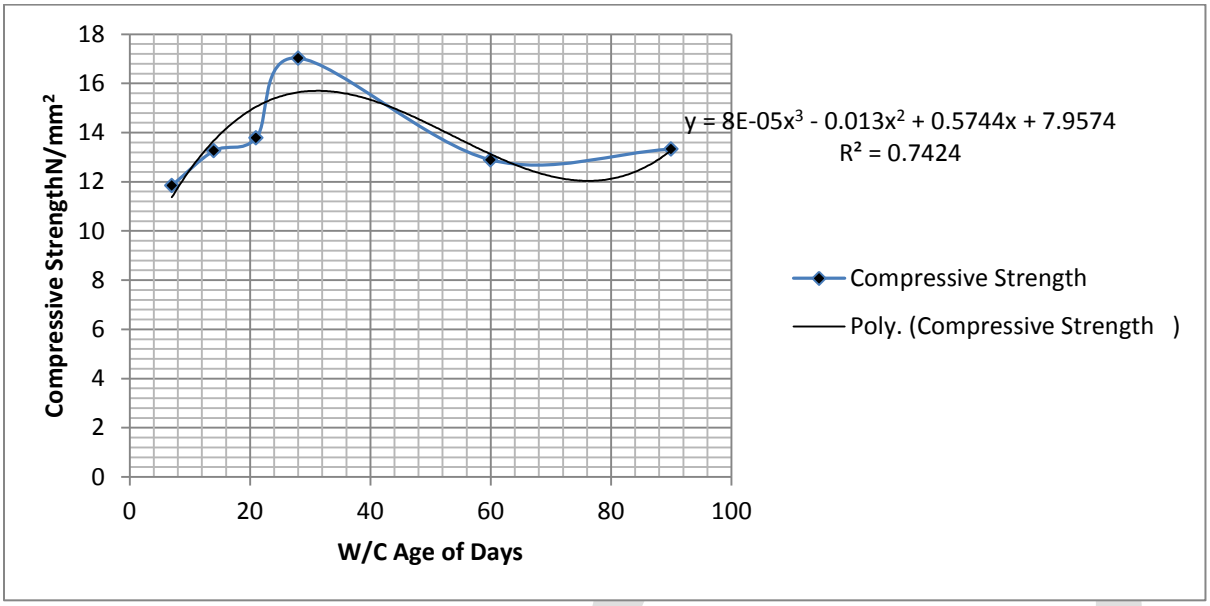

Figure: 25 compressive strength of washed Mix at [0.85] at Different Curing Days

The study express the compression rate of concrete made from unwashed and washed locally 3/8 gravel at different mix ratio, these graphical representation has definitely shows various ways that compression strength are attained in different curing age. Figure one express the compressive strength in gradual process at seven days thus maintained linear state within fourteen and twenty one days, sudden increase were observed at the maximum rate of twenty eight curing days, thus decrease down to the lowest at ninety days. Figure two express fluctuation with gradual increase to the maximum compressive strength at twenty eight days thus declined between sixty and ninety curing days. Figure three express oscillations similar to previous figures, the maximum values at twenty eight days and suddenly decrease down with slight increase at ninety days. Figure four express slight increases within seven and fourteen and suddenly increase to the optimum values at twenty eight days. Thus experiences gradual decrease with fluctuation between sixty and ninety days. figure five express slight vacillation and gradually increase to the maximum values at sixty days, sudden decrease were observe to the lowest at ninety days, figure six in similar condition were observed where slight vacillation were experienced, the maximum values recorded at sixty day with slight decrease at ninety days. Figure seven observed rapid increase to the optimum values recorded at twenty one days fluctuation were experiences to the lowest point recorded at ninety curing days. Figure eight experienced gradual increase with slight fluctuation to the maximum values at ninety days. Figure nine maintained similar condition as gradual increase were also observed with linear increase to the optimum values recoded at ninety curing age. Figure ten experienced fluctuation between seven and twenty eight days thus the optimum values were recorded, suddenly declined down with an increase at ninety days. Figure eleven developed fluctuation within seven and twenty one days thus increase gradually to the optimum point developing slight decrease at ninety day. Figure twelve rapidly increase with slight fluctuation to the optimum values recorded at ninety days. Figure thirteen express fluctuations between seven and twenty days that recorded the optimum values thus experienced decrease with slight increase at ninety curing days. Figure fourteen maintained vacillation between seven and twenty eight days thus observed gradual increase to the maximum values recorded at sixty days with slight decrease at ninety days. Figure fifteen observed gradual increase to the maximum values at twenty eight day, sudden decrease were observed with slight increase at ninety days. Figure sixteen observed fluctuations between seven and twenty eight days and suddenly increase to the optimum values recorded at ninety days. Figure seventeen express vacillation to the point where the maximum values were recorded at ninety days. Figure eighteen maintained similar conditions with fluctuation like the previous, the presented figure observed increase on the trend down to the maximum values recorded at ninety curing days. Figure ninety days developed oscillations between seven to the optimum values at sixty days with slight declined at ninety days. Figure twenty generated serious fluctuation, the optimum values recoded at twenty eight days thus experienced rapid declined between sixty and ninety day. Figure twenty one maintained vacillation between seven and twenty eight days, thus express linear increase to the maximum values at ninety days. Figure twenty two, gradually increase between seven and twenty eight thus developed sudden decrease at sixty days with rapid increase to the optimum values at ninety days. Figure twenty three express gradual increase with slight decrease thus developed exponential phase to the maximum point at

ninety curing age. Figure twenty four generated fluctuation between seven twenty eight were the highest values were recorded thus finally developed slight decrease at ninety days. Figure twenty five developed slight fluctuation from seven to the maximum point at twenty eight days, thus experienced sudden decrease with sixty days with slight increase at ninety days.

4. Conclusion

The compressive strength of locally 3/8 gravel has been express through experimental techniques, these values has shows various curing age, these result were subjected to thorough calibration that has generated different model equations at different mix ratios, the study were able to express the variations of compressive strength as a result of different application of water cement ratios, the locally occurring 3/8 gravel were characterized were the gravel was separated washed and unwashed samples, the result were generated base on these two conditions, graphical representation of these values expressed the variations of compression from different mixed ratios, it was observed that compressive strength are attained base on the rate of impurities in the deposited unwashed locally 3/8 gravel, the water cement ratios applied express lower compression results, these condition generated some compressive results that may not developed good concrete performance, the calibration from the experimental result has definitely generates model equations that will developed predictive values.

The gravel in its naturally occurring form contains some impurities that affect some of the cubes which result to drop in strength. Concrete attain his 95% -97% strength at 28 days. The long time strength is only 0% as such the impurities are responsible for drop. In the study of gravel strength development is not much compared to other forms of aggregate, this form the bases for drop in strength especially when wet carry beyond twenty eight days, it is recommended that air curing should be adopted after twenty eight days because of porosity of materials.

Smooth River gravel produces weaker concrete, while small size of coarse aggregate produces highest strength concrete attaining its high specific surface area. Iravani (1996) works also affirmed this with regards to wet curing and strength development of aggregate types.

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