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# DEVELOPMENT OF COMPRESSIVE STRENGTH PREDICTIVE MODELS OF SELF-COMPACTING CONCRETE CURED USING DIFFERENT CURING METHODS

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## ABSTRACT

Curing is the process of controlling the rate and extent of moisture loss, relative humidity and temperature from newly poured concrete for a certain period of time after it has been cast or finished to ensure that the cement has been properly hydrated and the concrete has hardened. The concrete strength, durability and other physical properties are affected by curing and application of the various types as it relates to the prevailing weather conditions in a particular locality, as curing is one of many requirements for concrete production, as such it is important to study the effect of different curing method. The concrete cube specimens produced with cement, fine aggregate, and coarse aggregate mix-ratio of 1:2.23:1.62 were prepared with a water-cement ratio of 0.5 and superplasticizer (SP) dosages of 0.5%, 1.0%, and 1.5%. The SP dosages were computed as percentages by weight of the cement content. The cubes were tested for compressive strength after curing for 7, 14, 21, 28, and 56 days using three curing methods namely; Immersion, open air, and wet burlap curing methods. This study assessed the effect of different curing methods on compressive strength of self-compacting concrete through the development of a mathematical method to model and analyze the effect of the curing methods used on the compressive strength of the SCC and also to validate the reliability of the method used. Data Fit software was used in the model development, the curing age and super-plasticizer dosage were used as independent variables while the compressive strength was used as the dependent variable. The air-dry curing method has the highest $R^2$ value of 94%, while the immersion curing method and wet burlap have only a 1% difference between their $R^2$ values. Additionally, the model's p-values are approximately 0.000, 0.04912, and 0.000 for immersion, wet burlap, and air dry, respectively, below 0.05 significance level. It was further observed that, the model's validation was carried out using the difference between the predicted (0.89) and Adj$R^2$ (0.86), (0.88) and Adj$R^2$ (0.82), (0.94) and Adj$R^2$ (0.92) values for immersion curing, wet burlap curing, air-dry curing methods respectively are less than 0.2. Based on the findings, having $R^2$ values greater than 80% signifies a strong interaction between the variables, also, the models established for various curing methods are enough for predicting the compressive strengths of SCC therefore, the predictive models of SCC can be used under the given conditions.

**Keywords**: Self-compacting concrete, Curing Methods, DataFit, Model

## INTRODUCTION

Curing in concrete refers to the method of managing the rate of moisture loss from concrete during the time of cement hydration. In other words, it may also be described as the task of governing the relative humidity and temperature of newly poured concrete for a certain amount of time after it has been cast or finished to ensure that the cement has been properly hydrated and the concrete has hardened (Karim *et al.,* 2020). The concrete strength is affected by the curing method and application of the various types as it relates to the moisture availability in a particular locality, as it is among the requirements for concrete production, it is important to study the effect of different curing methods (James *et al*., 2011).

The strength development on curing depends on the following criteria; the type of cement, mix proportions, strength, size of member, ambient weather, future exposure, and method of curing. Since all prudent parameters are improved with curing, the period of curing should be as long as realistic (Shaikh *et al*., 2017).

The evolution in technology has led to the innovation of new types of concrete with distinct uses as the construction of mega structures all over the world continued to improve; Self-compacting concrete (SCC) is among the excellent evolutions in the construction industry, which is a fluid mixture of aggregate that is fine aggregate, coarse aggregate, and binder, suitable for placing in structures with crowded reinforcement without the introduction of vibration machine. Quite a several sites have problems with congestion of reinforcement in the principal structural members. This was an important driving force behind the development of self-compacting concrete (Rajasekaran *et al*., 2017).

This problem coupled with difficulty in predicting concrete strength models of cured in-situ cast structural members motivates the research.

In recent technology emanating from civil engineering, evolution in computer programming persists with a good influence on modelling and data interpretation. New expertise and algorithms are emanating in model developments that warrant civil engineers computing in various forms to simplify data interpretation (Tufail *et al*., 2023). Data obtained from the laboratory are used on the statistical instrument for data analysis and it aims to model and simplify mathematical data for easier assimilation for systems design. The software used, DataFit used many input engineering data for predicting various output variable data.

According to Sunday (2022), the tools included in the model prediction include; adjusted [$R^2$(adj)], predicted [$R^2$(pred)], coefficient of determination squared ($R^2$), prediction error sum of squares (PRESS), standard deviation (σ), and factors', terms' and model's p-values. Thus, the selection of the best and adequate model was based on the model characterized by the highest percentage of $R^2$(adj) and $R^2$(pred) in combination with the lowest PRESS, the standard deviation of error and the hypothetical model's p-value for the lack-of-fit tests. He further stated that, in the selection of the statistically adequate compressive strength (CS) model the hypothetical model's p-value for the lack-of-fit tests at the significance level of α= 0.05 must be greater than 0.05. Hypothetically, this reads: “Reject the CS model, if $H_0$: the model’s lack-of-fit p-value < 0.05 and accept the CS model if $H_1$: the model’s lack-of-fit p-value > 0.05”. On the other hand, the statistical relevancy of each of the model’s predictors, and terms was tested; also, at the significance level, α = 0.05. Similarly, this reads: “Reject the model’s predictor or term if $H_0$: term’s p-value > 0.05 and accept the CS model’s predictor or term if $H_1$: term’s p-value < 0.05”. Based on these hypothetical criteria, the model can be selected based on observations with 95% statistical confidence, and at a statistical significance level (α) of 5%.

When Kumator *et al.,* (2023) modelled the permeation of SCC made with *Sporosarcina pasteurii*, the points of fit for the normal probability lie close to the diagonal line, the author then concluded that the model is satisfactory for efficient prediction of the water absorption. He further stated that a curved U-shaped pattern means the model under consideration was not appropriate and another one might fit better.

This study assessed the effect of different curing methods on compressive strength of self-compacting concrete through the development of a mathematical method to model and analyze the effect of the curing methods used on the compressive strength of the SCC and also to validate the reliability of the method used.

## MATERIALS AND METHODS

### Materials

Ordinary Portland cement of 42.5N grade manufactured by Dangote Cement Plc and obtained from Samaru market Zaria was used as a binder material, the coarse aggregate used was obtained from Abdu-Kwari quarry site opposite the Nigerian College of Aviation Technology, Zaria, the aggregate is of 20mm nominal size. The fine aggregate was river sand obtained from a village behind Ahmadu Bello University Teaching Hospital Shika, Zaria. A poly-carboxylic ether-based Super-plasticizer (SP) named Conplast SP430 was used, the SP is a good component of SCC necessary for workability, it was obtained from a scientific supplier in Zaria, Kaduna State Nigeria. Portable water obtained at the Department of Civil Engineering, A.B.U Zaria was used for mixing and curing the concrete.

### Methods

The models were generated from the set of data obtained from the laboratory experimental tests using DataFit 9.0 software, to predict the strengths of SCC. In generating the models, the influence of curing age and super-plasticizer dosages were considered independent variables. The software develops numerous model equations.

### *Model Development*

Data fit software which is a mathematical model development software was used in the research for the development of a model of compressive strength of the different curing methods considered in the research the software is version 9.0, 2008.

### *Mix Design Procedure*

In this model development, two factors were considered, the percentage of super-plasticizer dosage and curing age of self-compacting concrete for each curing method (immersion, wet burlap, and Air dry), for each mix, the concrete was cured for five (5) curing age (7, 14, 21, 28, and 56 days).

$$N = nr \quad (1)$$

Based on the design variables twenty sets of experimental data were generated based on Equation 1.

where N is the required experimental points, n is the number of levels for the first factor (curing age(c)) and r is the number of levels for the second factor (SP dosage(s)), hence the required number of experimental points is N=20. The performance of the different factors was assessed independently using the runs randomly ordered by DataFit software (Version 9, 2009).

**Table 1: Laboratory data used for model development**

| Immersion | | | Wet burlap | | | Air dry | | |
|---|---|---|---|---|---|---|---|---|
| $F_c$ | C | S | $F_c$ | C | S | $F_c$ | C | S |
| 22.7 | 7 | 0 | 18.2 | 7 | 0 | 14 | 7 | 0 |
| 25.3 | 14 | 0 | 24 | 14 | 0 | 18.4 | 14 | 0 |
| 29.5 | 21 | 0 | 24.2 | 21 | 0 | 19.4 | 21 | 0 |
| 32.5 | 28 | 0 | 26 | 28 | 0 | 21 | 28 | 0 |
| 32.7 | 56 | 0 | 27 | 56 | 0 | 20.5 | 56 | 0 |
| 16 | 7 | 0.5 | 14.1 | 7 | 0.5 | 13.9 | 7 | 0.5 |
| 28.5 | 14 | 0.5 | 24.3 | 14 | 0.5 | 18.9 | 14 | 0.5 |
| 32 | 21 | 0.5 | 24.4 | 21 | 0.5 | 19.7 | 21 | 0.5 |
| 32.3 | 28 | 0.5 | 28.5 | 28 | 0.5 | 21.5 | 28 | 0.5 |
| 32.5 | 56 | 0.5 | 29.3 | 56 | 0.5 | 22 | 56 | 0.5 |
| 24.8 | 7 | 1 | 22.5 | 7 | 1 | 14.3 | 7 | 1 |
| 29.4 | 14 | 1 | 24.4 | 14 | 1 | 18.2 | 14 | 1 |
| 34.8 | 21 | 1 | 25.5 | 21 | 1 | 19.2 | 21 | 1 |
| 34.9 | 28 | 1 | 28.5 | 28 | 1 | 21.3 | 28 | 1 |
| 35.1 | 56 | 1 | 30.3 | 56 | 1 | 23.2 | 56 | 1 |
| 18.3 | 7 | 1.5 | 18.5 | 7 | 1.5 | 7 | 7 | 1.5 |
| 29.3 | 14 | 1.5 | 23.2 | 14 | 1.5 | 13 | 14 | 1.5 |
| 31.3 | 21 | 1.5 | 24.8 | 21 | 1.5 | 14 | 21 | 1.5 |
| 34.4 | 28 | 1.5 | 28.5 | 28 | 1.5 | 18 | 28 | 1.5 |
| 34.8 | 56 | 1.5 | 29 | 56 | 1.5 | 23.1 | 56 | 1.5 |

**Experimental Validation**

A mix ratio of 1:2.23:1.62 was cast in the laboratory to check the validity of the models developed in the research. 100×100×100 cubes were cast in the laboratory environment and subjected to 28 days of age curing. The cubes were crushed to obtain the 28-day compressive strength. The predicted compressive strength was obtained by substituting the independent variables curing age (c) and superplasticizer dosage (s) for 28 days age and obtained the compressive strength (Fc) as obtained from equations are immersion, wet burlap and air-dry of curing respectively the computed values are shown in table 8. The percentage error was also computed using equation (2).

$$Error(\%) = \frac{\mathrm{F(actual)-F(predicted)}}{\mathrm{F(actual)}} * 100\% \quad (2)$$

***Theoretical Validation***

The models were validated using the parameters obtained from the Datafit software, these are coefficient of correlation (R) square and adjusted R square values.

**RESULTS AND DISCUSSIONS**

**Compressive Strength Predictive Model for the Immersion Method of SCC Concrete**

The model generated for this curing method was displayed in equation (3), it is used to predict the effect of the percentage of SP dosage and curing age on the compressive strength of SCC cured by immersion method.

$$F_c = 1.106c - 12.093s + 26.7s^2 - 12.72s^3 + 13.127 \quad (3)$$

And ($R^2$ = 0.89 and Adj$R^2$ = 0.86)

In the model developed the symbols c and s are the independent variables donating the curing age and superplasticizer (SP) dosage respectively and Fc are the dependent variable; donating the compressive strength of cured SCC. The model developed by the software can be used to estimate and analyze the effect of the response variables (compressive strength, curing age, and SP dosage).

The test of significance and goodness of fit of strengths of the SCC concrete model was carried out using the P value to assess if the gradient in the model was equivalent to zero as developed in the zero hypotheses.

The null hypothesis states that the curing age and SP dosage of samples do not influence the strength of concrete. At a 5% level of significance, the value of P is equal to 0.000 for curing and SP dosage. Therefore, the zero hypotheses (HO) declined in both cases since the P-value (0.000) is extremely low and this indicated that all variables are majorly significant ($P < 0.05$) highlighting that the difference in the strengths of concrete was influenced by the percentage of SP dosage and curing age of the concrete. The validation of the strengths of the SCC concrete model was carried out by looking into the coefficient of determination. The coefficient of determination ($R^2$) is 89 %, this proves the variation of concrete compressive strength is extremely dependent on the variations of SP dosage and curing age of the concrete as their $R^2$ value of 1 (unity) implied a perfectly fitted model, while a lower $R^2$ value implied a poorly fitted mode, where only less than 11% of the experimental data could not be explained by the model. This inferred that the models are good for prediction as also stated by (Busic *et al.,* 2020; Murad *et al*., 2020; Haruna *et al*., 2020 and Sunday 2022).

**Table 2: Results of regression variables**

| Variable | Value | Standard Error | t-ratio | Prob(t) |
|---|---|---|---|---|
| C | 13.12655 | 1.806296 | 7.267109 | 0 |
| S | 1.106347 | 0.128374 | 8.618165 | 0 |

**Table 3: Results of variance analysis**

| Source | DF | Sum of Squares | Mean Square | F Ratio | Prob(F) |
|---|---|---|---|---|---|
| Regression | 5 | 522.2578 | 104.4516 | 24.92382 | 0 |
| Error | 14 | 58.67165 | 4.190832 | | |

Figure 1, shows the 3D plots of the compressive strength model it can be deduced that the compressive strength increased with an increase in curing age. This increase was attributed to the continuous hydration process in which the samples stayed long in water, resulting in better bonding between the matrix of the aggregate particles and hence increased strength. The introduction of SP dosage in the mix improved the strengths of mixes. There is a slight rise in the strength of SCC as the SP dosage percentage increases. This can be a result of the interaction of polycarboxylic ether-based super-plasticizer with free lime to make extra CSH and CAH, hence decreasing the amount of $Ca(OH)_2$ present, this was in agreement with (Okorie *et al*., 2022; Nada and Amar 2018).

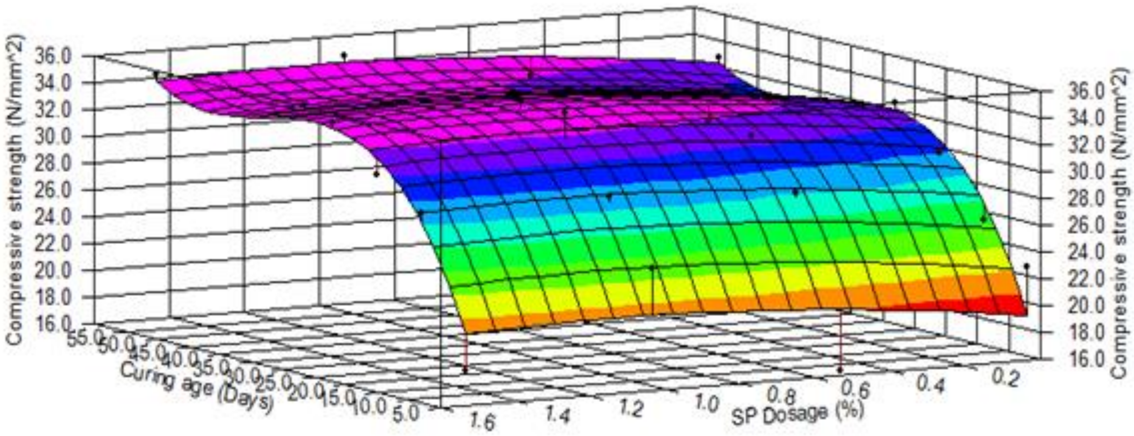


Figure 1: 3D plot for compressive strength model for SCC

The model was also validated by plotting the predicted plots against the actual. From the plots presented in Figure 2, the point was all aligned along a straight line which assumed the normal probability distribution. Hence, the developed models can sufficiently predict the compressive strength of the SCC under curing age and SP dosage percentage as the variables with a high degree of accuracy according to (Mohammed *et al*., 2021, Kumator *et al*.,2023 and Haruna *et al.,* 2020).

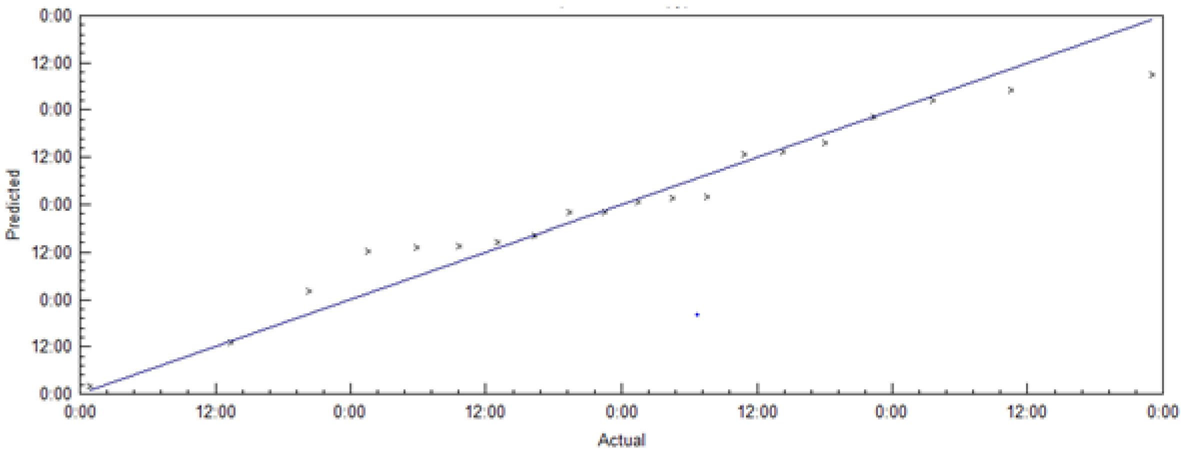


Figure 2: Predicted plot against Actual compressive strength of SCC

**Compressive strength Predictive Model for the Wet burlap Method of SCC Concrete**

The model generated in equation (4) was used to predict the effect of the percentage of SP dosage and curing age on the compressive strength of SCC cured by the wet burlap method.

$$F_c = 1.088c - 2.464c^2 + 1.887c^3 - 5.027s + 14.639s^2 - 7.253s^3.239 \quad (4)$$

And ($R^2$ = 0.88 and Adj$R^2$ = 0.82)

The model generated in equation (4) was used to predict the effect of the percentage of SP dosage and curing age on the compressive strength of SCC cured by the wet burlap method. The test of significance and goodness of fit of strengths of the SCC concrete model was carried out using the P value to assess if the gradients in statistical regression models are equivalent to zero as developed in the zero hypotheses.

The null hypothesis states that the curing age and SP dosage of samples do not influence the strength of concrete. At a 95% level of significance, the P-value is equal to 0.00442 for curing and 0.04912 for SP dosage as shown in Table 4. Therefore, the zero hypotheses ($H_O$) declined in both cases since the P-value is extremely lower than the threshold value and this indicated that the variables are significant ($P < 0.05$) highlighting that the difference in the strengths of concrete is because of SP dosage and curing age interference. The validation of the strengths of the SCC concrete model was carried out by looking into the coefficient of determination. The coefficients of determination (R2) are 88 %, this proves the variation of concrete compressive strength is extremely dependent on the variations of SP dosage and curing age. This was also confirmed by Mohammed *et al*., (2021) and Sunday (2022) that the models are adequate for prediction.

**Table 4: Results of regression variables**

| Variable | Value | Standard Error | t-ratio | Prob(t) |
|---|---|---|---|---|
| C | 11.2392 | 3.2701 | 3.43697 | 0.00442 |
| S | 1.08797 | 0.50858 | 2.13923 | 0.04912 |

**Table 5: Results of Variance Analysis**

| Source | DF | Sum of Squares | Mean Square | F Ratio | Prob(F) |
|---|---|---|---|---|---|
| Regression | 6 | 282.648 | 47.108 | 15.1361 | 3.00E-05 |
| Error | 13 | 40.4598 | 3.11229 | | |
| Total | 19 | 323.108 | | | |

Figure 3, shows the 3D plots of the compressive strength model it can be deduced that the compressive strength increased with an increase in curing age. This increase is attributed to the continuous hydration process in which the samples are allowed in a wet condition for a quite long period, they are always in a moist condition which results in better bonding between the matrix of the aggregate, hence increased strength. The introduction of SP dosage improved the strengths of the mixes, which was more effective at a higher SP dosage percentage. This can be a result of the interaction of polycarboxylic ether-based super-plasticizer with free lime to produce extra CSH and CAH, this was in agreement with (Okorie *et al.*, 2022; Nada and Amar 2018).

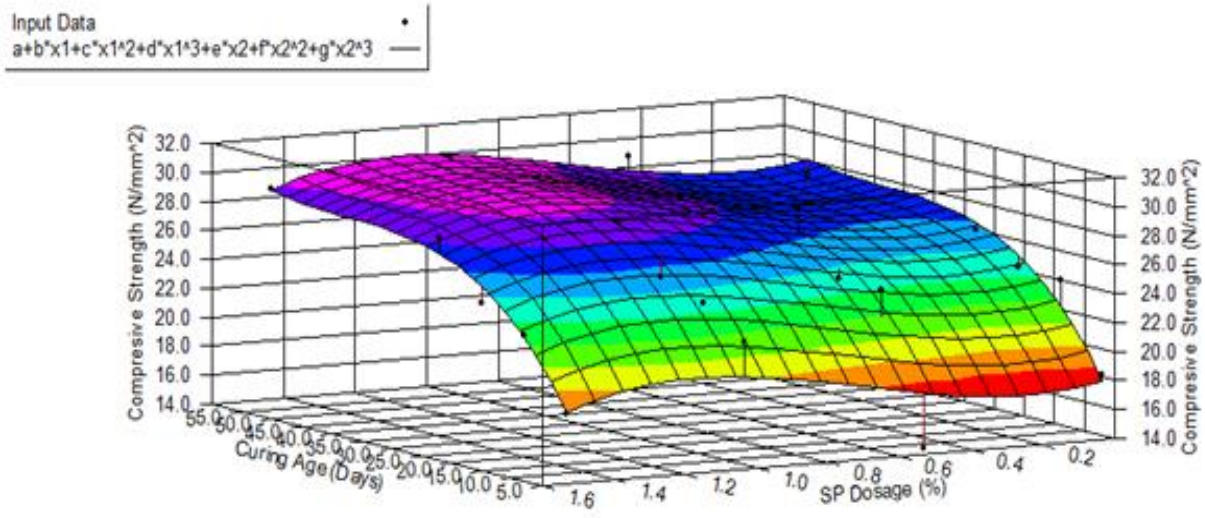


Figure 3: 3D plot for compressive strength model for SCC

The model was further validated graphically by plotting the predicted plots against the actual. From the plots shown in Figure 4, all of the models are in order of the normal probability distribution as all the data points were reasonably aligned across the linear trend line. Hence, the developed models can be used, under curing age and SP dosage percentage as the variables with a high degree of accuracy as also obtained by (Gao *et al*., 2016; Kumator *et al*., 2023).

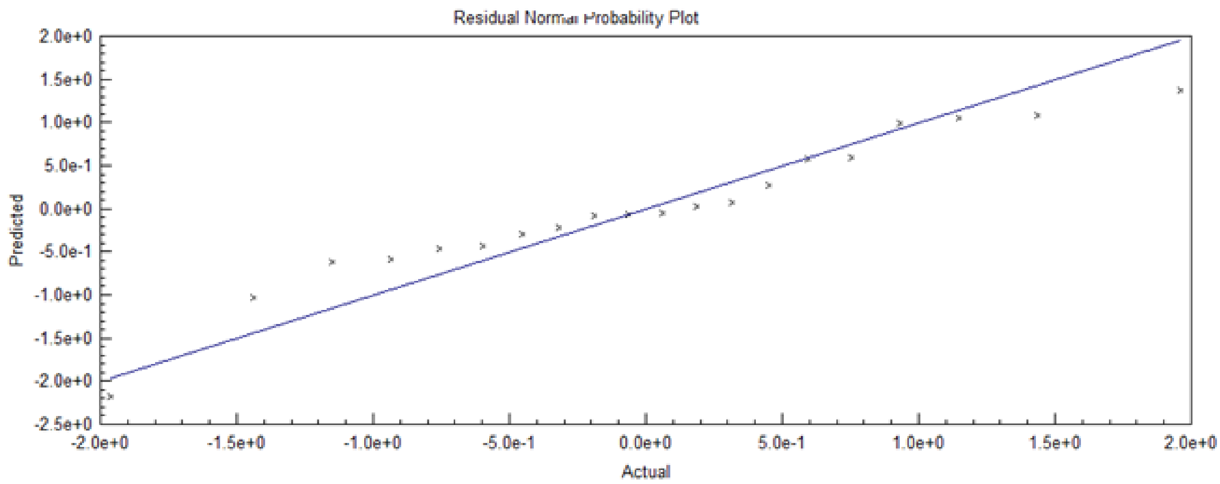


Figure 4: Predicted plot against Actual compressive strength of SCC

**Compressive Strength Predictive Model for the Air-Dry Method of SCC Concrete**

The model generated in equation (5) was used to predict the effect of the percentage of SP dosage and curing age on the compressive strength of SCC cured by air dry method.

$$F_c = 0.499c + 1.844s - 6.376c^2 - 4.76s^2 + 0.124cs + 11.754 \quad (5)$$

And ($R^2 = 0.94$ and Adj$R^2 = 0.92$)

In the model developed the symbols c and s are the independent variables donating the curing age and superplasticizer (SP) dosage respectively and Fc are the dependent variable; donating the compressive strength of cured SCC. The model developed by the software can be used to estimate and analyze the effect of the response variables (compressive strength, curing age, and SP dosage).

The test of significance and goodness of fit of strengths of the SCC concrete model was carried out using the P value to assess if the gradient in the statistical model was equivalent to zero as developed in the zero hypotheses.

The null hypothesis states that the curing age and SP dosage of samples do not influence the strength of concrete. At a 0.05 level of significance, the P-value is equal to 0.000 for curing and SP dosage. Therefore, the zero hypotheses ($H_O$) declined in both cases since the P-value is extremely low and this indicated that all variables are majorly significant ($P < 0.05$) highlighting that the difference in the strengths of concrete is because of SP dosage and curing age. The validation of the strengths of the SCC concrete model was carried out by looking into the coefficient of determination. The coefficients of determination ($R^2$) are 94 %, this proves the variation of concrete compressive strength is extremely dependent on the variations of SP dosage and curing age. This confirms that the model was adequate for prediction as confirmed by (Mohammed *et al*., 2021).

**Table 6: Regression Variable Results**

| Variable | Value | Standard Error | t-ratio | Prob(t) |
|---|---|---|---|---|
| C | 11.7541 | 1.097 | 10.7148 | 0 |
| S | 0.49964 | 7.27E-02 | 6.87728 | 0.00001 |

**Table 7: Variance Analysis**

| Source | DF | Sum of Squares | Mean Square | F Ratio | Prob(F) |
|---|---|---|---|---|---|
| Regression | 5 | 305.822 | 61.1644 | 49.213 | 0 |
| Error | 14 | 17.3999 | 1.24285 | | |
| Total | 19 | 323.222 | | | |

Figure 5, shows the 3D plots of the compressive strength model it can be deduced that the compressive strength slightly increased with an increase in curing age. This slight increase was attributed to the unavailability of moisture for the continued hydration process which the samples only use available atmospheric moisture for the cement hydration process. The addition of SP dosage improved the strengths of the mixes. This strength increment was more effective at a higher SP dosage percentage. This can be a result of the interaction of polycarboxylic ether-based super-plasticizer with free lime to produce extra CSH and CAH, this was in agreement with (Okorie *et al*., 2022; Nada and Amar 2018).

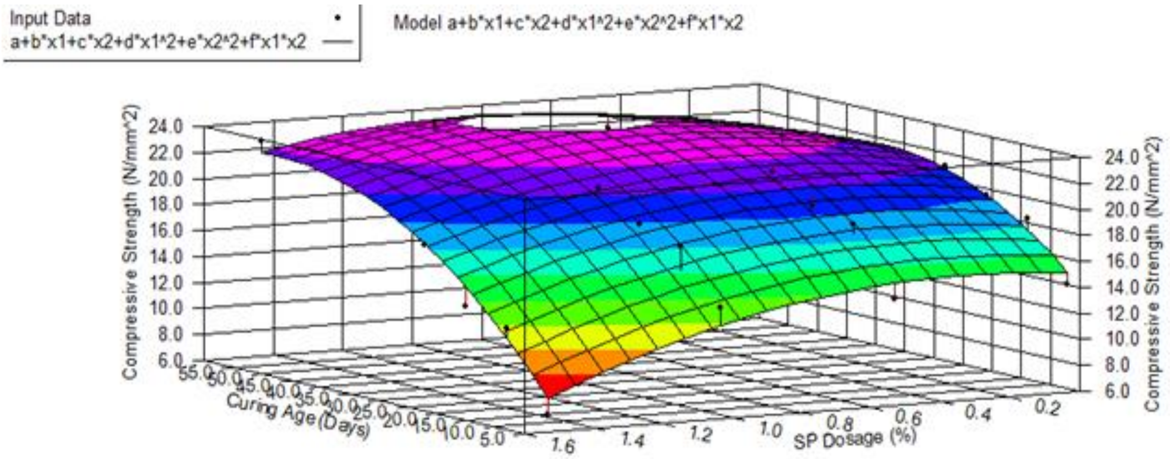


Figure 5: 3D plot for compressive strength model for SCC

The model was further validated through plotting the predicted plots against the actual. From the plots presented in Figure 6, it can be seen that all the points aligned close to the normal diagonal line. Similar to Kumator *et al*, (2023), this means that the model agrees with the experimental values and as such, with a high degree of accuracy, the model can be used to predict the compressive strength of the SCC with curing age and SP dosage as the independent variables.

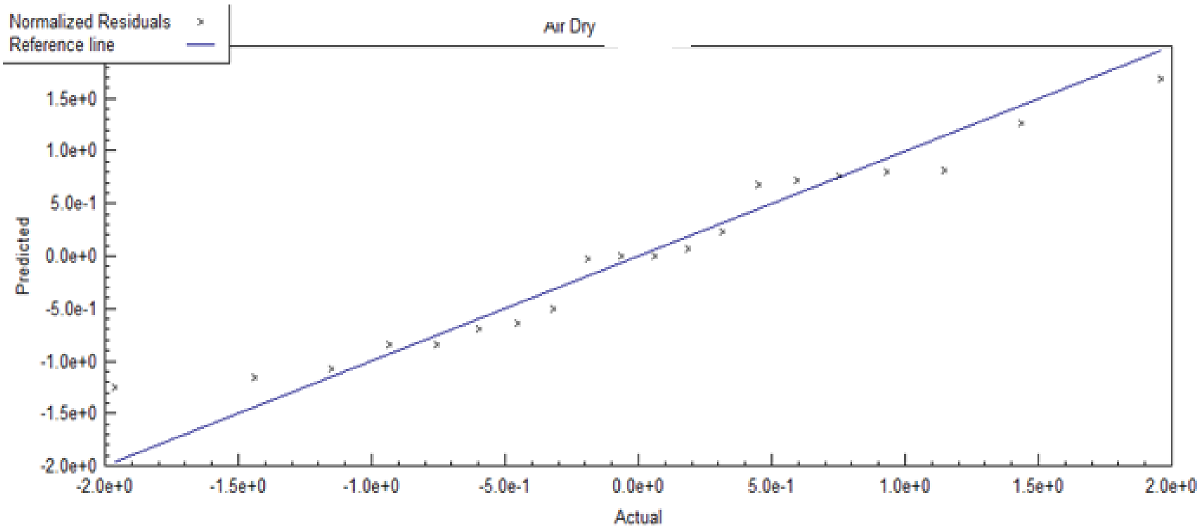

Figure 6: Predicted plot against Actual compressive strength of SCC

***Experimental Validation***

The predicted compressive strength was obtained by substituting the independent variables curing age (c) and super-plasticizer dosage (s) for 28 days age and obtained the predicted compressive strength (Fc) from equations 3,4, and 5 for immersion, wet burlap, and air-dry method of curing respectively the computed values are shown in table 8. Based on the strength responses obtained the predicted results displayed by computing the values in the equations and their corresponding experimental results are in good agreement with each other, as their percentage error which was obtained using equation 2 was less than 10%. A similar trend was observed from finding by Bashar *et al.*, (2019) and Vivian *et al*., (2022).

**Table 8: Computed values for model validation**

| | C | s | $F_c$ (actual) | $F_c$ (predicted) | Error |
|---|---|---|---|---|---|
| **Immersion** | 28 | 0 | 32.5 | 33.49449 | 3.059958 |
| | 28 | 0.5 | 32.3 | 33.21449 | 2.831227 |
| | 28 | 1 | 34.9 | 36.75449 | 5.313714 |
| | 28 | 1.5 | 34.4 | 34.57449 | 0.507228 |
| wet burlap | 28 | 0 | 26 | 26.52709 | 2.027277 |
| | 28 | 0.5 | 28.5 | 26.76709 | 6.080379 |
| | 28 | 1 | 28.5 | 28.88709 | 1.358218 |
| | 28 | 1.5 | 28.5 | 27.44709 | 3.694414 |
| air dry | 28 | 0 | 21 | 20.74573 | 1.210808 |
| | 28 | 0.5 | 21.5 | 22.21107 | 3.307315 |
| | 28 | 1 | 21.3 | 21.29642 | 0.01683 |
| | 28 | 1.5 | 18 | 18.00176 | 0.009765 |

***Theoretical Validation***

In the immersion method of curing the validation of the strengths of the SCC concrete model was carried out by looking into the coefficient of determination ($R^2$) which is 89 %, this proves that there is a strong dependency between the variables, SP dosage and curing age as only 11% of the variables could not be explained. This confirms that the models are adequate for prediction as stated by (Busic *et al.*, 2020 and Murad *et al*., 2020).

Also, the models were further validated by evaluating the difference between the predicted (0.89) and adjusted $R^2$ (0.86) values as computed in Table 9. For a model to fit, the speculated and adjusted $R^2$ values need to be reasonably in consensus with each other (i.e., their differences should be less than 0.2). (Haruna *et al*., 2020; Rahul *et al*., 2020 and Sunday, 2022).

In the wet burlap method of curing the validation of the strengths of the SCC concrete model was also carried out by looking into the coefficient of determination. The coefficient ($R^2$) is 88 %, this proves the variation of concrete compressive strength is extremely dependent on the variations of SP dosage and curing age. This was also confirmed by Mohammed *et al.*, (2021) that the models are adequate for prediction.

So also, in air dry method of curing, the validation of the strengths of the SCC concrete model was followed by looking into the coefficient of determination. The coefficient ($R^2$) is 94 %, this proves the variation of concrete compressive strength is extremely dependent on the variations of SP dosage and curing age. This confirms that the model was adequate for prediction as confirmed by (Mohammed *et al.*, 2021 and Sunday, 2022).

**Table 9: Computed values for theoretical validation**

| Methods | Predicted $R^2$ | Adjusted $R^2$ | Difference |
|---|---|---|---|
| Immersion | 0.89 | 0.86 | 0.03 |
| Wet burlap | 0.88 | 0.82 | 0.06 |
| Air-dry | 0.94 | 0.92 | 0.02 |

## CONCLUSIONS

The developed mathematical models have $R^2$ values of 89% for the immersion method of curing, 88% for the wet burlap method, and 94% for the air-dry method of curing, as such all the models developed are above 80%, signifies a strong interaction between the variables. Additionally, the model's p-values are approximately 0.000, 0.04912, and 0.000 for immersion, wet burlap, and air dry respectively and it is below 0.05. Therefore, the models established for various curing methods are enough for predicting the compressive strengths of SCC. Based on the strength responses obtained, the results of the compressive strength proposed by the software are in good agreement with each other, as their percentage error is less than 10%. The models were further validated using the difference between the predicted (0.89) and Adj$R^2$ (0.86), (0.88) and Adj$R^2$ (0.82), (0.94) and Adj$R^2$ (0.92) values for immersion, wet burlap, air dry respectively are less than 0.2. The predictive model's results of compressive strength of SCC at a 5% confidence level with super-plasticizer and curing age as independent variables were well correlated with the experimental results; therefore, the predictive models of SCC can be used under the given condition.

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