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Data Article

Dataset on predictive compressive strength model for self-compacting concrete

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ABSTRACT

The determination of compressive strength is affected by many variables such as the water cement (WC) ratio, the superplasticizer (SP), the aggregate combination, and the binder combination. In this dataset article, 7, 28, and 90-day compressive strength models are derived using statistical analysis. The response surface methodology is used to investigate the effect of the parameters: Varying percentages of ash, cement, WC, and SP on hardened properties-compressive strength at 7, 28 and 90 days. The levels of independent parameters are determined based on preliminary experiments. The experimental values for compressive strength at 7, 28 and 90 days and modulus of elasticity under different treatment conditions are also discussed and presented. This dataset can effectively be used for modelling and prediction in concrete production settings.

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Specifications Table

Subject area	Civil Engineering
More specific subject area	Production of concrete and strength properties
Type of data	Table, graph.
How data was acquired	Laboratory experiment via response surface methodology
Data format	Raw and Analysed
Experimental factors	Modelling and concrete strength

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Experimental features	Compressive strength and self-compacting concrete
Data source location	Experimental and laboratory, Nigeria
Data accessibility	Within this article.

Value of the data

- The present data can be used to predict the strength of auto-compacting concrete at varying days.
- The dataset can be used to determine the trend of strength associate with concrete.
- The dataset can be used to detect the effect of SP.
- The dataset can be used to determine the nature of concrete, and the corresponding degree of hydration.
- The dataset can serve as an experimental framework for the analysis of other basic properties of concrete.
- The dataset can help in developing experimental programme for the evaluation of model accuracy and precision.

1. Data, and experimental design

Strength data presented here are from seventy-two (72) different POFA concrete samples fabricated to compare with normal concrete without ash. We make reference to [1–8] for related views such as forecasting and prediction. In this dataset article, a 7-day, 28-day, and 90-day compressive strength models were derived by statistical analysis and the proposed models results and description as contained in Tables 1–3, and Figs. 1–5 are as follows.

1.1. Sample preparation methods

In this investigation, concrete samples were prepared using Palm Oil Fuel Ash (POFA) at varying percentages, with ordinary Portland cement. The POFA was replaced at 5%, 10%, 15%, 20%, 25%, and 30% with cement and superplasticer at 2%.

2. Materials and methods

2.1. Quadratic equation generated from the model

Besides the statistical software used in the data analysis, is a predictive quadratic model defined as follows:

$$f(x) = C_0 + \frac{C_1(x-x_0)}{1!(5^1)} + \frac{C_2(x-x_0)(x-x_1)}{2!(5^2)} + \frac{C_3(x-x_0)(x-x_1)(x-x_2)}{3!(5^3)} + \frac{C_4(x-x_0)(x-x_1)(x-x_2)(x-x_3)}{4!(5^4)} + \frac{C_5(x-x_0)(x-x_1)(x-x_2)(x-x_3)(x-x_4)}{5!(5^5)} + \frac{C_6(x-x_0)(x-x_1)(x-x_2)(x-x_3)(x-x_4)(x-x_5)}{6!(5^6)} \quad (1)$$

where x and C_i , $i \geq 0$ denote varying percentages of POFA and compressive strength respectively.

2.2. Data analysis

For x the varying percentages of POFA with zero (0) as the control, and the average compressive strength, we present in Tables 1–6 the relationship between xandy at varying intervals in days.

It is noted from Tables 1–6 that there was an increase in strength as the percentage of POFA increased but the control was slightly high. Table 7 shows the experimental and numerical results for POFA with regards to Compressive Strength for 7, 28, and 90 days.

Table 1
3days experiment.

x	0	5	10	15	20	25	30
y	30.94	12.34	14.24	17.52	23.63	26.08	30.68

Table 2
7 daysexperiment.

x	0	5	10	15	20	25	30
y	40.60	12.77	15.35	18.67	30.32	31.80	35.78

Table 3
ppp 14 daysexperiment.

x	0	5	10	15	20	25	30
y	52.10	14.45	17.24	20.40	34.71	36.82	46.30

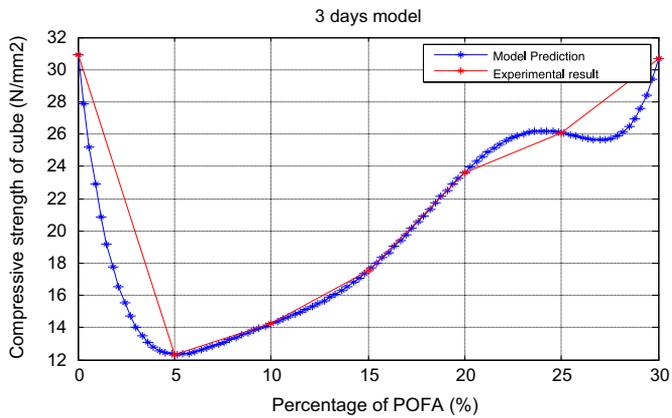


Fig. 1. Prediction and experimental result (3-days model).

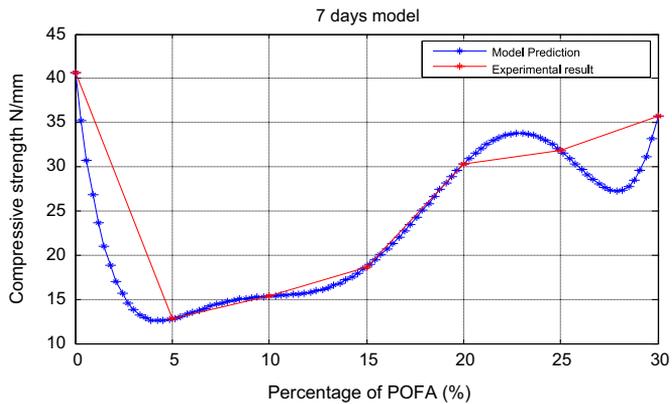


Fig. 2. Prediction and experimental result (7-days model).

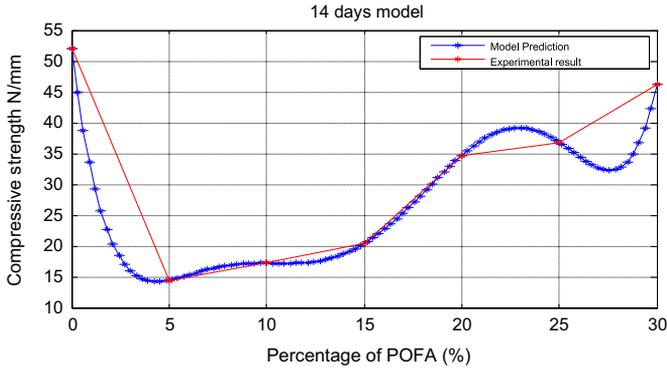


Fig. 3. Prediction and experimental result (14-days model).

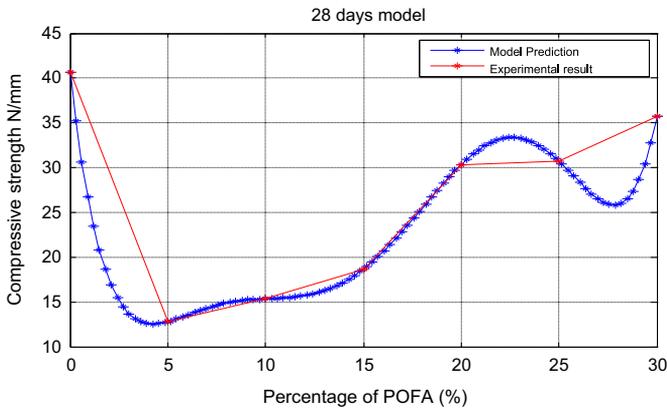


Fig. 4. Prediction and experimental result (28-days model).

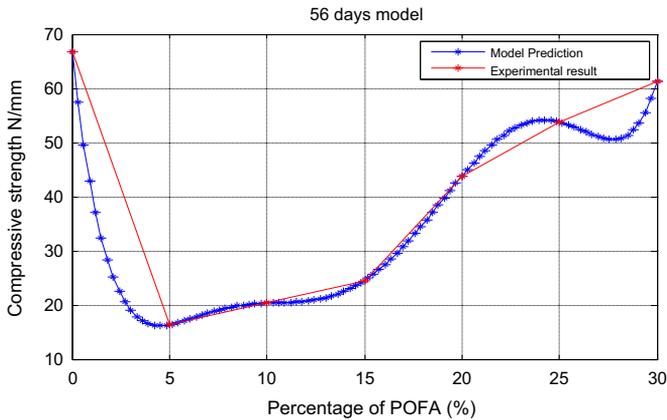


Fig. 5. Prediction and experimental result (56-days model).

Table 4
28 daysexperiment.

x	0	5	10	15	20	25	30
y	40.60	15.72	17.85	22.63	38.35	48.70	55.74

Table 5
56 daysexperiment.

x	0	5	10	15	20	25	30
y	66.80	16.35	20.36	24.56	43.80	53.79	61.32

Table 6
90 daysexperiment.

x	0	5	10	15	20	25	30
y	80.50	17.28	21.40	26.77	57.09	59.54	75.60

Table 7
The experimental and numerical results.

POFA (%)	7 days		28days		90days	
	Compressive Strength (N/mm ²)		Compressive Strength (N/mm ²)		Compressive Strength (N/mm ²)	
	Experimental	Numerical	Experimental	Numerical	Experimental	Numerical
0	40.6	40.6	59.6	59.6	80.5	80.5
5	12.77	12.77	15.28	15.28	17.28	17.28
10	15.35	15.35	19.41	19.41	21.40	21.40
15	18.67	18.67	22.47	22.47000005	26.77	26.77
20	30.32	30.32	38.10	38.100000020	57.09	57.09
25	31.8	31.800000305	41.5	41.5100050125	59.54	59.54000001
30	35.78	35.48001000125	53.48	53.4800100125	75.60	75.6000000625

The plots of the experimental values of the compressive strength at varying days vs the predicted strength using Matlab are shown via Fig. 1 through Fig. 5. The compressive strength values of POFA concrete were very close to the strength of normal concrete: 75.60 N/mm², 80.5 N/mm² respectively at 90 days.

2.3. Models correlation – predicted and measured

Matlab statistical software was used to analyse and investigate the effect of the parameters (cement, water cement (WC) ratio, POFA and superplasticiser (SP) on the hardened properties (compressive strength at 7, 28 and 90 days. Determination of the independent parameters with respect to their percentage replacement was made on initial experiments as shown in Tables 1–6, which also contains the experimental values of the increase in strength at 7, 28 and 90 days. The quadratic model equation was used to determine the experimental values and compared with the model. The predictive and experimental models showed the same values and pattern graphically as depicted in Figs. 1–5.

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Transparency document. Supplementary material

Supplementary data associated with this article can be found in the online version at <http://dx.doi.org/10.1016/j.dib.2018.02.008>.

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