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INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)
(Int Peer Reviewed Journal)
Vol. 06, Issue 01, January 2026, pp : 37-41

e-ISSN : 2583-1062
Impact Factor : 7.001

EFFECT OF ALGAE IMBUED WATER ON PROPERTIES OF PSC CEMENTS

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DOI: https://www.doi.org/10.58257/IJPREMS50909

ABSTRACT

Biological materials like phytoplankton (algae) are abundantly found in tropical and subtropical floor water bodies. Algae and water have a vital function withinside the houses of concrete. The modern-day look at goals to analyze the impact of organic materials like phytoplankton (algae) with diverse concentrations jumbled together water on putting time, soundness, and compressive electricity of admixture cement. Admixture cement is used and cubes have been forged with deionized water containing with and without Algae. The outcomes display that the Algae in deionized water quickens the preliminary and very last putting instances in all of the concentrations. Algae in deionized water lower the compressive electricity from an early age (3-days) to the most age (2 years). The hydration traits of the admixture cement with deionized water containing and without Algae had been studied.

Keywords: PSC, Silica Fume, Strength Development, X-Ray Diffraction, SEM Analysis.

1. INTRODUCTION

Algae are present abundantly in tropical water bodies especially in summer season. Use of such water affects the initial and final setting times and also the compressive strength of cement mortar. Hence, in the biological substances category only algae are considered for experimentation. The presence of algae in water changes the properties of concrete in setting times as well as strength. Water is an essential ingredient of concrete as it effectively participates in the chemical reactions with natural admixture cements like natural pozzolana and other supplementary cementitious materials (Silica fume). Pozzolans are commonly used as an addition to Portland cement to increase the long-term strength and other material properties. Concrete is not only material that is risk to physical and chemical process of deterioration associated with water. Therefore, it will be desirable to review, in general, the characteristics of water that make it the principal agent of destruction of material. The I.S. Code 456-2000 also specifies the minimum pH-value as 6.0 and also permissible limits for solids in the water to fit for construction purposes. The code has not specified the limits to the individual components like algae etc., and other substances. The use of natural and economical materials seems to be one of the possible solutions for the future. The development of an economical cement concrete with interesting properties in the fresh and hardened state will certainly help and encourage the use of this material in the construction industry. Hence, in the present investigation to find the effects and quality of water on setting and strength properties of admixture cement. The effect of algae on setting, hardening and strength development of admixture cement are not known much. Hence, an investigation is carried out on setting time, soundness and strength of admixture cements.

2. MATERIALS

The details of various materials used in the present experimental investigation are presented below:

2.1 Cement:

The cement used in the present investigation is of 43 grade Pozzolana Slag Cement. The chemical composition and Physical properties of the Portland Slag Cement (PSC) is presented in Table 1 and Table 2.

Table 1: Chemical Composition of Portland Slag Cement (PSC)

S. No.	Type of Oxide	Percentage (%)
1	CaO	46.10
2	SiO_2	29.90
3	Al_2O_3	7.37
4	Fe_2O_3	4.21

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5	SO_3	1.79
6	MgO	3.12
7	K_2O	1.98
8	Na_2O	1.35

Table 2: Physical Properties of Slag Cement (PSC)

S. No.	Property	Result	IS 1489(part-1)-1991
1	Specific Surface (m^2/kg)	372	Not less than 300
2	Normal consistency	35%	Not specified
3	Setting times (minutes) a) Initial b) Final	 165 225	Not less than 30 & Not more than 600
4	Compressive strength (MPa) a) At 72 ± 1 h b) At 168 ± 2 h c) At 672 ± 4 h	 30.4 39.3 53.19	 Not less than 23 Not less than 33 Not less than 43

2.2 Fine aggregate:

The fine aggregate used in this investigation is the river sand obtained from Swarnamukhi river near Tirupati, Chittoor district in Andhra Pradesh. The following tests are conducted on fine aggregate according to IS: 383-1987. The physical properties of fine aggregate are shown in Table 3.

Table 3: Physical Properties of Fine Aggregates

S. No	Properties	Results
1	Bulk density, kg/m^3	1618
2	Specific gravity	2.66
3	Fineness modulus	3.22

2.3 Coarse Aggregate:

The crushed aggregate was used from the local quarry. In this experiment the aggregate was used of 20mm down and tested as per IS: 2386-1963(I, II, III) specification. The physical properties of coarse aggregate are shown in Table 4.

Table 4: Physical Properties of Coarse aggregate

S.No	Property	Test Results	Standard Values as per IS codes
1	Maximum nominal size	20 mm	
2	Bulk density (kg/m^3)	1523	As per IS: 2386 (part -3)-1963
3	Specific gravity	2.85	As per IS: 2386 (part -3)-1963

2.4 Silica fume:

For the present study the admixture brought from Elkem India Pvt. Ltd. The properties of silica fume are shown in Table 5 respectively.

Table 5: Characteristics of Silica fume

Name of the content	Standards	Results
SiO_2	% Min 85.0	89.6
Moisture content	% Max 3.0	0.6
Loss on ignition	% Max 6.0	2.7
45 micron	% Max 10	7.5
Bulk density	500-700 Kg/m^3	0.60

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2.5 Water:

The characteristics of water to which various chemical and biological substances were spiked are presented in the Table 6 and the characteristics of water were analyzed according to the standard methods for the examination of water. (APHA 1994).

2.6 Algae:

Phyto plankton has been utilized in the present investigation to study the blended cement concrete. The algae with different concentrations of 435,915,1130, 1570 cells/mL in mixing water is considered.

Table 6: Properties of water (Deionised water)

S. No.	Name the of content	Max.limit
1	pH	6.7
2	Total dissolved solids	8 (mg/L)
3	Alkalinity	9.8(mg/L)
4	Acidity	1.5(mg/L)
5	Hardness	1.5(mg/L)
6	Sulphates	0.15(mg/L)
7	Chlorides	7(mg/L)

3. EXPERIMENTAL PROGRAM

The following equipment is used for casting and testing of specimens: (i)Cube moulds, (ii)200T U.T.M (Universal Testing Machine) for cube compressive strength determination, (iii) Vicat's apparatus including moulds conforming to IS4031(part-5)-1988 for setting times, (iv)Le-Chatelier's equipment to determine the soundness of cement and (v) cement cubes prepared with water containing, Algae in the concentrations of 435,915,1130, 1570 cells/mL in mixing water.

3.1 Setting time:

Vicat's apparatus confirming IS4031(part-5) 1988 consist of a frame to which a movable rod having an indicator is attached which gives the penetration, weighing 100g and having diameter and length of 10mm and 50mm respectively. Vicat's apparatus included three attachments-square needles for initial setting time, plunger for determining normal consistency and needle with annular collar for final setting time.

The variation of Setting times of natural admixture cement (PPC+10%SF) corresponding to different concentrations of algae in deionized water is as shown in Fig. 1.

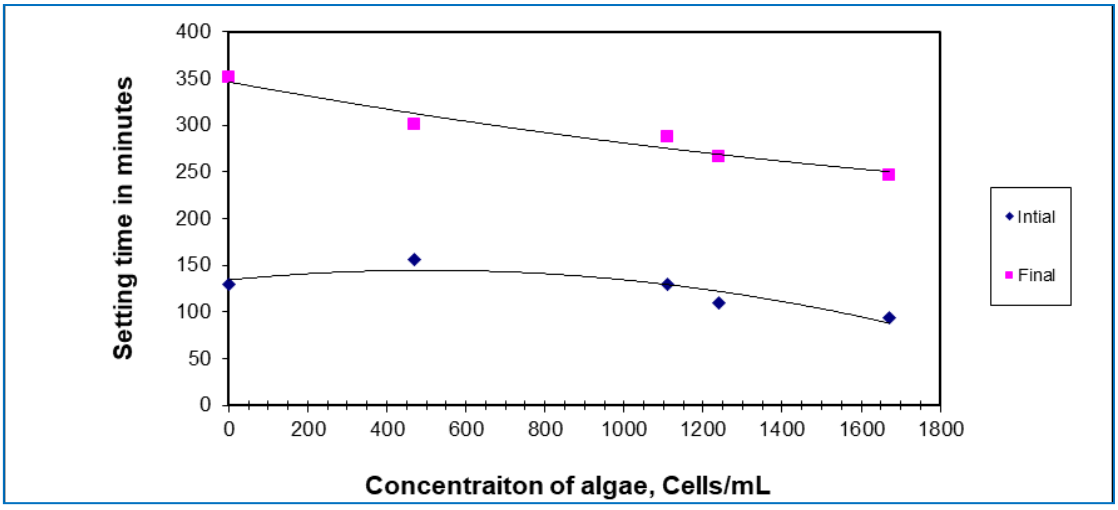

Fig 1: Setting times of natural admixture cement (PSC+10%SF) cubes corresponding to different concentrations of algae in deionised water

3.2 Compressive Strength:

The test specimens for determination of compressive strength of admixture cement prepared using standard metallic cube moulds adopting IS procedure for the compactions. The cubes were demoulded after 24hours of casting and cured in water having similar quality as used in preparation of mix. The cubes are tested for compressive strength for short term and long term. The compressive strength is computed as the average value of the three samples.

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4. RESULTS AND DISCUSSION

4.1 Setting time of cement:

The effect of algae on initial setting time and final setting times is presented in Fig.1. Initial and final setting of cement got accelerated with increased cells of algae in the deionised water. The acceleration in the initial and final setting is are significant when the algae content exceeds 1240 cells/mL. The decrease in the initial setting time is 35 minutes and that in the final setting lime is 104 minutes at the maximum concentration of algae 1670cells/mL.

4.2 compressive strength of cement mortar cubes:

The effect of algae on compressive strength of cement mortar cubes is presented in Fig.2. There is nominal change in the compressive strength of mortar cubes for the early day samples like 3-day. As time proceeds, there is a significant change for all concentrations of algae until the maximum concentration of 1670 cells/mL.

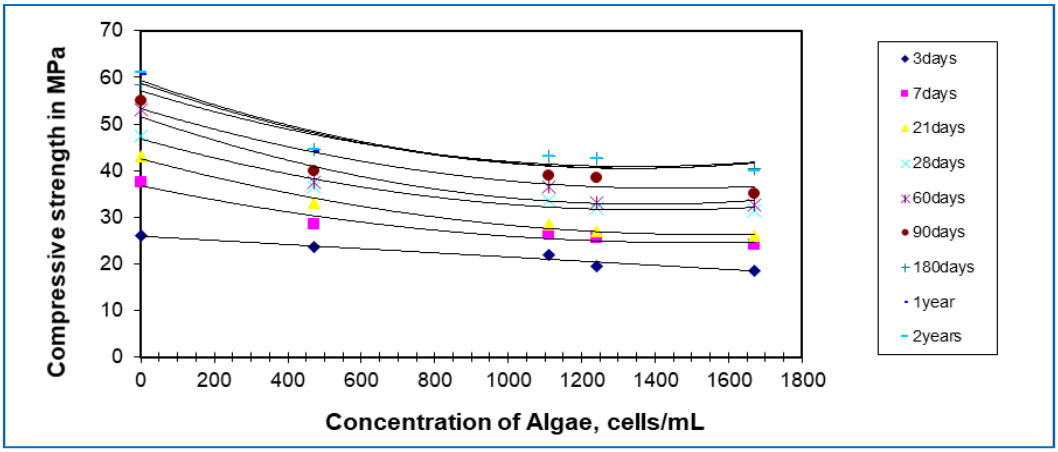

Fig 2: Compressive strength of natural admixture cement (PSC+10%SF) cubes at different periods corresponding to different concentrations of Algae, in deionised water

4.3 Percent change in compressive strength compressive strength of cement mortar cubes:

The percent change in compressive strength of natural admixture cement cubes prepared with different concentrations of algae in deionised water is shown in Fig.3. There is a nominal change in the compressive strength of cement mortar cubes of 3-day samples. As time elapses there is continuous decrease in compressive strength of all other age cells ranging from 3-days to 2-year. The rate of decrease in compressive strength is also gradually increases with the increase in the concentration of the algae samples as well as duration. For 3-day, significant decrease in strength occurs beyond 1110 cells/mL. and the trend continues up to the maximum concentration. The 2-year sample shows the maximum decrease in compressive strength with increase in concentration of algae. When the algae concentration is 1670 cells/mL, the decrease in compressive strength is 40% than that of the control mix.

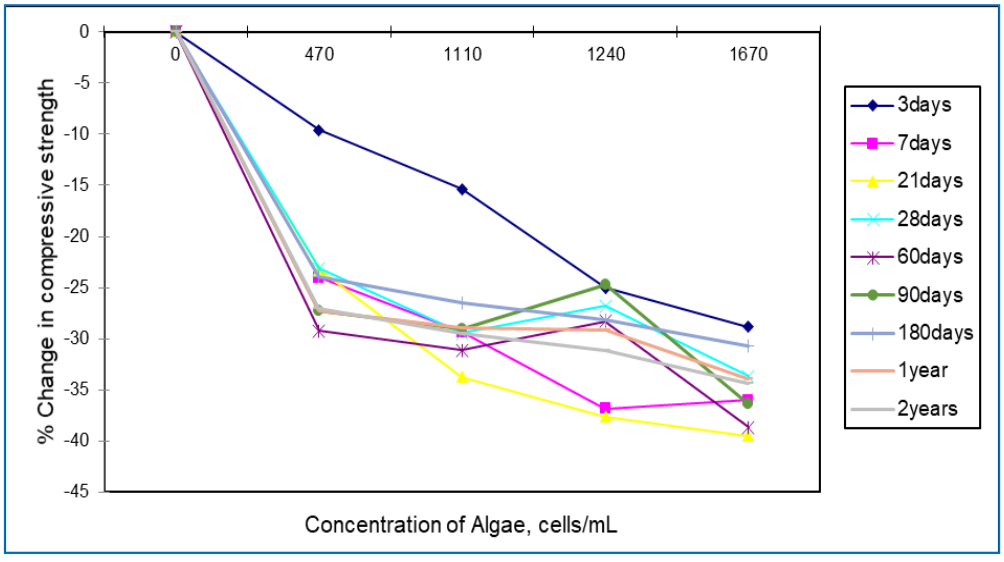

Fig 3: Percentage change in compressive strength of natural admixture cement (PSC+10%SF) cubes at different periods corresponding to different concentrations of Algae, in deionised water.

5. CONCLUSION

From this work, the following conclusions may be drawn

1. The mixing of deionised water in natural admixture cement containing with and without algae has a considerable change in setting times (i.e., acceleration) is observed due to water contains algae more than 1240 cells/mL.

2. If the concentration is more than 1110cells/mL, there is a considerable decrease in strength. While using this type of water containing algae proper care should be taken.

3. There is nominal change in the compressive strength of mortar cubes for the early day samples like 3-day. As time proceeds, there is a significant change for all concentrations of algae until the maximum concentration of 1670 cells/mL.

4. For 3-day, significant decrease in strength occurs beyond 1110 cells/mL. and the trend continues up to the maximum concentration.

5. The 2-year sample shows the maximum decrease in compressive strength with increase in concentration of algae. When the algae concentration is 1670 cells/mL, the decrease in compressive strength is 40% than that of the control mix.

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