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Review Article

Fresh, Mechanical, and Durability Properties of Concrete Contains Natural Material as an Admixture, an Overview

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Abstract

Nowadays, the performance criteria for concrete construction are moving toward eco-efficiency, a method of producing highly durable and environmentally friendly concrete while minimizing both manufacturing costs and environmental load. Admixtures are commonly used in all concrete construction; however, some harm human health and cause leaching, which is responsible for environmental pollution. On this principle, one of the eco-efficiency method's techniques is to use natural materials as additives in concrete. The paper continues to discuss the experimental data generated at the author's laboratory as part of exploratory work on the use of natural materials and their impact on the properties of cement, mortars and concretes in terms of improving fresh, mechanical, and durability properties of concrete, The paper concludes that the observed impacts of using these natural material additions on the properties of mortar and concrete will motivate greater research in these areas, thereby improving the sustainability of concrete constructions.

1. Introduction

Concrete is the most widely used construction material in the world, and it is primarily composed of Portland cement, various aggregate types, water, and admixtures. Concrete production accounts for approximately one ton for each human being living on Earth, and with this much consumption all over the world, concrete is the second most used material after water. [1, 2].In modern construction, it is normal practice to use chemical admixtures in concrete either to reduce water demand or improve concrete properties. However, while chemical admixtures improve concrete properties, they are also responsible for environmental pollution [3].

Moreover, some chemical admixtures harm one's health by releasing chemicals like formaldehyde [4]. Furthermore, chemical admixture has environmental issues due to production, storing, transporting, handling, use, and leaching while constructing structures. So finding alternative admixtures is therefore helpful in producing environmental sustainable concretes. Researchers and concrete scientists worldwide are trying to produce non-chemical admixtures considered eco-friendly and environmentally acceptable building materials. These admixtures are made from herbs, fruits, and animal products. Organic and bio-polymers admixtures created by biotechnological processes are called bio-admixtures. Natural admixture based on herbs or fruit extracts appears to be a good option. However, research on this area is few. Natural admixtures can be considered eco-friendly in terms of their environmental impact and low cost, particularly compared to chemical admixtures [5].

This study discusses the results and reviews of the studies that use natural and organic materials as admixtures to improve the durability and mechanical properties of concrete, as well as the effects on the fresh properties of concrete. The review of studies on the use of natural materials in concrete construction is a way for scientists and researchers to know more about these types of admixtures, considered eco-friendly and environmentally sustainable construction materials. Furthermore, using mostly natural materials as admixtures, which are waste products, provides no further benefits.

2. Literature Review

According to studies on historic buildings, lime was used in construction and as a herb extract [5]. However, given that some of the constructions have stood for centuries and have shown their durability, it is clear that plant extract increases the durability of concrete [6].

Moreover, agricultural waste or vegetable material has been studied recently and has been discovered to improve mechanical properties and durability. In terms of the environment, an agricultural or vegetable waste product is natural, environmentally beneficial, and less expensive than a chemical admixture. Furthermore, the liquid extraction procedure significantly influences the concrete's residual properties. For instance, Woldemariam et al. [6] showed that the property of concrete is greatly improved by boiled cypress plant extract compared to cold water extraction.

According to Otoko and Ephraim's studies [7], palm liquor works as a set retarder due to its high sugar content and can improve the workability, honeycombing, and compaction of concrete. When the water/cement ratio is between 0.4 and 0.5, there is an increase in overall tensile and compressive strengths. Chemical analysis of hardened concrete indicates that palm liquor of early age is safe for use in reinforced concrete as long as the dose in concrete does not exceed 16% palm liquor replacement of water (Optimum dosage). They concluded that the improvement in concrete.

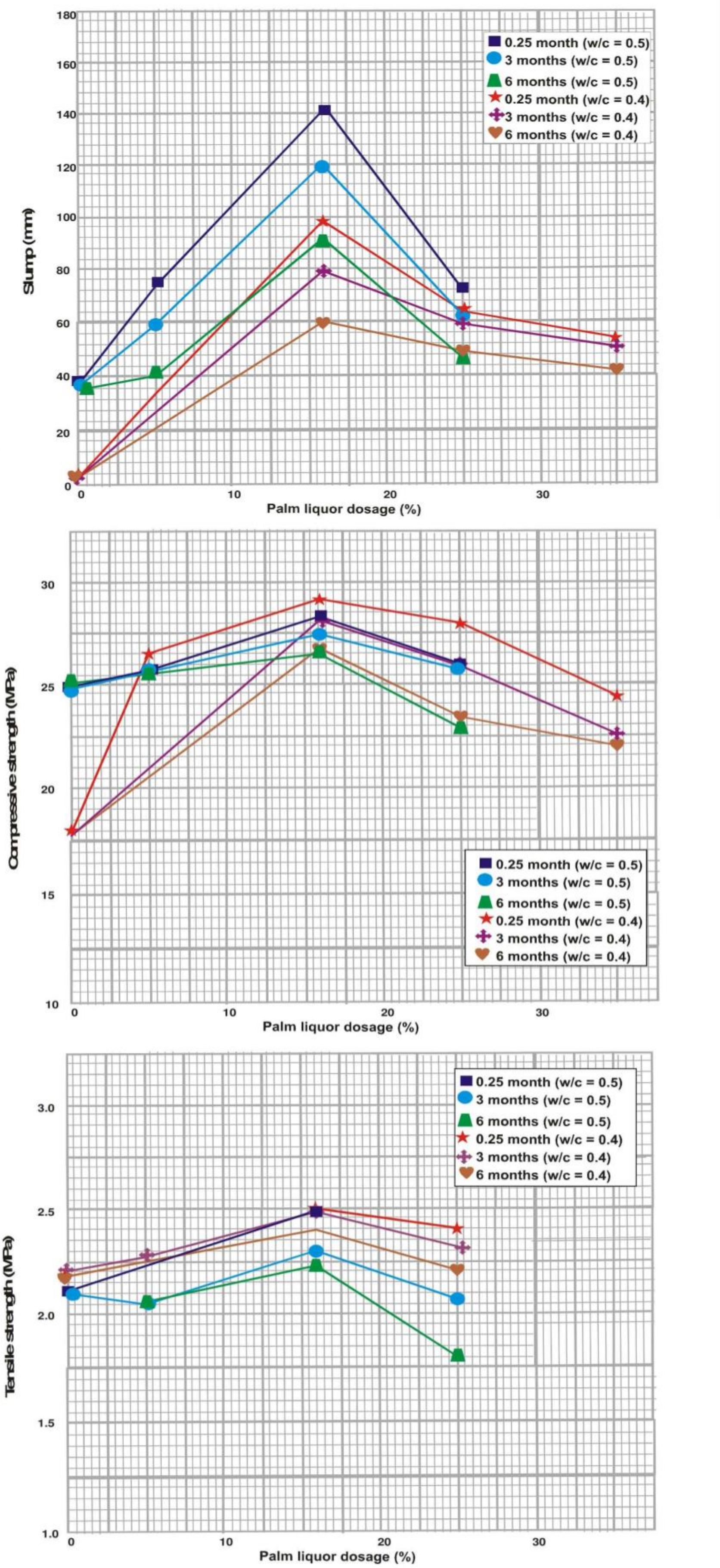


Figure 1. Test results palm liquor with different water/cement ratios (Otoko and Ephraim [7])

Woldemariam et al. [6] studied concrete with an admixture of cypress plant extract, using 5, 10, and 15% of the extract by cement weight to the mixing water. The results show that using cypress plant extract can delay the setting time of cement so that it can be used as a retarder. It was also found that cypress plant extract improved the workability of the fresh concrete mix at a constant liquid: cement ratio and reduced the liquid requirement of the concrete mix at a constant slump. The results of the tests show that increasing the amount of plant extract in water improved the compressive strength of concrete.

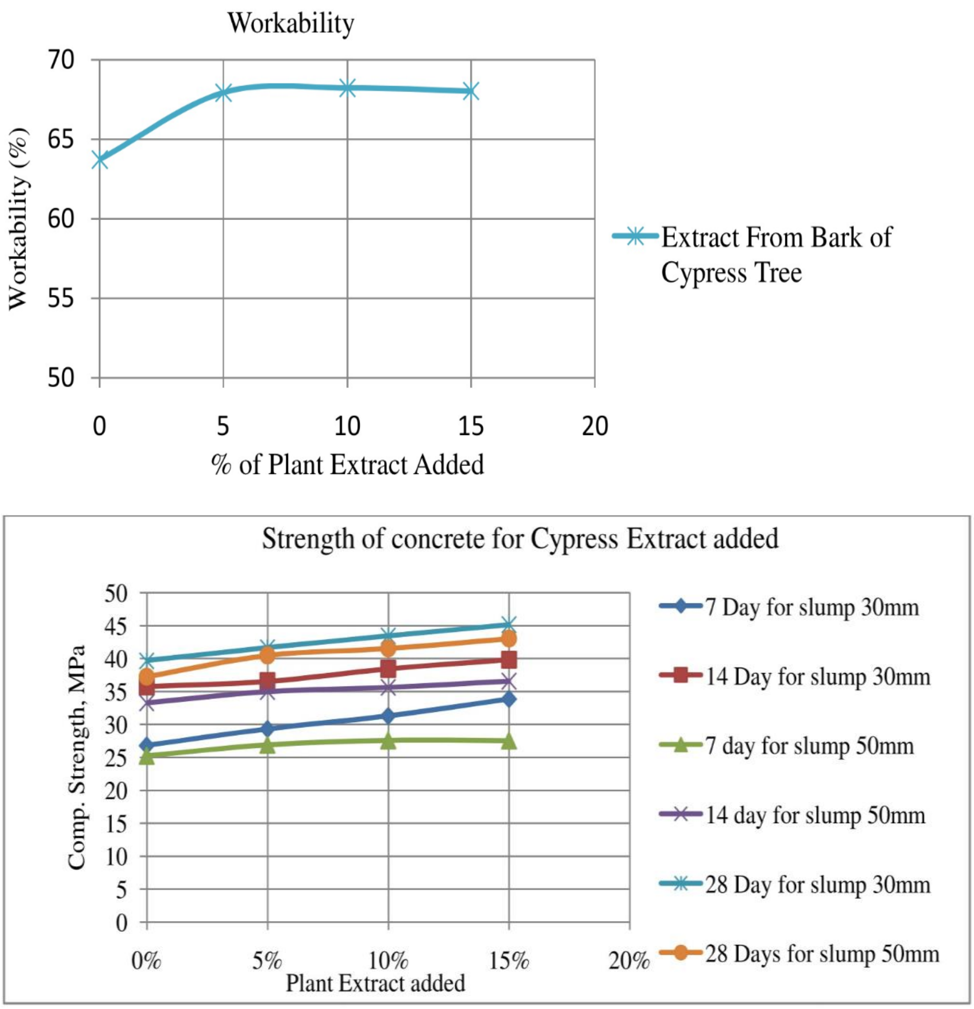


Figure 2. Test results plant extract with different mixes (Woldemariam et al [6])

Muhammed Shareef et al. [20] tested fresh and hardened properties of concrete containing 0, 1, 1.5, and 2% pulp black liquor (PBL), a waste material from the paper industry. Based on their data, 1.5% PBL is an optimum dosage to enhance slump, compressive strength, and splitting tensile strength. There was an increase in the concrete slump of about 5% as the maximum value. The 28-day compressive strength was found to increase from 25.04 MPa to 34.02 MPa for the M25 mix, while for the M30 mix, the strength was increased from 30.46 MPa to 37.83 MPa, while splitting tensile strength was increased from 3.67 MPa to 4.75 MPa and from 3.99 MPa to 5.12 MPa for the two concretes respectively.

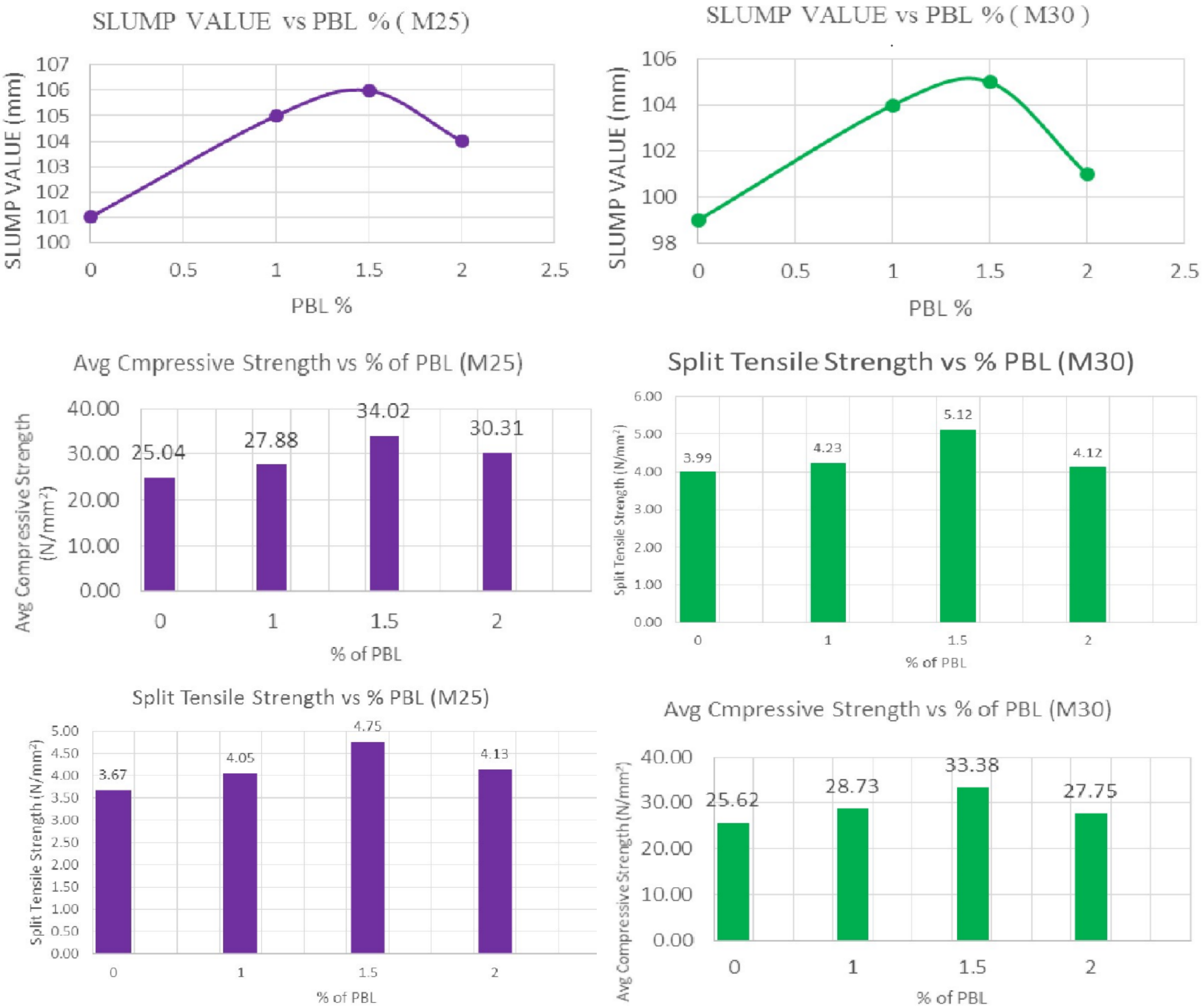


Figure 3. Test results pulp black liquor (PBL) for different grades of concrete [20]

By conducting studies on electrical resistivity, carbonation depth, and ultrasonic pulse velocity (UPV), Patel and Devo [9] studied the impact of natural organic materials (Triphala, gram-flour, and ghee) as an additive on the durability of concrete. They found that adding gram flour improved durability, increasing electrical resistivity by up to 26.65% and UPV by up to 0.8%. The percentage drop in electrical resistivity and UPV after applying a 70% loading was less than it was for control concrete. Up to 11.63% lower carbonation depth than control concrete was seen, and after applying 70% loading, there was a greater percentage decline in carbonation depth than in control concrete. By using Triphala, it was found that the electrical resistivity and UPV decreased but that the carbonation depth increased. Electrical resistivity increased with ghee addition by a maximum of 8.86%, and after applying a 70% load, electrical resistivity was higher than control concrete. In this case, UPV was found to have decreased while carbonation depth had increased. They recommended using gram flour as a natural organic admixture in concrete.

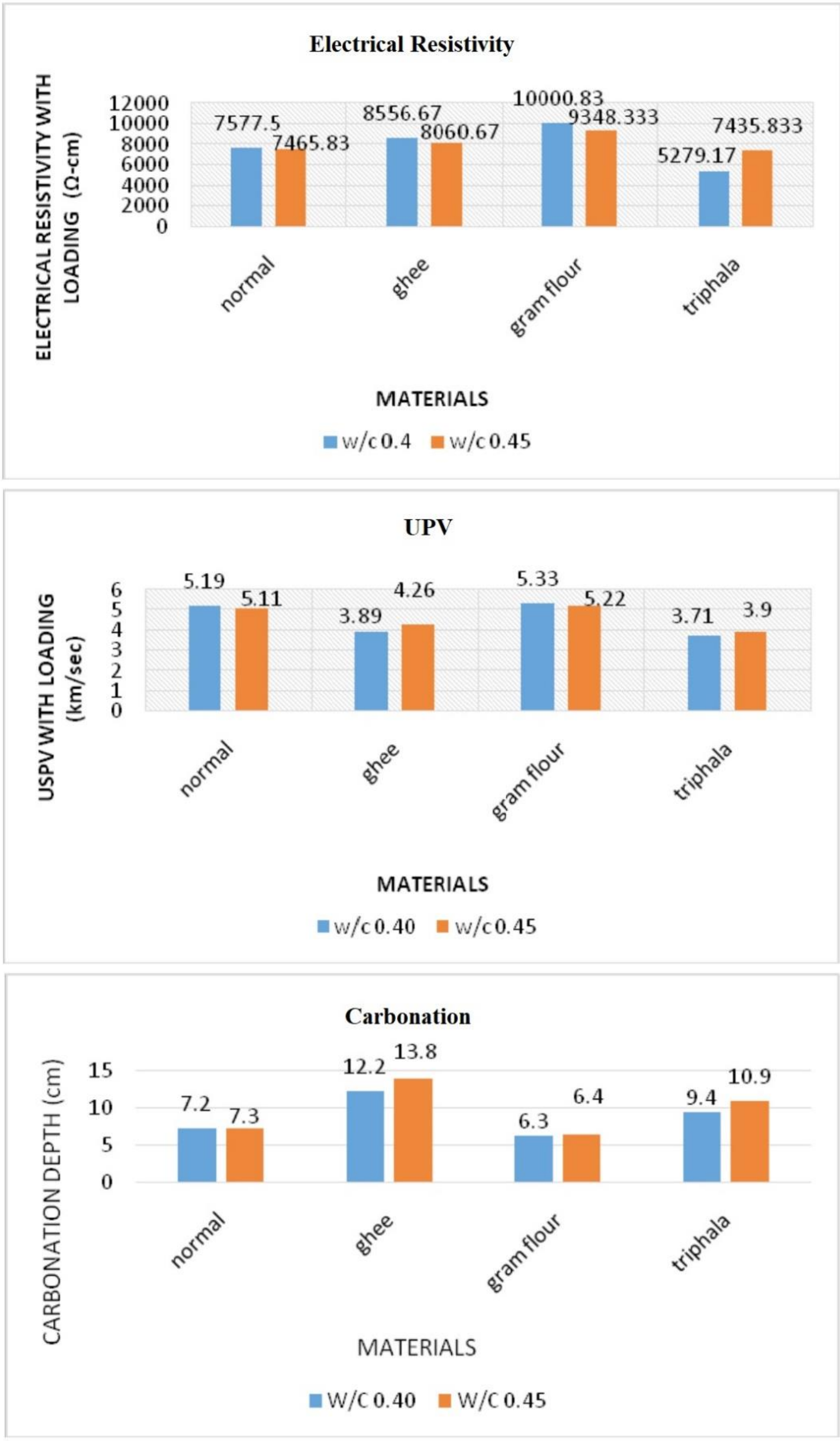


Figure 4. Test results (gram-flour, ghee and triphala) on concrete properties (Patel and Devo [3])

Broiler hen egg-white albumen and yellow yolk were mixed by Ramesh Babu et al. [10] and used as a natural admixture (NAD). The latter was added to the concrete at different replacement dosages of 0%, 0.25%, 0.5%, and 1.00% by its volume to water content. It was concluded that 0.25% of NAD dosage was considered optimum for both control and Class C fly ash blended concrete. The studies revealed that 25% Class C fly ash blended concrete mix with 0.25% NAD had higher compressive strength, lower water absorption, lower porosity, and less percentage loss of compressive strength when immersed in HCL and H_2SO_4. The cause of compressive strength increases at 0.25% NAD was attributed to the calcium content of egg ingredients (NAD) that accelerates the hydration in control concrete at all curing periods. The strength increments of the mixes at 0% FA from 0% to 0.25% NAD dosages at 7, 28, and 56 days were observed as 63.16%, 20.63%, and 24.11%, respectively. At 0.25% NAD dosage, the lower water absorption and porosity of concrete were attributed to the formation of crystals of calcite in voids causing, disrupting the connectivity of pores.

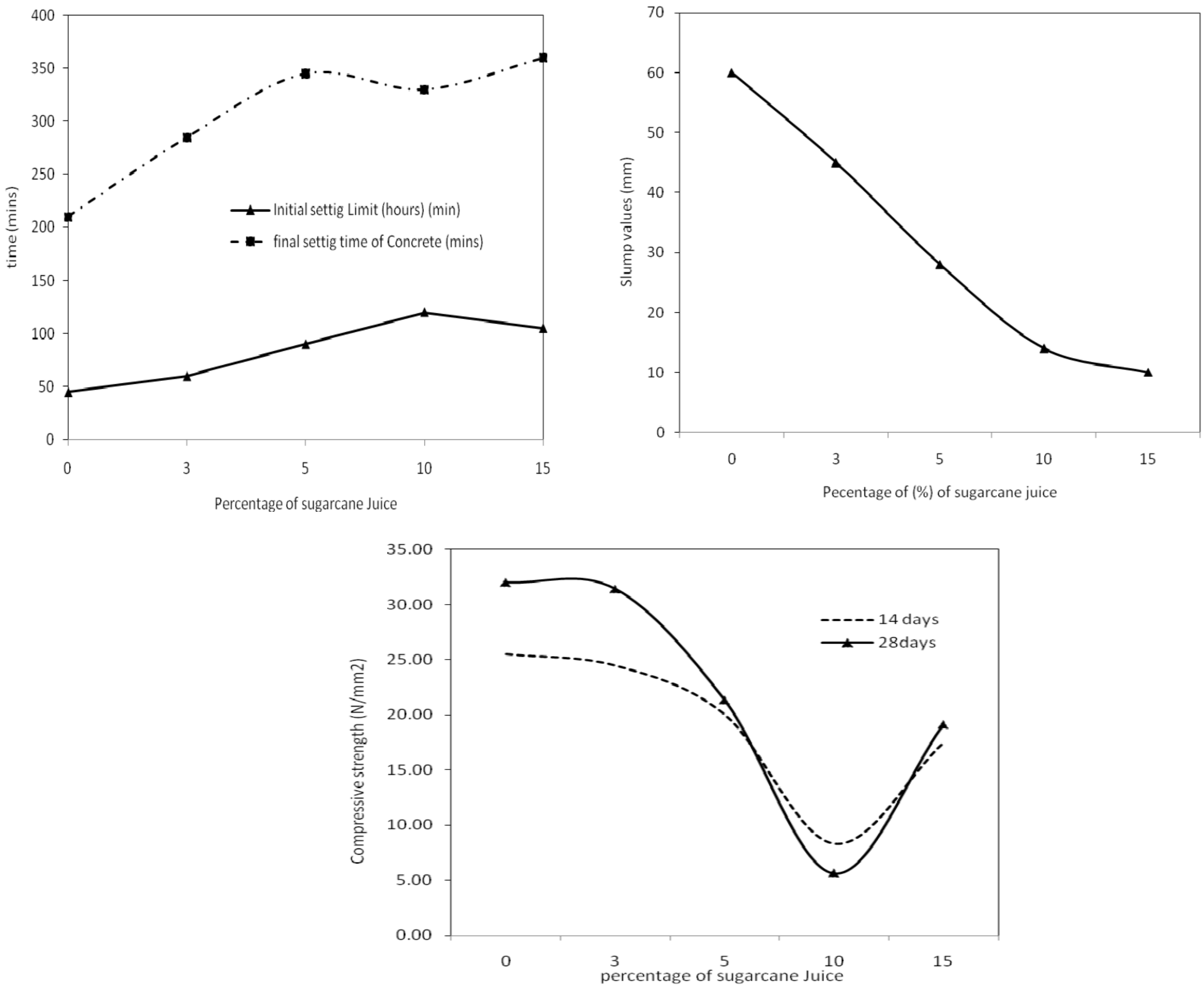


Figure 5. Test results showed molasses (sugar) affecting concrete properties (Pathan and Singh [11])

Additionally, Pathan and Singh [11] added molasses as a byproduct of sugar production as an additive to concrete. Some sugar will remain in the waste liquid substance known as molasses after sugar is extracted from the sugar juice. At different dosages (0.80, 0.60, and 0.40) wt. % of cement content), and molasses was added. The addition of molasses was shown to significantly increase the final and initial setting times as well as the fluidity of fresh concrete. Molasses' retarder action was attributed to the sugar's carbohydrates. As a result, excluding the early days, the compressive strength of the concrete was significantly increased. Both the tensile and flexural strengths were slightly increased after 28 days. The two scientists determined a significant increase in strength and concluded that molasses could be used as a water-reducing and retarding admixture.

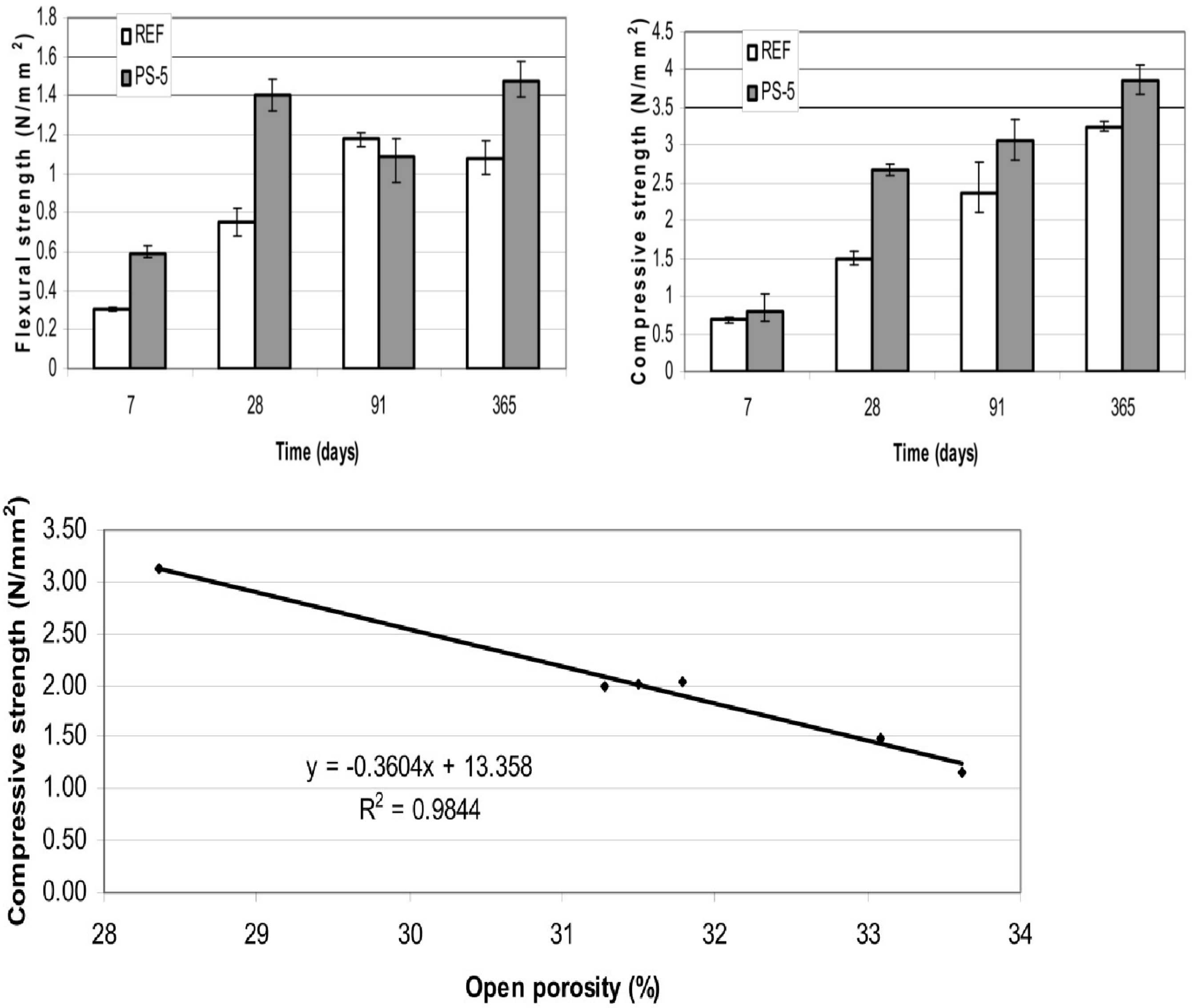
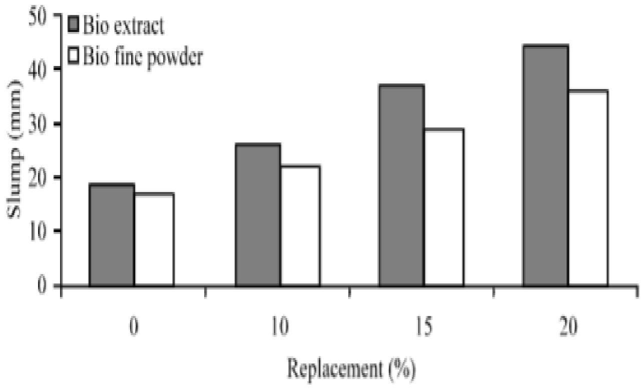


Figure 6. Test results from potato starch affect concrete properties (Izaguirre et al.[12])

Izaguirre et al. [12] investigated the properties of mortar which contained (0.80, 0.50, 0.30, 0.150. 0.06 and 0.03) % potato starch (PS) by weight. Water absorption through capillarity, water vapour permeability, density, shrinkage, open porosity, pore size distribution, mechanical strengths, and the freezing-thawing cycle as durability properties were all investigated. The increase of additions increased the shrinkage coefficient, absorption was reduced by 0.3% using PS, and the slump was reduced from 160 mm to 100 mm. The residual properties of mortar were found to be dosage-dependent: when the dosage was less than 0.30%, it behaved as a thickener, forming a tangled fresh mass that resulted in a less porous hardened material. They concluded that using 0.30% PS, a large amount of polymer produced such a large amount of agglomerates that the fresh mortar became scarcely workable, which will increase porosity, perhaps causing mechanical strength to be damaged.

Sathya et al. [13] investigated the concrete's properties by replacing water with up to 20% water hyacinth (WH). With increasing dosages of bio extract, setting time was shown to be delayed, and there was a gradual increase in slump and compressive strength.



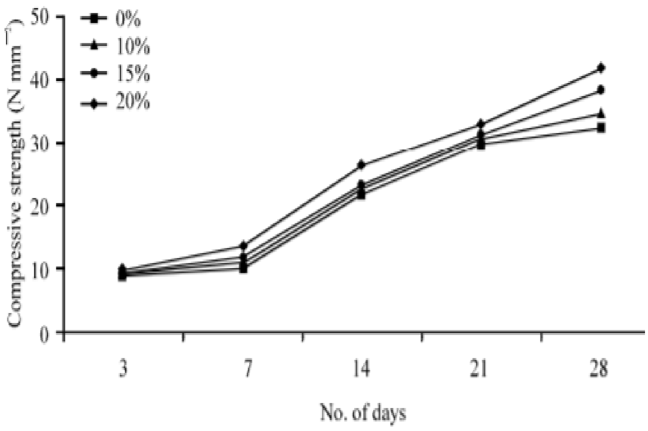


Figure 7. Test results water hyacinth effecting on concrete properties (Sathya et al. [13])

A. M. Woldemariam et al. [14] investigated the applicability of blue gum extract as a shrinkage-reducing additive for concrete at different dosages (15, 10, 5, and 0%). First, the bark of the blue gum tree was extracted by boiling it in water. Then, mortar slabs were exposed to the environment, allowing shrinkage and cracks to be monitored over time (5 hours). 3 days, 7 days, and 28 days). The plant extract reduced shrinkage, suggesting that blue gum extract can be used as a shrinkage-reducing addition in concrete to reduce cracks.

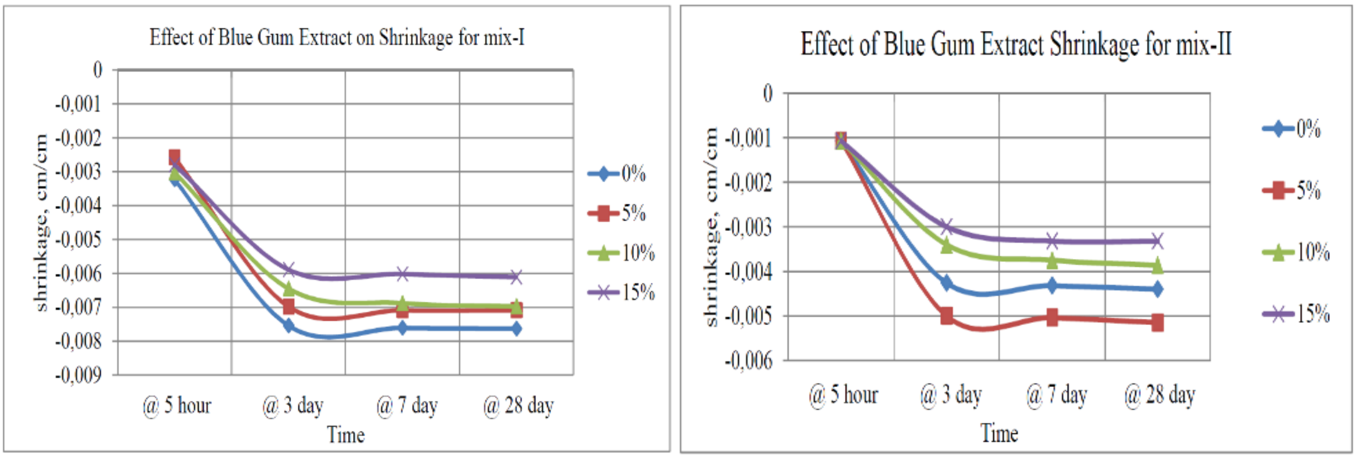


Figure 8. Test results from blue gram effecting on shrinkage (Woldemariam et al. [14])

Otunyo and Koate [15] evaluated concrete properties by replacing sugar cane juice (SCJ) with water in the following proportions: 0, 3, 5, 10, and 15%. The findings indicate that with the increasing percentage of SCJ in the concrete mix, the final setting time of concrete increased, at (15%) of SCJ added (2.5) hours to the setting time. Also, when SCJ content increased, the slump values decreased as at 0% SCJ replacement, the slump values of 60 mm were obtained, and at 15% SCJ replacement, the slump values were 10 mm. As a result, SCJ decreases the workability of concrete. Furthermore, compressive strength dropped as the SCJ amount increased to 10% SCJ replacement, then began to increase for 15% SCJ replacement.

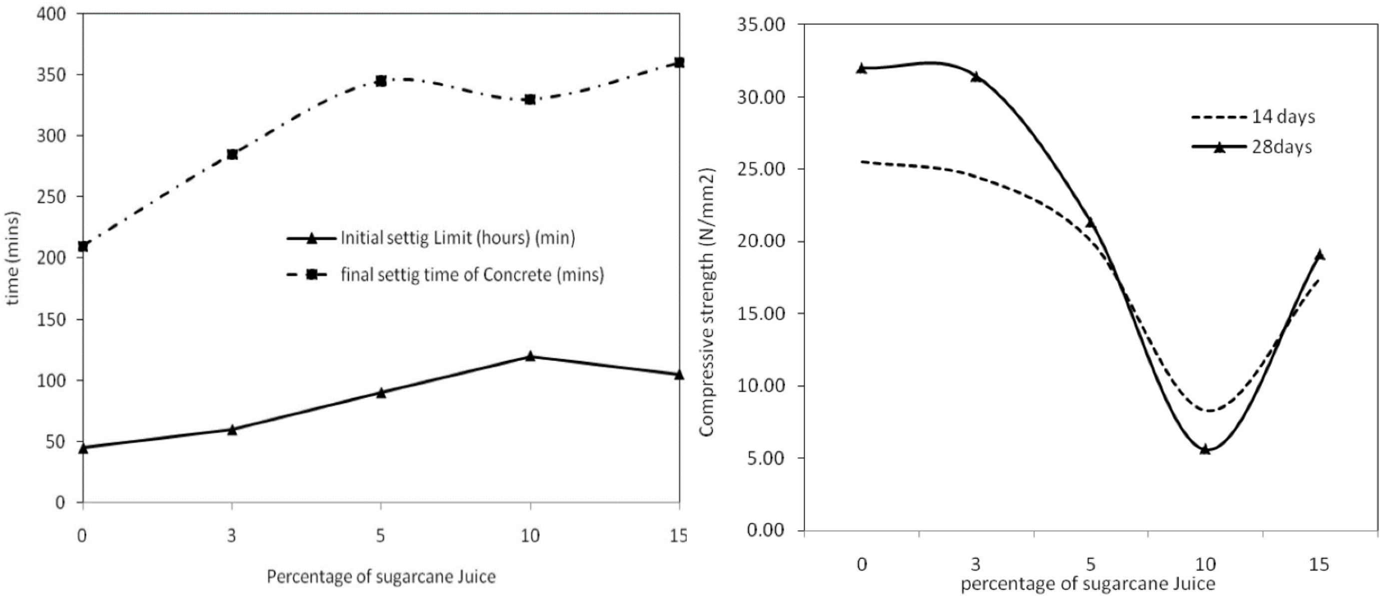


Figure 9. Test results sugar cane juice affects concrete properties (Otunyo and Koate)

Otunyo et al. [16] investigated the effect of sugar cane juice on concrete properties such as setting time, workability, bulk density, and compressive strength. The study found that partial water replacement with SCJ delayed setting time. Furthermore, as the amount of SCJ in the mix increased, the slump values decreased, and the concrete's compressive strength reduced from 39.0 N/mm2 to 13.08 N/mm2 when the dosage of SCJ from 0% to 25% of water replacement. The study also found that replacement of SCJ by 25% and 75% of water, the setting time could reach as long as 42 hours (almost 2 days).

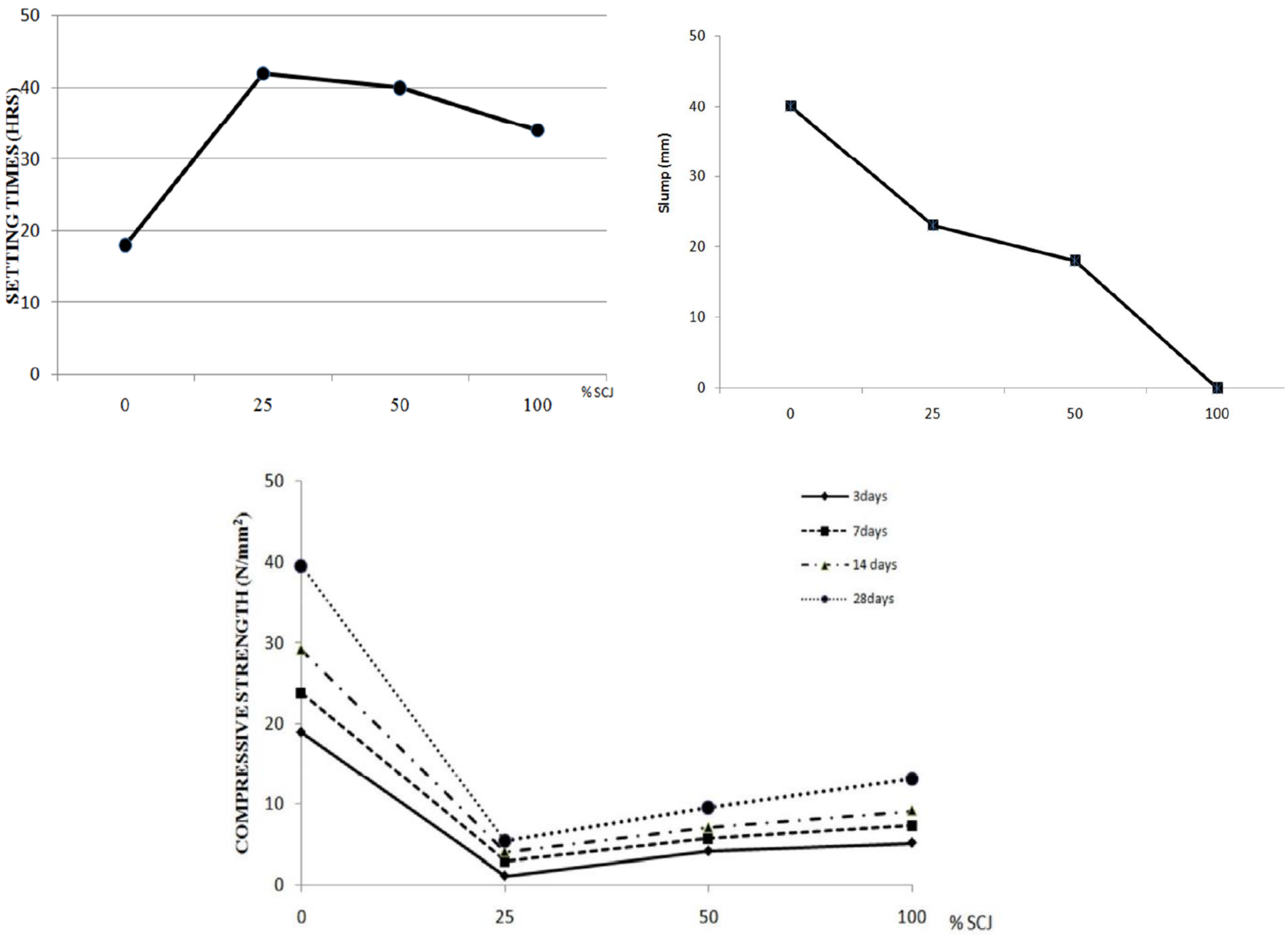


Figure 10. Test results sugar cane juice affects concrete properties (Otunyo et al. [16])

Other studies by Arpana et al. [17] have shown that 0.06% sugar by weight of cement delays both the setting times and leads to a 15% improvement in compressive strength at 28 days for a 0.45 w/c ratio. Sugar concentrations were more than 0.08% by weight of cement fast setting time with no increase in the strength, but the concrete had excessive volume expansion and cracking. They determined that careful use of sugar can be more cost-effective than commercially supplied set retarders.

Okra (Abelmoschus esculents) vegetable extract was investigated by Hazarika et al. [18] for its effects on concrete's consistency, setting time, and compressive strength. According to the results, the bio admixture has a remarkable capacity for water retention. Consistently lower setting times at higher extracts indicate an accelerated hydration reaction in the cement paste. The compressive strength of the biopolymer at its maximum dosage initially decreased, but it recovered after a 7-day curing age, and by 28 days, it reached the strength of a reference mortar. This result is in line with Karandikar et al. [19], who found a maximum strength improvement of 10.25%.

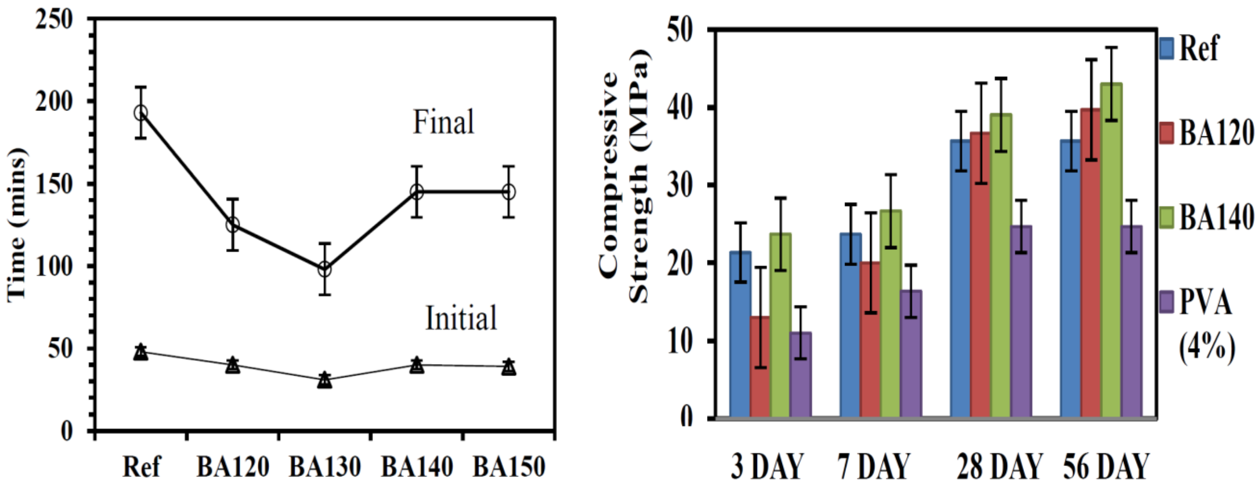


Figure 11. Test results extract okra effecting on concrete properties (Hazarika et al. [18])

Studies conducted by Paul Shaji et al. [20] observed that 0.9% of natural rubber latex improves concrete's compressive strength with a good compacting factor value.

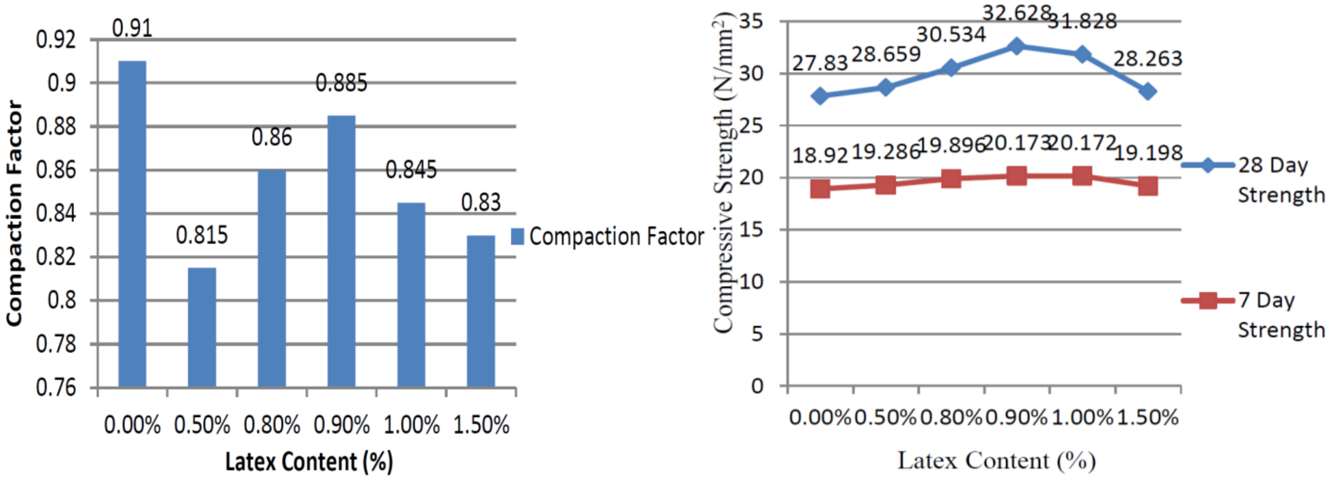


Figure 12. The Flow Chart of The Proposed Model. Test results showed that natural rubber latex affects concrete properties (Paul Shaji et al [20]).

In their study of the properties of gum Arabic concrete (GAC), Elinwa et al. [21] used experimental microstructure and X-ray diffraction techniques to collect data that were then analyzed. These properties included density, workability, water absorption, and compressive strengths. The dosage range of 0.50-0.75% is optimum for application, and with the dosage of GA increased, the compressive strengths of the GAC increased. The best results were obtained at 0.50% dosage, with an increase of 29.5-39.5% over the control. The use of GA increased the properties of GAC and transformed the GA elements into minerals, which influenced the concrete's strength. The water absorption and porosity of GAC increased as the dosage of GA increased, suggesting that a water-reducing admixture with GA may be required. GAC has a normal-weight concrete density.

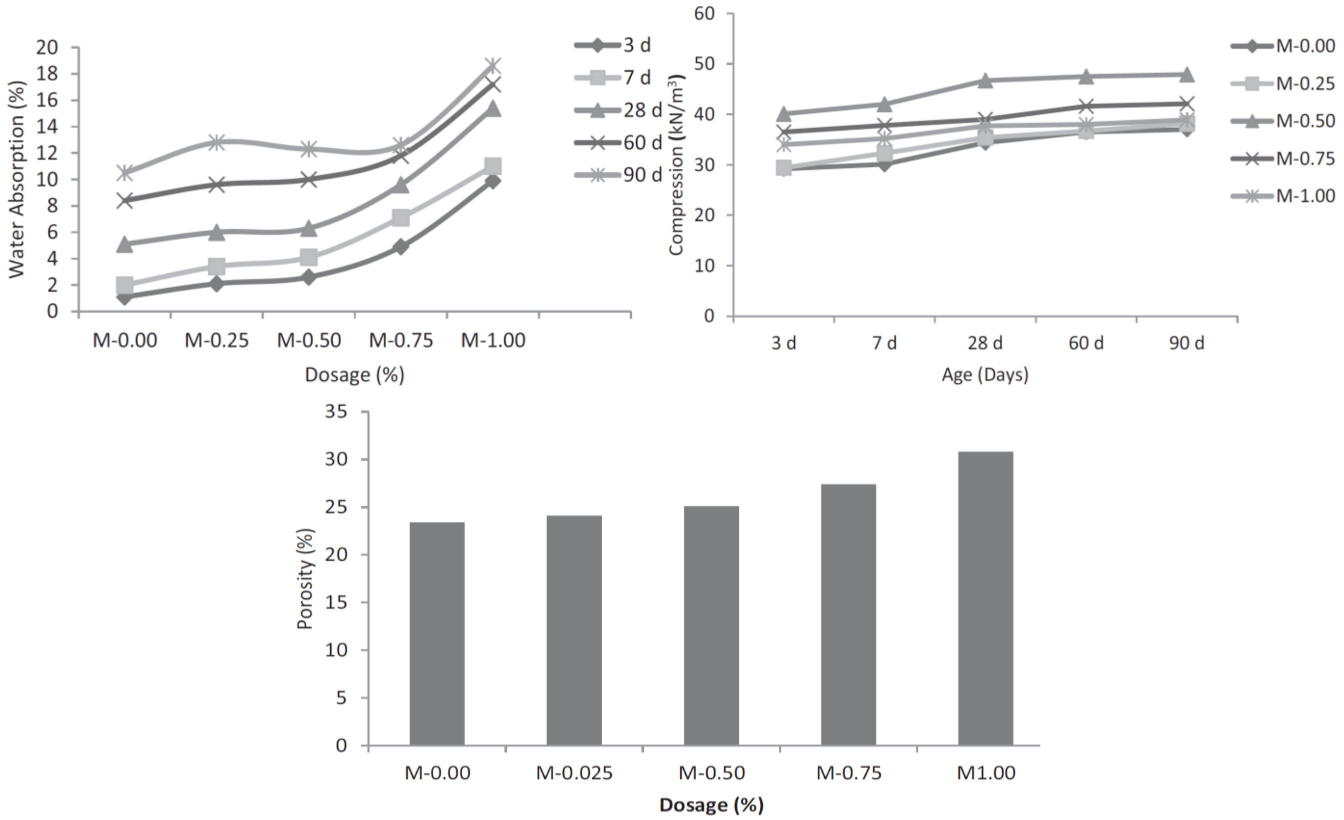


Figure 13. Test results gum Arabic effecting on concrete properties (Elinwa et al. [21])

Ramesh Babu and Neeraja [22] added broiler eggs to concrete at various replacement dosages (0%-0.75%) in the water while keeping the liquid to binder ratio constant at 0.5. The normal consistency of the binder was increased with increasing replacement levels to 1.00% of NAD, causing a decrease in NAD consistency, which was attributed to the fact that NAD film thickness increased on the binder, which resulted in a barrier that caused a delay in hydration. At 0.25% NAD dosage, the binder sets significantly faster than without NAD for all FA replacement levels. Increasing the NAD above 0.25%, NAD increased in the initial setting time. In addition, the increase in NAD dosage decreased slump value at each FA replacement level. Slump reduction was related to increased mix viscosity and ingredient adhesion with the addition of NAD dosage.

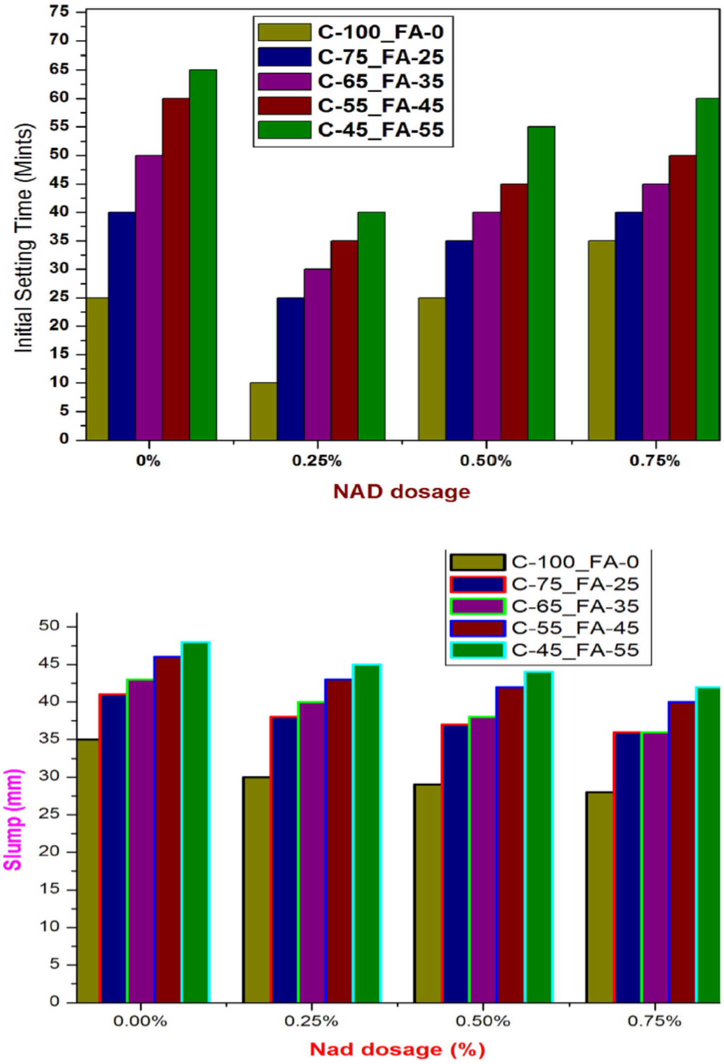


Figure 14. Test results Broiler egg with different Class F fly ash effecting on concrete properties [22]

The addition of viscous material causes concrete slump loss. The compressive strength increased significantly at 0.25% NAD replacement during all curing durations. For concrete without FA, strength gain was 72.04%, 30.83%, 22.64%, and 17.45% at 7, 28, 56, and 112 days, respectively. They concluded that the optimum NAD dosage for type C and type F fly ash mixed concrete is 0.25 %. The improved reactivity of calcium in egg ingredients (NAD) and silica in fly ash occurs more rapidly during all curing durations and causes the production of calcium-silicate-hydroxide (C-S-H) gel, which was often responsible for the increase in strength. The 0.25% NAD dosage positively impacted all fly ash blends. NAD dosage increases above 0.25% reduced the mechanical strength of all mixtures, causing the formation of air voids in concrete or enhancing the content of entrained or entrapped air.

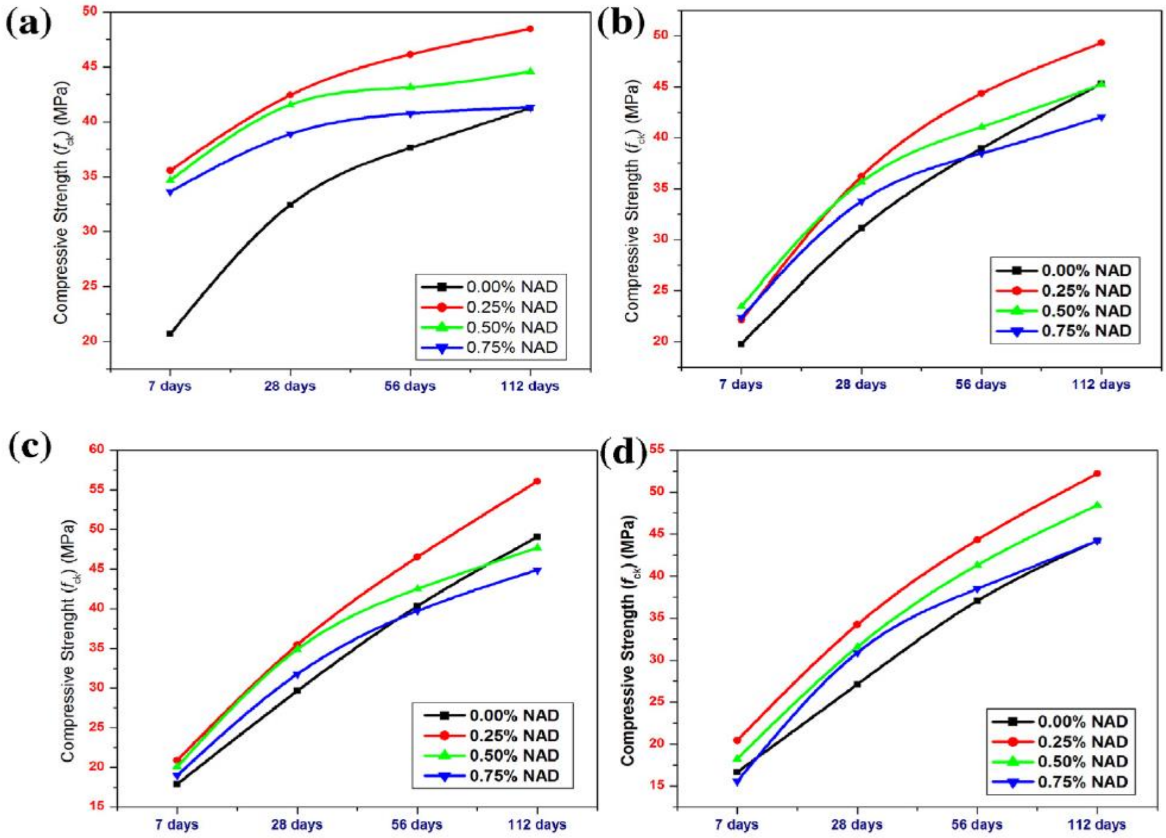


Figure 15. Test results Broiler egg with different ratios of Class F fly ash (FA) affecting concrete properties (a)C-100-FA-0, (b) C-75-FA-25 (c) C-65-FA-35 (d) C-55-FA-45 (Ramesh Babu and Neeraja[22])

Other studies involving Opuntia ficus-indica as an admixture with liquid and powder replacements for cement-based mortars and cement paste samples indicated increasing setting times for both liquid and powder replacements, recommending that Opuntia ficus-indica additives could be used as retarder admixtures. Compressive strength results also indicated an early loss of strength due to the retardation at 3 and 7 days [23].

In other studies, eggshells, egg albumen, jaggery powder, and aloe Vera were used as natural additives (NA) in concrete. The results show that with increasing replacement, the workability of concrete has increased and provided more properties like the ease of applications, breathability, stickiness, moisture resistance, a natural antiseptic, self-healing, durability, low thermal conductivity, non-combustible, solar production, and harmonious balance. However, with time, natural, ecofriendly concrete loses some of its durability and compressive strength [24].

F. Mahmood et al. [25] found that using grape, mulberry extracts, and chemical admixtures with 0.25%, 0.35%, and 1% by weight of cement, respectively, improved the workability and mechanical properties of the concrete. As can be observed, using mulberry extract in concrete costs 85.7% more than using a chemical additive, but using grape extract only costs 61.8% more. The largest of the natural admixtures used in the past and their influence on the properties of concrete are shown in table 1.

Table 1. The Attributes and Data Types of Training Dataset.

Reference	**Type of NA**	**Addition**	**Property studied**	**The action of NA in concrete**
Chandra and Aavik (1983)	Black gram	1, 3, 5% (Cement weight)	Air content, water absorption, compressive strength	Black gram works as an air-entraining admixture, and water absorption is reduced while compressive strength is increased.
Chandra et al. (1998)	Cactus extract	50, 100% (Water replacement)	Water absorption, density, compressive strength, freezing-thawing resistance.	Density and water absorption are decreased, compressive strength is reduced at early ages, and freezing-thawing resistance is increased.
Ismail et al. (2009)	Natural rubber latex (NRL)	1.5, 3, 5% and 2.5, 5, 7.5, 10%	Sodium sulphate resistance (SSR), water absorption	1.5% NRL is the optimum dosage for SSR, and 5% NRL results in low absorption.
Otoko and Ephraim (2014)	Palm liquor (PL)	5, 15, 25, 35% (Water replacement)	Slump, Setting time, compressive strength, splitting tensile strength.	Slump, compressive strength, and tensile strength were increased up to 15% PL and then decreased. Final and initial setting times are increased with increasing PL.
Woldemariam et al. (2014)	Cypress tree (CT)	5, 10, 15% (by weight of water)	Consistency, setting time, flow table, compressive strength	Initial and final setting times increased, workability increased (OD=5%), and compressive strength increased (OD=15%). The performance of the boiled extract is better than the soaked extract.
Sathya et al. (2014)	Water hyacinth (WH)	10, 15, 20% (Water replacement)	Setting time, slump, compressive strength, water absorption.	Setting time, slump, and compressive strength were increased (OD=20%). Water absorption is reduced.
Woldemariam et al. (2015)	Blue gum (BG)	5, 10, 15% (by weight of water)	Shrinkage, cracking	Shrinkage is reduced, OD is between 10% and 15%. Using BG will reduce shrinkage cracking even if the concrete is subjected to direct heat from the sun.

Table 1.Continued

Reference	Type of NA	Addition	Property studied	The action of NA in concrete
Otunyo and Koate (2015)	Sugar cane juice (SCJ)	3, 5, 10, 15% (Water replacement)	Slump, setting time, compressive strength	Setting times were delayed. The slump decreased. Compressive strength was reduced up to 10% SCJ.
Patel and Deo (2016)	Gram flour	1% (Cement weight)	Electrical resistivity, UPV, carbonation depth.	Electrical resistivity was increased, UPV was nearly unchanged, and carbonation depth was reduced.
Muhammed Shareef et al. (2016)	Pulp black (PB)	1, 1.5, 2%	flow, slump, compressive strength, splitting tensile strength	Flow value, slump, compressive strength, and splitting tensile strength are increased up to 1.5% PB and then decreased.
Amaran and Ravi (2016)	Cactus (OFI)	10, 20% (Water replacement)	workability, setting time, Standard consistency, compressive strength	Standard consistency, final and initial setting times, workability, and compressive strength are increased with increasing cactus up to 20%.
Paul shaji et al. (2017)	Natural rubber latex	0.5, 0.8, 0.9, 1, 1.5% (by cement weight)	Compacting factor, compressive strength	There was a compacting factor decrease with latex content of minimum loss at 0.9%. In addition, there was a compressive strength enhancement up to 0.9% latex and a strength loss.
Shobha (2017)	Natural rubber latex	0.5, 1, 1.5% (by cement weight)	Compacting factor, Vee-Bee, compressive strength, split tensile strength, modulus of elasticity, modulus of rupture, rapid chloride ion permeability (RCIP), acid immersion.	Vee-Bee time and compacting factor are increased, and optimum dosage for compressive and split strengths increase by 1% while modulus of rupture increases up to 1.5% latex content. RCIP was reduced to 1.5% latex content, and compressive strength loss after acid immersion was reduced with latex content up to 1.5%.
Ramesh Babu and Neeraja (2017)	Hen egg	0.25, 0.5, 0.75, 1, 1.5% (Binders weight)	Normal consistency, setting time, slump	Normal consistency is increased (OD=1%), setting time is reduced, compressive strength, tensile strength and elastic modulus are increased (OD=0.25%), and slump is reduced (OD=0.75%).

Table 1.Continued

Reference	Type of NA	Addition	Property studied	The action of NA in concrete
Ramesh Babu et al. (2017)	Hen egg	0.25, 0.5, 1% (Concrete volume)	Water absorption, porosity, acid attack	Water absorption and porosity are reduced, and acid attack resistance increases (OD=0.25%).
Pathan and Singh (2017)	Molasses	0.4, 0.6, 0.8% (by cement weight)	Slump, setting time, compressive strength, splitting tensile strength, flexural strength	There is a slump increase, setting time increase, and a slight increase of compressive, slitting tensile, and flexural strengths increased with increasing molasses up to 0.8%.
Elinwa et al. (2018)	Gum Arabic (GA)	0.25, 0.5, 0.75, 1% (by cement weight)	Workability, density, water absorption, compressive strength	Slump, porosity and water absorption are increased with GA increase. The optimum dosage is 0.5% for compressive strength enhancement.
Andayani et al. (2018)	Copolymer - natural latex methacrylate (KOLAM) and copolymer - natural latex styrene (KOLAS).	1, 5, 10% (by cement weight)	Compressive strength, Dynamic properties: load and energy dissipation	There is a compressive strength reduction except for a mix with 1% KOLAM. Impact load is reduced, and energy dissipation is increased by using 1% KOLAM. KOLAS addition into the concrete mixture does not perform well in strength and impact properties.
Aquilina et al. (2018)	Cactus (OFI)	10, 20, 40, 60% (Water replacement)	Consistency, setting time, compressive strength, UPV	Flow is decreased, setting time is increased, and compressive strength and UPV are reduced at early ages.
F.Mahmood et al.(2020)	Mulberry and grape extract	0.35% and 0.35 addition	Slumps, water absorption, compressive strength, tensile,	Improve both slump and compressive strength but a reduction in tensile strength

4. Results and Discussion

According to the results, the most preferred natural admixture type affects the fresh properties such as workability and setting time of concrete and mortar. Some of them work as retarders, which delay the cement's hydration and increase the setting time of concrete and mortar. Examples include palm liquor (PL), cypress tree (CT), Water hyacinth (WH), sugar cane juice (SCJ), pulp black (PB), cactus (OFI), hen egg, molasses, cactus (OFI), mulberry extract, and grape extract are these of natural admixture that improves the fresh properties besides of this these natural admixture were improved the mechanical and durability of concrete and mortar with the optimum dosage that the researchers conducted it. Also, some of the natural admixture act to accelerate, decreasing the setting time of cement mortar such as Okra extract extracted from the plants of the common plant, (Abelmoschus esculent us), some natural admixture such as Black gram worked as air-entraining admixture, and Blue gum (BG) Using to reduce shrinkage cracking even the concrete is subjected to direct heat from the sun. While some of the natural effects on fresh properties have more impact on the mechanical and durability properties of concrete and mortar, such as hen egg, experimental and laboratory tests on using natural admixture can be used for data results from tests.

5. Conclusions

Nowadays, concrete construction methods are focused on a technique known as eco-efficiency, which aims to produce environmentally friendly and highly durable concrete while minimizing both production costs and environmental load. The paper attempts to bring forward the importance of understanding natural Materials taking guidance from the studies that used natural materials in construction. Based on the review of the studies mentioned above, it has been concluded that these studies showed the significance and validity of focusing on environmentally friendly natural admixtures, and these natural admixtures are available in nature. Some are environmental issues, so using them as admixture improves the environmental problem. The data indicate that organic (natural) admixtures are acceptable options. The concrete industry should start moving in this direction because of its nature, which can improve the fresh, mechanical and durability properties of concrete, natural admixtures become less expensive than chemical admixtures, and the use of natural admixtures with the environment is environmentally friendly. At the same time, admixture from nature can be made. The behaviour of natural admixture is highly dependent on the source of the plant or resources; concrete with natural admixture produces green concrete that is environmentally friendly; the production of natural admixture does not require more advanced technology. However, many of them are wastes that cause environmental issues. Also, using natural admixture in concrete construction must be tested and approved because the behaviour of natural admixture depends on the origin of the plant or resources, with the situation of the natural materials.

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References

[1] Gagg, C.R., 2014. Cement and concrete as an engineering material: An historic appraisal and case study analysis. *Engineering Failure Analysis*, *40*, pp.114-140.

[2] Faqe, H., 2020, November. Effect of Chemical Activators on the Compressive Strength of Cement-Slag Mortar. In *IOP Conference Series: Materials Science and Engineering* (Vol. 978, No. 1, p. 012004). IOP Publishing.

[3] Patel, G.K. and Deo, S.V., 2016. Effect of natural organic materials as admixture on properties of concrete. *Indian J. Sci. Technol.*, *9*(37), pp. 1-8.

[4] Faqe, H., Dabaghh, H. And Mohammed, A., 2020. Natural Admixture as an Alternative for Chemical Admixture In Concrete Technology: A Review. *Journal of Duhok University*, *23*(2), pp.301-308.

[5] Thirumalini, P. and Sekar, S.K., 2013. Review on herbs used as admixture in lime mortar used in ancient structures. *Indian J. Appl. Res*, *3*(8), pp.295-298.

[6] Woldemariam, A.M., Oyawa, W.O. and Abuodha, S.O., 2014. Cypress tree extract as an eco-friendly admixture in concrete. *International Journal of Civil Engineering & Technology (IJCIET)*, *5*(6), pp.25-36.

[7] Otoko, G.R. and Ephraim, M.E., 2014. Concrete admixture and set retarder potential of palm liquor. *European International Journal of Science and Technology ISSN: 2304*, *9693*(3), pp. 74-80.

[8] Shareef, K.M., Navaneeth, A.P., Bhavia, K.K., Harikrishna, A.S., Anas, P.M. and Maya, P., 2016. Pulp black liquor-an admixture in concrete. *Int. J. Civ. Eng.*, *3*(3), pp.40-46.

[9] Patel, G.K. and Deo, S.V., 2016. Parametric study of natural organic materials as admixture in concrete. *International Journal of Applied Engineering Research*, *11*(9), pp.6271-6277.

[10] T.S. Ramesh Babua, T.S., Neeraja, D., Daniel, M. and Warabo, U., 2017 Effect of Natural Admixture on Durability Properties of Conventional and Class C Fly Ash Blended Concrete, *American Journal of Engineering Research (AJER)*, 6(10), pp.321-333.

[11] Pathan, S.B. and Singh, V.V., 2017. Using molasses in concrete as a time retarding admixture. *International Journal of Engineering Research & Technology*, *6*(11), pp.509-513.

[12] Izaguirre, A., Lanas, J. and Álvarez, J.I., 2011. Effect of a biodegradable natural polymer on the properties of hardened lime-based mortars. *Materiales de construccion*, *61*(302), pp.257-274.

[13] Sathya, A., Bhuvaneshwari, P., Niranjan, G. and Vishveswaran, M., 2014. Influence of bio admixture on mechanical properties of cement and concrete. *Asian journal of applied sciences*, *7*(4), pp.205-214.

[14] Woldemariam, A.M., Oyawa, W.O. and Abuodha, S.O., 2015. The use of plant extract as shrinkage reducing admixture (SRA) to reduce early age shrinkage and cracking on cement mortar. *International Journal of Innovation and Scientific Research*, *13*(1), pp.136-144.

[15] Otunyo, A.W. and Koate, I., 2015. Sugar cane juice as a retarding admixture in concrete production. *Global journal of engineering research*, *14*(1), pp.17-23.

[16] Otunyo, A.W., Onwusiri, S.C. and Nwaiwu, N., 2015. Effect of sugar cane juice on slump values, setting times and strength of concrete. *Nigerian Journal of Technology*, *34*(2), pp.254-258.

[17] Aprana, A.B. and Keerthi Gowda, B.S., 2017. Effect of Sugar on Setting-Time and Compressive Strength of Concrete. In *International conference ICGCSC-2017, MITE*. pp.335-337.

[18] Hazarika, A., Hazarika, I. and Saikia, N., 2016. The effect of a plant based polymeric material on the fresh and hardened states properties of cement mortar. In *1st International Conference on Civil Engineering for Sustainable Development-Opportunities and Challenges*. Guwahati, India, pp. 1-5.

[19] Karandikar, M.V., Sarase, S.B., Lele, P.G. and Khadaikar, S.A., 2014. Use of natural bio-polymers for improved mortar and concrete properties of cement–a review. *Indian Concrete Journal*, *88*(7), pp.84-109.

[20] Aswathi, K.P., Hanna, P., George, J.K. and Shameer, K., 2017. Effect of Natural Rubber Latex as admixtures in concrete. *Int. Res. J. Eng. Technol.*, *4*, pp.2031-2034.

[21] Elinwa, A.U., Abdulbasir, G. and Abdulkadir, G., 2018. Gum Arabic as an admixture for cement concrete production. *Construction and Building Materials*, *176*, pp.201-212.

[22] Ramesh Babu, T. and Neeraja, D., 2017. A experimental study of natural admixture effect on conventional concrete and high volume class F flyash blended concrete. *Case studies in construction materials*, *6*, pp.43-62.

[23] Aquilina, A., Borg, R.P. and Buhagiar, J., 2018, November. The application of Natural Organic Additives in Concrete: Opuntia ficus-indica. In *IOP Conference Series: Materials Science and Engineering* (Vol. 442, No. 1, p. 012016). IOP Publishing.

[24] Raj, S.M., Raja, C.K., Karuthapandi, M. and Saranya, M.V., 2019. Experimental Study on Eco-Concrete using Natural Admixtures. *SSRG International Journal of Civil Engineering (SSRG-IJCE)*, pp.5-7.

[25] Mahmood, H.F., Dabbagh, H. and Mohammed, A.A., 2021. Comparative study on using chemical and natural admixtures (grape and mulberry extracts) for concrete. *Case Studies in Construction Materials*, *15*, p.e00699.