Effect of natural admixture on the Compressive Strength of Concrete (Review paper)

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Abstract

Environmental productivity, a technique for creating exceptionally durable and environmentally friendly concrete while minimizing both production costs and environmental impact, is currently the primary performance criterion for concrete buildings. All concrete construction requires the use of additives, some of which are hazardous to people and pollute the environment when they leach. Using natural resources as concrete additives is one of the eco-efficiency method's strategies, which is based on this idea. The paper continues by elucidating the experiment results acquired during exploratory work on the utilization of natural materials in the laboratory and their effects on the mechanical, fresh, and lasting properties of cement, mortars, and concretes. The study suggests that additional research in these areas will be encouraged by the observed effects of adding these natural materials on the characteristics of concrete and mortar, ultimately enhancing the sustainability of concrete projects. To affect the mechanical and durability properties of concrete, several natural elements are added as an admixture. This study provides a critical assessment of these materials. In terms of environmental impact, this type of admixture can be regarded as eco-friendly, and it is less expensive than chemical admixtures.

Keywords: Natural admixture, Chemical admixture, Durability, Compressive strength.

1. Introduction

The main ingredients of concrete, which is the most often used building material in the world, are Portland cement, several kinds of aggregate, water, and admixtures. With approximately one ton produced for every human person on the planet, concrete is the second most used material worldwide, slightly less than water. Chemical admixtures are frequently used in today's constructions to enhance the characteristics of concrete or lower the water content required to mix it. Concrete's qualities can be enhanced by chemical admixtures, although the environment may be contaminated. Moreover, it is detrimental to one's health for some chemical admixtures to emit substances like formaldehyde. In addition, chemical admixtures pose environmental hazards during production, handling, leaching, storage, transportation, and application in the construction process. Therefore, it is beneficial to design substitute admixtures in order to produce environmentally friendly concrete. Scientists and researchers working with concrete are working around the world to develop non-chemical admixtures that are considered environmentally acceptable and eco-friendly building materials. They consist of fruits, herbs, and animal-derived ingredients. Combinations of organic and biopolymers created by biotechnological techniques are known as bio-admixtures. A natural combination made of fruit or herb extracts seems like an intelligent decision. In spite of this, little research has been done in this field. Since natural admixtures are less expensive and have less of an impact on the environment than chemical admixtures, they are seen as environmentally beneficial. This research examines the results and analyses of studies that supplement concrete with natural and organic materials to improve the material's mechanical and long-term properties as well as its novel features. Scientists and researchers can learn more about these admixtures, which are thought to be environmentally sustainable and eco-friendly building materials, by looking at research on the use of natural resources in concrete construction. Furthermore, employing waste products as admixtures—mostly natural materials—produces no extra benefits.

2. Review of the Literature

Studies conducted on historic structures have revealed the usage of lime as a plant extract and in building. However, it is evident that plant extract improves the durability of concrete given that some of the structures have endured for millennia and demonstrated their resistance. Furthermore, it has been demonstrated in recent experiments that adding vegetable or agricultural waste might enhance durability and mechanical qualities. An agricultural or vegetable waste product is a less expensive, more eco-friendly, and natural substitute for a chemical admixture. Furthermore, the liquid extraction process has a major effect on the residual qualities of the concrete.

According to Paul shaji et al. [1], the latex is only tree that can naturally make rubber latex is the para rubber tree. All that latex refers to is a liquid polymer based on water. Natural rubber latex is not what is meant by the term "latex" in isolation. Additionally, latex refers to the organic polymer that has been dispersed throughout the concrete during mixing. First planted in South America, rubber trees are subsequently grown in Kew Garden, England, Sri Lanka, Indonesia, and Singapore.Kerala was where it was initially grown in India. These days, rubber trees are growing in Karnataka as well, therefore conducting experiments on natural rubber latex in relation to concrete would be interesting. Since natural rubber latex increases the concrete's flexural and tensile strengths when added in modest amounts, it also strengthens the concrete's compression strength. Given that natural rubber latex is created by the polymerization of a single monomer, this process is known as polymerization. The primary criterion for determining the mechanical properties of concrete is its compression strength. In this case, the compressive strength of the concrete is measured for different percentages of natural rubber latex added to the concrete; where the natural rubber latex was added at a lower percentage, the natural rubber latex added concrete's compression strength increased up to 0.9% of the total;

thereafter, the natural rubber latex added concrete's compression strength decreased; hence, 0.9% is the ideal percentage of natural rubber latex for the compression.

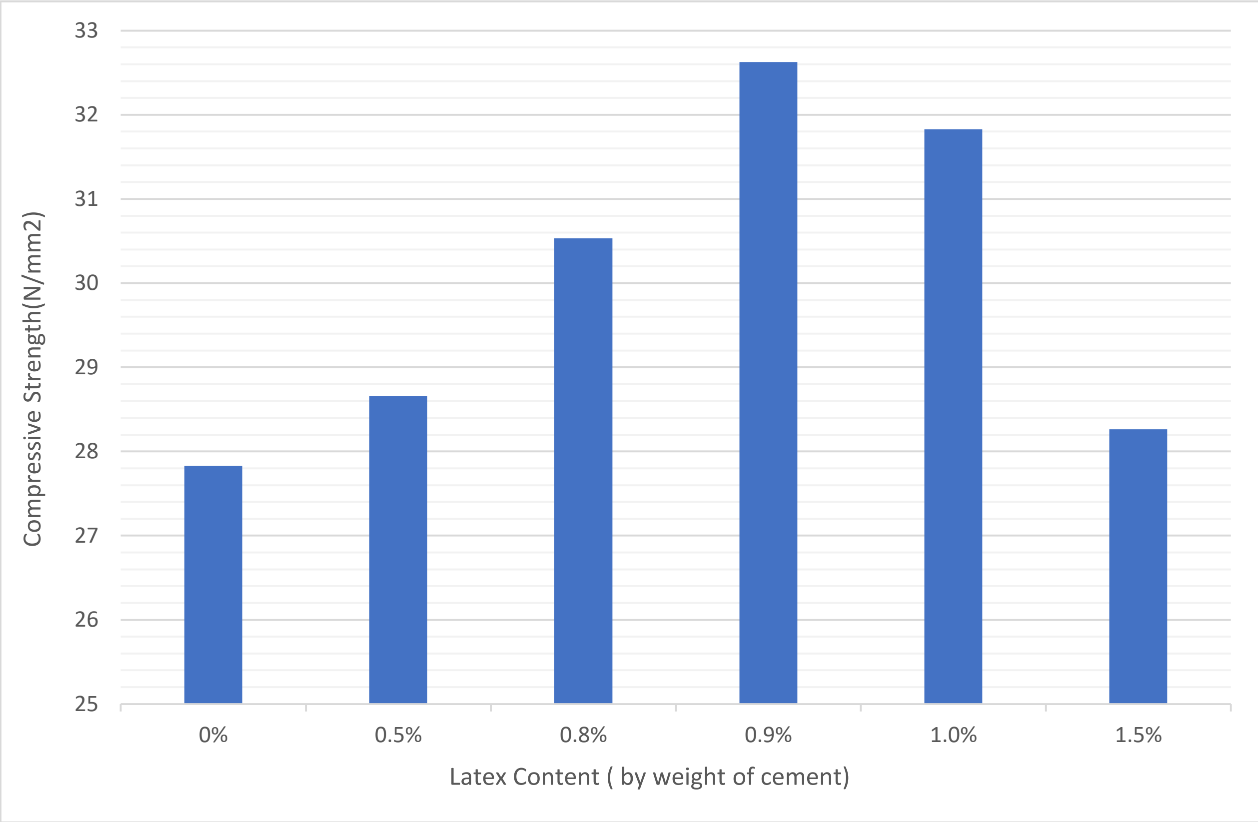


Figure 1. Test results Latex content Vs Compressive Strength [1]

(Sumaiya Afroz et al. [2]) studid a starchy material known as arrowroot powder taken from the roots of the tropical plant called Maranta arundinacea. It is utilized in Bangladesh's textile sector and for cooking, among other things. The arrow-root powder that was utilized had a fineness value of 732 m2/kg and was white in color and odorless. At room temperature, it was quite soluble in water. There hasn't been any mechanical, hydrothermal, or chemical preparation used. To make the admixture application process simple, untreated arrowroot powder was utilized. An arrowroot's overall biodegradability has been evaluated using a standard wastewater characterisation index. The arrowroot's observed biodegradability index (BI) was 0.19, which is less than the 0.4 criterion and confirms the plant's minimal biodegradability. The compressive strength of concrete specimens containing arrowroot additive displayed a slower increase in strength at an early curing age, as illustrated in Figure 2. The tendency changed after 14 days of curing, and concrete with an additive continued to build strength at an accelerated pace for up to 120 days. All of the starch-infused mixes' compressive strengths exceeded the control's values after 28 days. While there is no clear trend regarding the impact of starch additive on concrete's compressive strength, it has been noted that the presence of arrowroot admixture kept the strength of the material within acceptable bounds, even surpassing that of control samples at later ages.

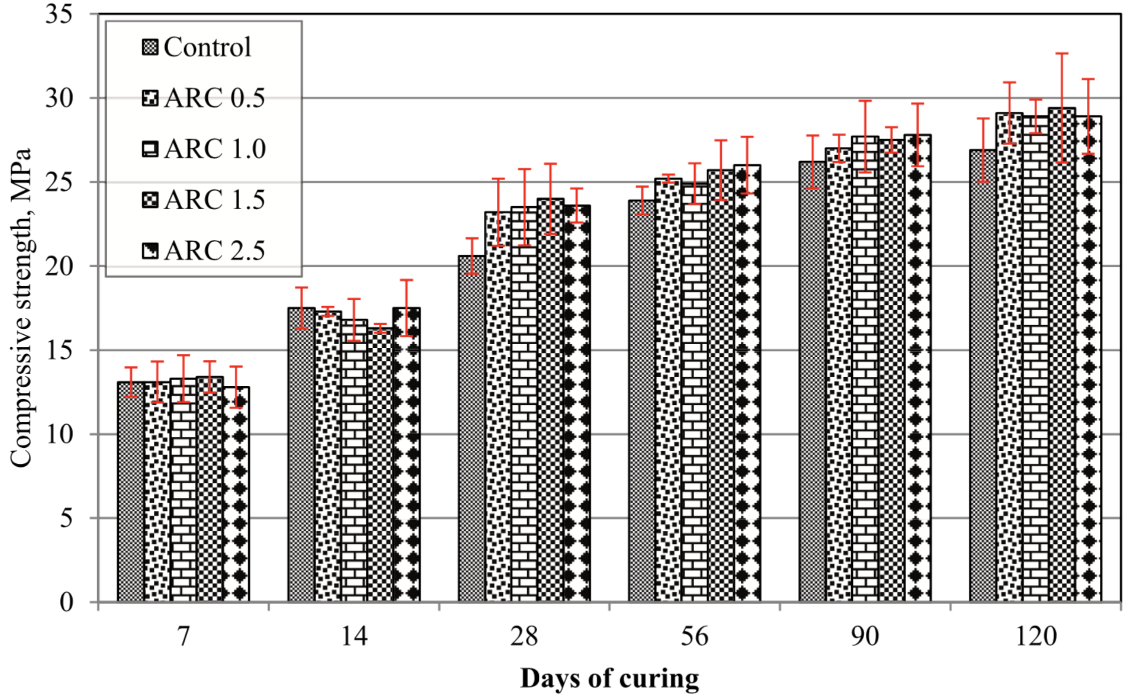


Figure 2. Test results compressive strength of concrete specimens with arrowroot admixture [2]

In a study by AMARAN et al. [3], Opuntia Ficus Indica was employed as a natural organic admixture in this investigation. Cactus leaves were sliced into tiny bits and submerged in water. One part water and three parts cactus by weight was the ratio used to create the extract. After that, the leaves are manually crushed.

The admixture-modified concrete's compressive strength was found to be higher than that of the reference concrete after the test was conducted on 7, 14, and 28 days. Comparing the concrete cube to the reference cube, Figure 3 illustrates how the compressive strength of the concrete cube increases.

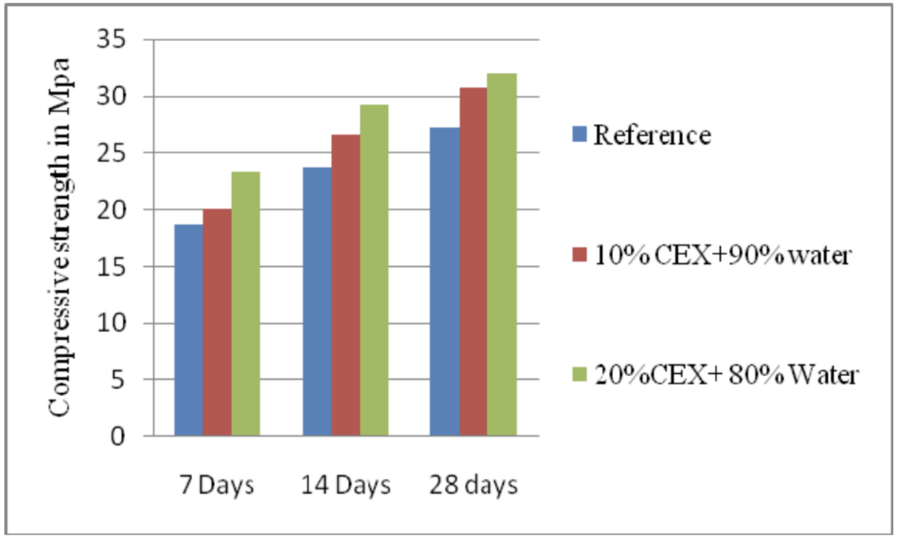


Figure 3. Test results of compressive strength of concrete specimens with Cactus admixture [3]

KOLAS and KOLAS are the polymers used in a study by Andayani et al. [4] as additives for concrete. They were made from natural rubber latex and grafted using either methacrylate (KOLAM) or styrene (KOLAS) utilizing a gamma-ray reactor (BATAN and PT. Rel Ion Indonesia study). Using commercial concrete additives, SBR and latex methyl methacrylate, their structures were created to be identical. Concrete quality will be impacted by polymer quality. [4])

After being cured for 28 days in saturated lime, the concrete was assessed for both static and dynamic qualities. Concrete's compressive strength was evaluated in a static environment. To learn more about the impact of polymers in the concrete mixture, it was examined. With the exception of KOLAM 1%, the compressive strength of polymer-modified concrete decreased (about equivalent to normal). Compressive strength will decrease more when polymer percentage in concrete mixtures increases. In Figure 4, the compressive strength values were displayed.

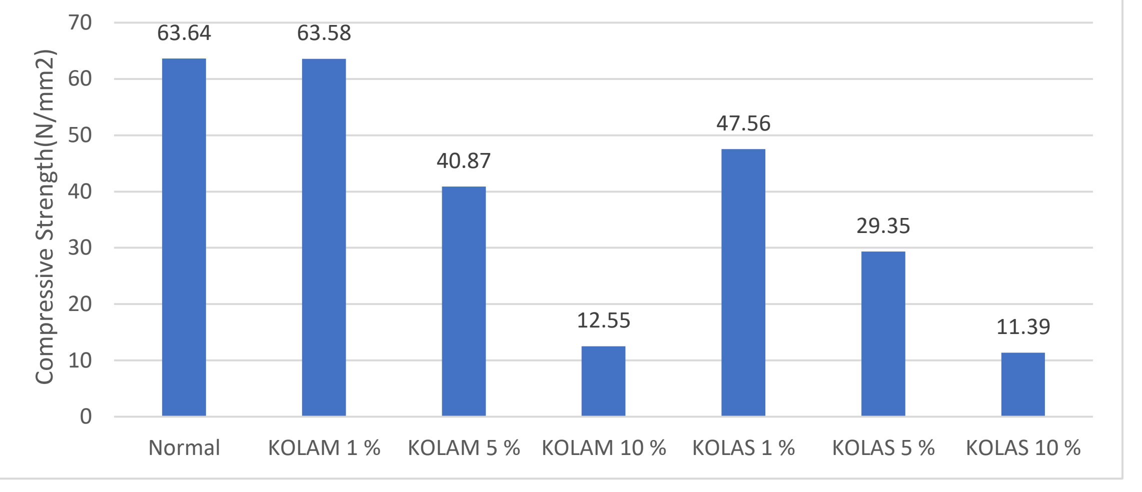
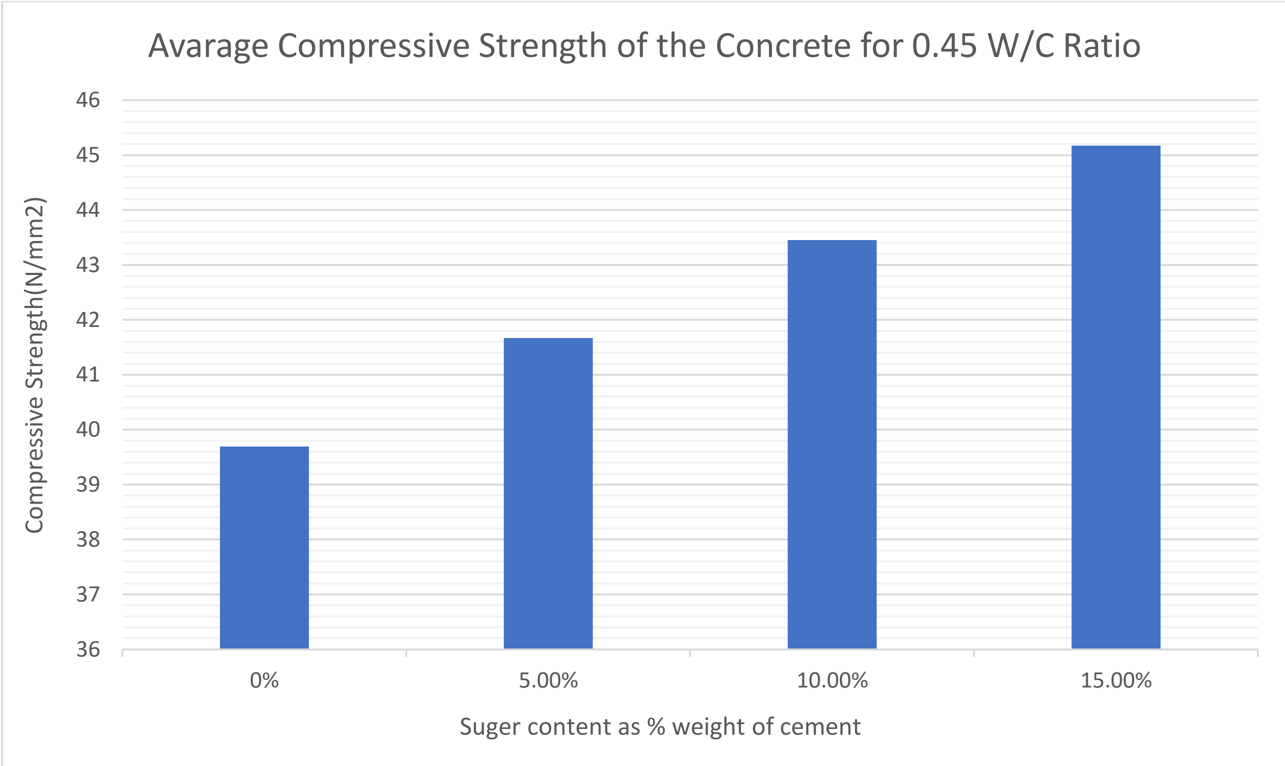
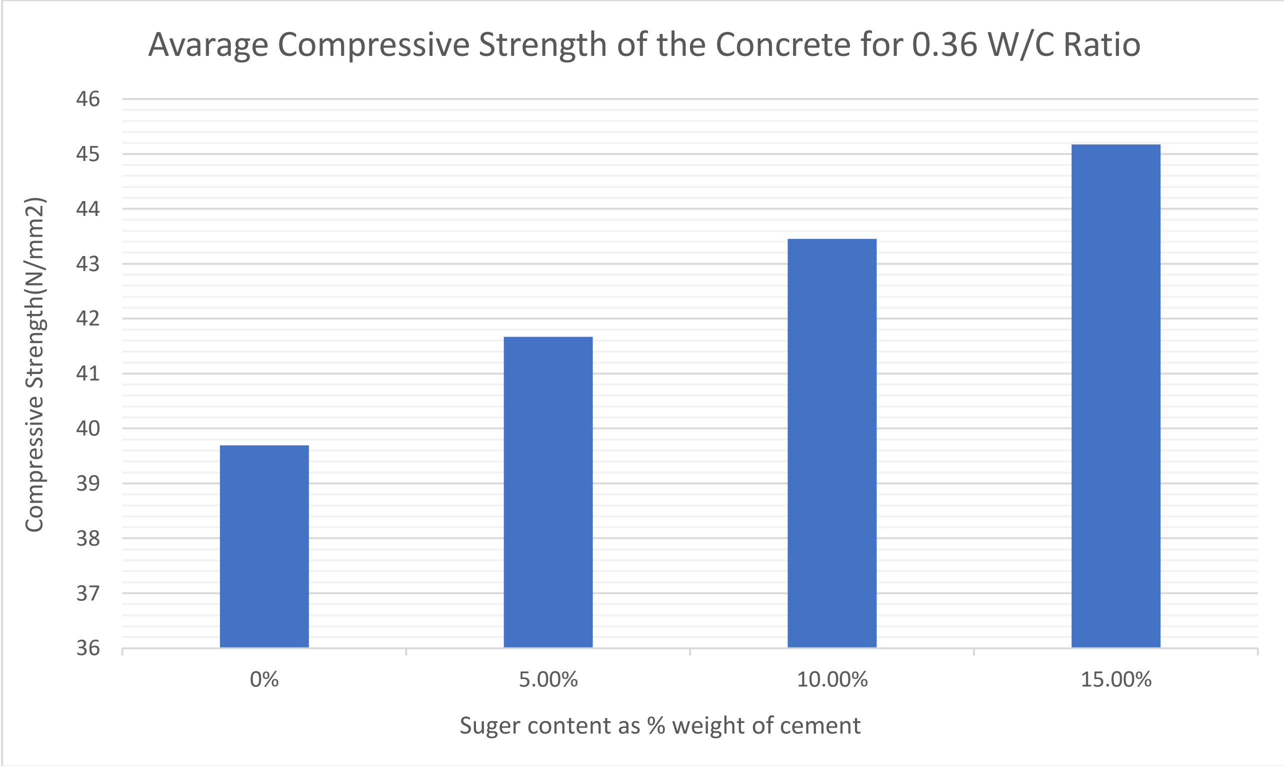


Figure 4. Test results compressive strength of concrete specimens with KOLAS [4]

According to DEVAKATE et al. [5], concrete was made with the use of sugar. A white, crystalline material that is readily available in stores, readily soluble in water, and utilized in experiments. Three separate dosages of sugar were added to the concrete mix: 0.0, 0.02, 0.04, 0.06, 0.08, 0.1, 0.2, and 1.0% by weight of cement.When utilized in the optimum ratio, sugar has the effect of retarding; nevertheless, when used in excess, it has the opposite effect and accelerates. Thus, it needs to be used under careful supervision. It has been discovered that adding 0.06% by weight of cement to a 0.45 w/c ratio will postpone the setting period and boost the compressive strength by around 15% after 28 days. With a minimal increase in initial strength, sugar added to cement above 0.08% by weight sped up the setting time. As fissures appeared in the sample, an excessive volume growth was observed. Therefore, using sugar sparingly can be more cost-effective than using set retarders that are sold in stores.





Avarage Compressive Strength of the Concrete for 0.36 W/C Ratio
Compressive Strength(N/mm2)
46
45
44
43
42
41
40
39
38
37
36
0%
5.00%
10.00%
15.00%
Suger content as % weight of cement

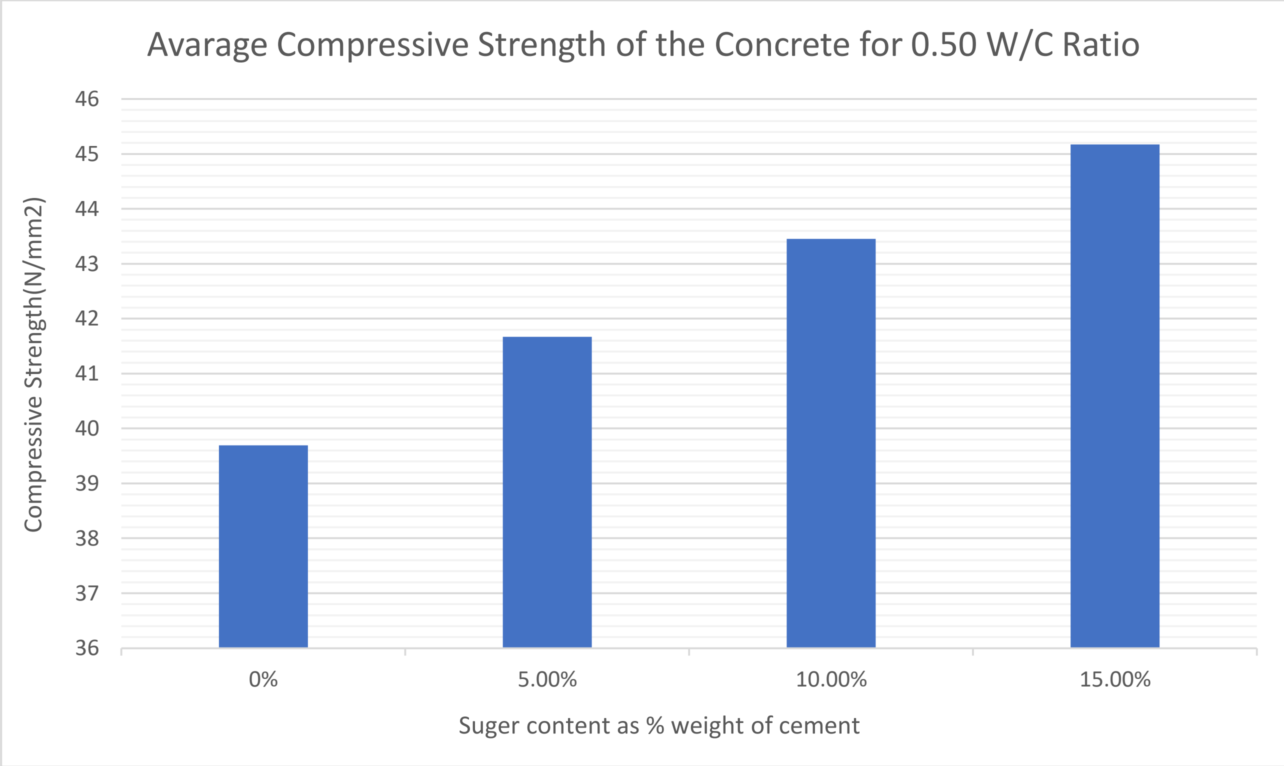


Figure 5. Test results compressive strength of concrete specimens with Suger [5]

Bahadur et al. [6] worked on molasses which was a raw ingredient used in many industries, including the animal feed business, to produce glycerine, alcohol, and ferments. About 173 cooperative sugar factories that produce sugar are now in operation in Maharashtra. After waste items are disposed away, negative environmental effects become apparent. As a result, numerous researchers have employed the waste materials in a variety of ways.

As a result, sugarcane molasses has been applied similarly to admixtures that reduce water . In addition, it reduces the cost of concrete compared to other admixtures while simultaneously boosting compressive strength. Ultimately, the concrete's quality, workability, durability, and strength will all be enhanced.

according to IS: 9103-1999. A 12% increase in compressive strength in the prepared concrete indicates that the additive used is a water-reducing admixture. The compressive strength of concrete cubes with different molasses dosages is displayed in chart 6. The outcome demonstrates that the dosage of molasses has no linear effect on compressive strength.

As seen in chart 6, a graph of compressive strength at different molasses dosages was drawn for each blend.

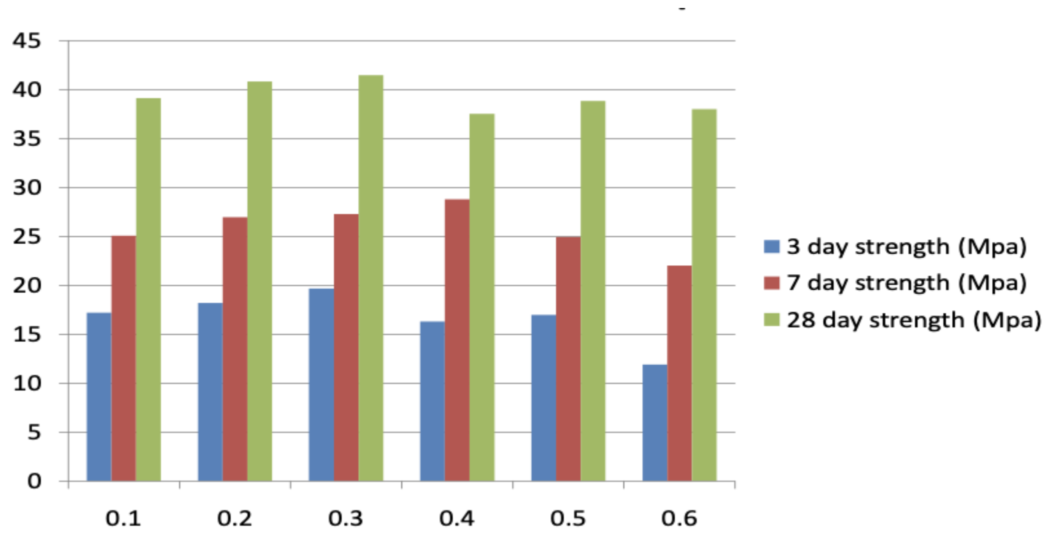


Figure 6. Test results compressive strength of concrete specimens with sugarcane molasses [6]

The findings demonstrated that in all three sample mixes, the compressive strength value for the 3-day strength dropped, as the observations provided below demonstrate. This may result from the concrete starting to gel into sucrose in the presence of water.

The 7-day strength suggests that longer hardening times are caused by higher molasses concentrations in the concrete mix. The molasses dosage of 3.30 percent produced the greatest outcomes for all mixtures.For every mix sample, the concrete compressive strength value at the 28-day strength was increased by up to 0.30% of the molasses dose. However, as the molasses dosage was increased beyond 0.30 percent.

The amount of proteins, lipids, and polysaccharides in the dried cactus gel was determined through analysis. The presence of fat in the additive was assessed using the crude fat test in accordance with IS: 7874-1975, and the amount of protein was assessed using the Kjeldahl digestion test . The polysaccharide content was computed based on the percentage mass of protein and fat, and the findings are shown. About 5% of cacti are polysaccharides, 1.82% are proteins, and 0.12% are lipids.

The primary functional organic groups of the addition that was utilized were identified using Fourier Transform Infrared Spectroscopy (FT-IR), which was also used to determine changes in the hydrated phases of the concrete caused by the contact of cactus gel.

Figure 7 shows the compressive strength values for the reference and CEX-modified concretes after 7, 28, 56, and 90 days of water curing. According to the obtained data, compressive strength falls regardless of the CEX% after 7 days of curing, but it increases with increasing CEX% after 28, 56, and 90 days of curing. Based on the previously noted changes in moisture retentivity and the role polysaccharides play in retaining the moisture content in cement, the early-stage reduction in strength at 7 curing days may be caused by the hardening retard in biopolymer modified cement (see bending vibration at 3460 cm^1 in CEX modified cement FTIR spectrum attributable to polysaccharides effects.

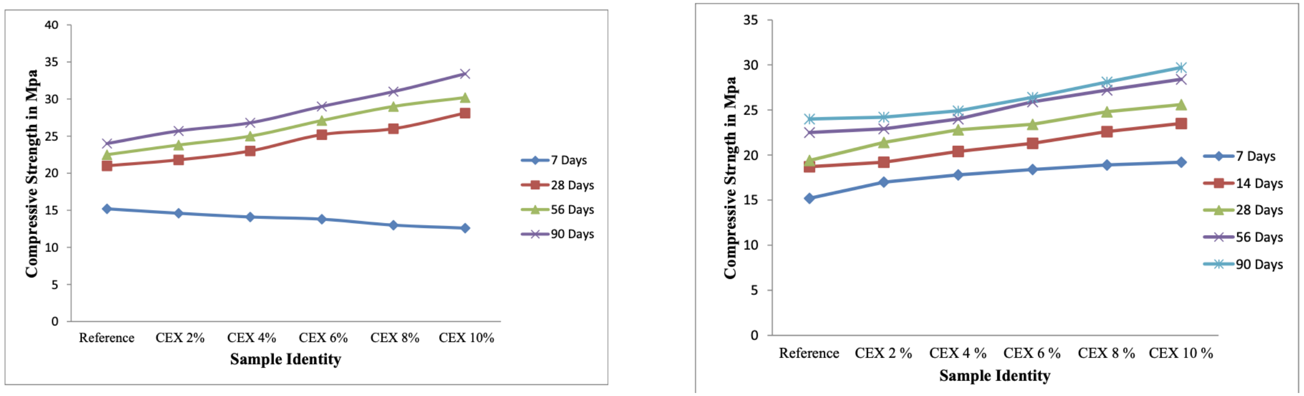
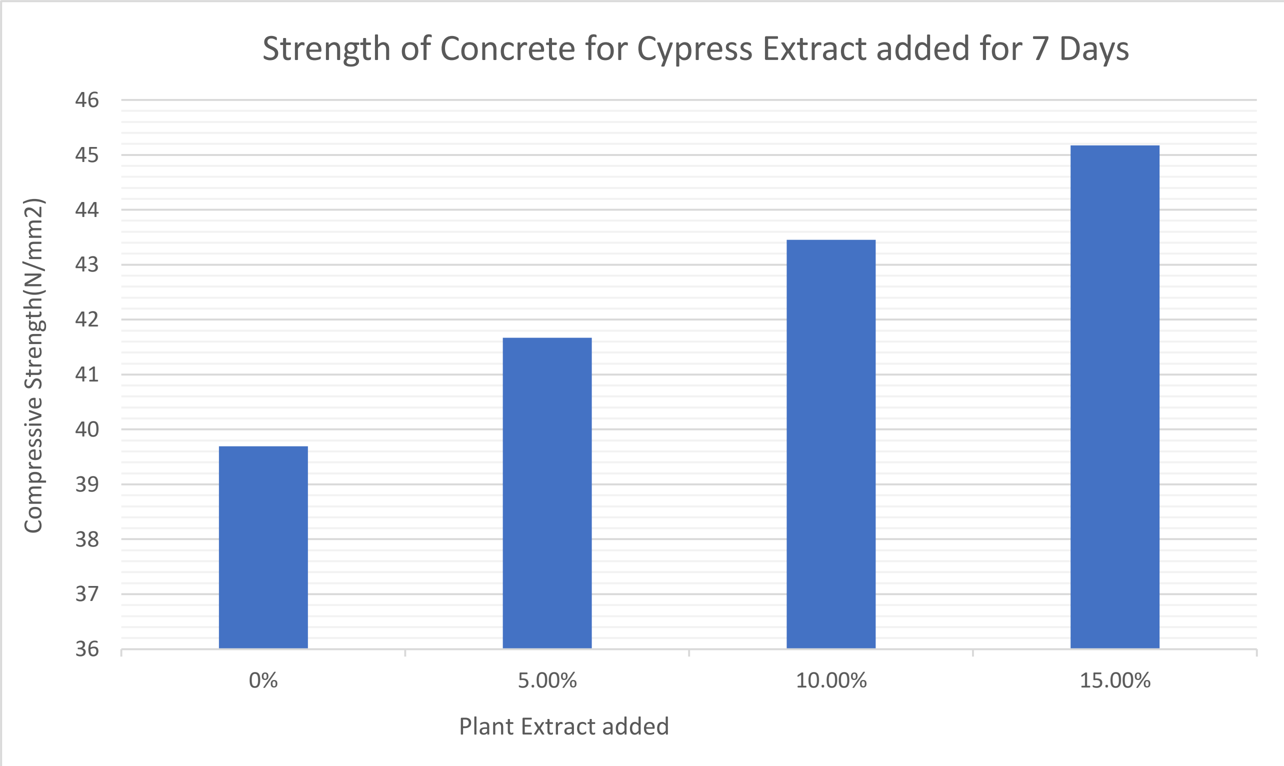
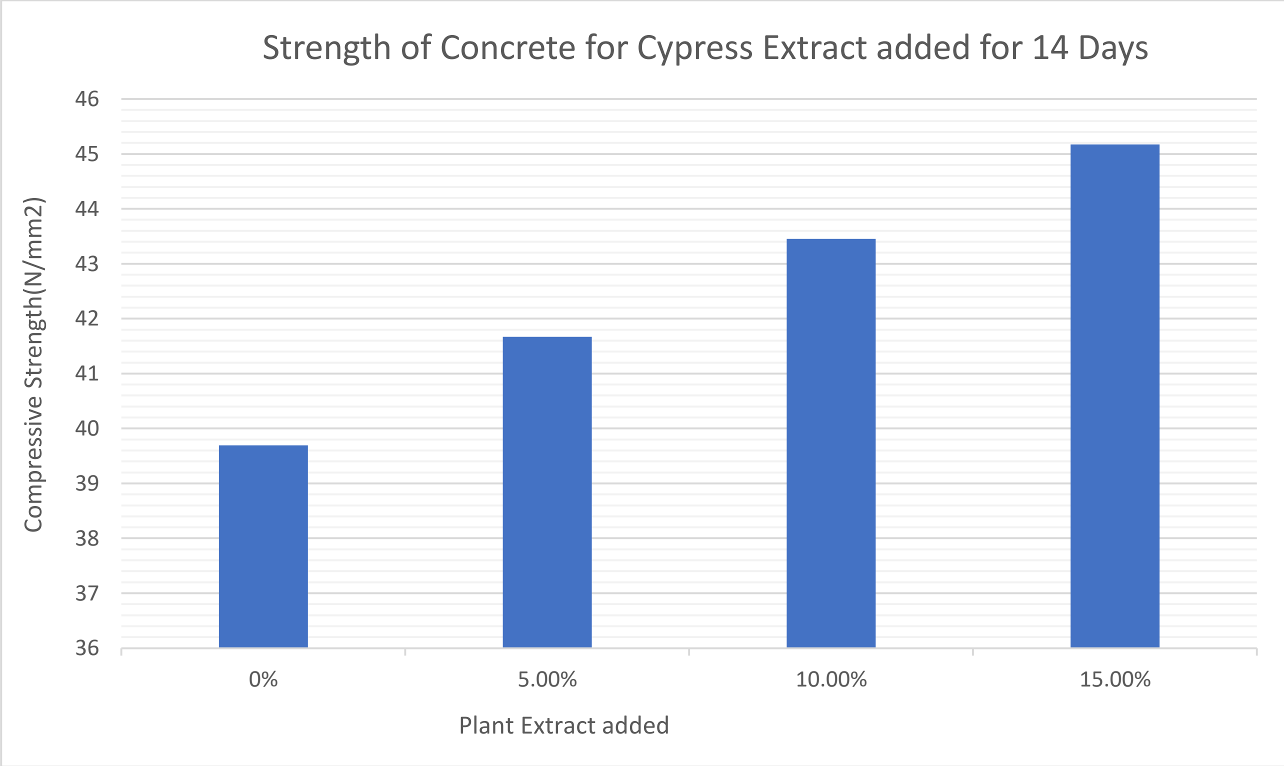


Figure 7. Test results compressive strength of concrete specimens with cactus [7]

Based on works by Woldemariam et al. [8], the cypress bark was boiled in water and then soaked in cold water to create the plant extract that was used as an admixture. In the first instance, cypress bark was chopped into extremely tiny bits, and one kilogram of the bark was pressure-boiled for two hours with four litters of water. Following several boils, an average of 700 ml/kg was achieved. For the second, cypress tree bark was chopped into chopped into tiny pieces and steeped in one liter of water with one kilogram of bark for a whole day. After the entire day, it was thrashed forcefully for five minutes in order to extract an average of 900 milliliters per kilogram.

The compressive strength of two types of plant extract—boiled and water-soaked—as well as two mixtures, two slumps, and two dosage percentages were investigated. They measured the compressive strength at 7, 14, and 28 days. The results of the compressive strength test indicated that the extract that was heated in water had a 15% rise in compressive strength, whereas the extract that was soaked in water had a 5% increase before falling. As a plasticizer, the boiled plant extract strengthened the concrete and decreased the quantity of water needed.




Strength of Concrete for Cypress Extract added for 14 Days
Compressive Strength(N/mm2)
46
45
44
43
42
41
40
39
38
37
36
0%
5.00%
10.00%
15.00%
Plant Extract added

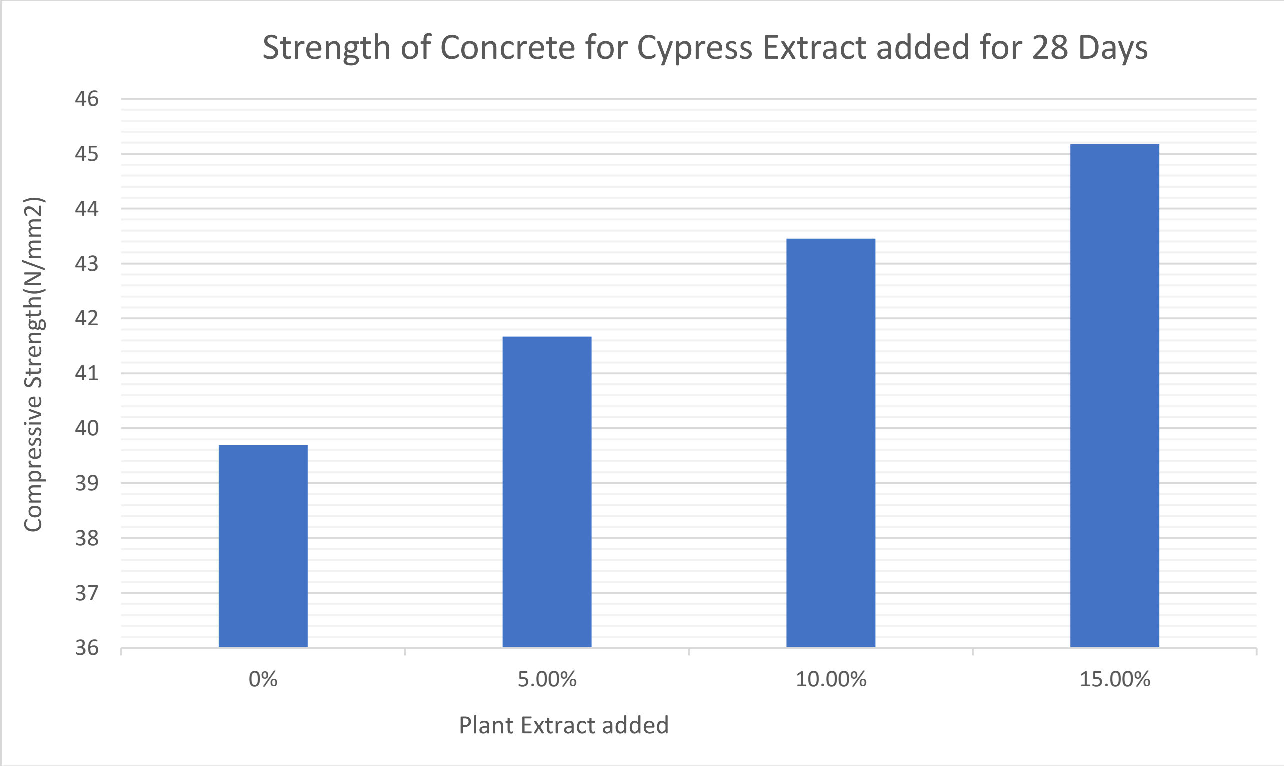


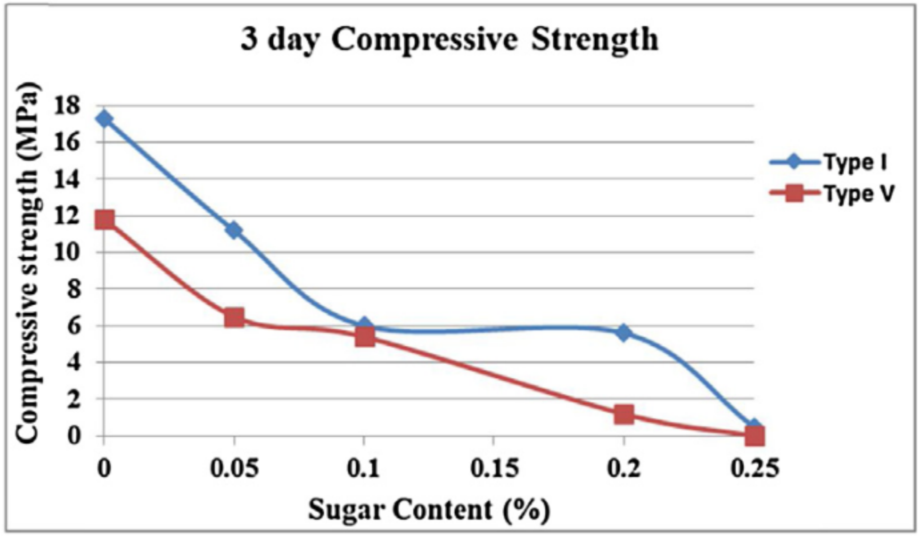
Figure 8. Test results compressive strength of concrete specimens with Cypress Extract [8]

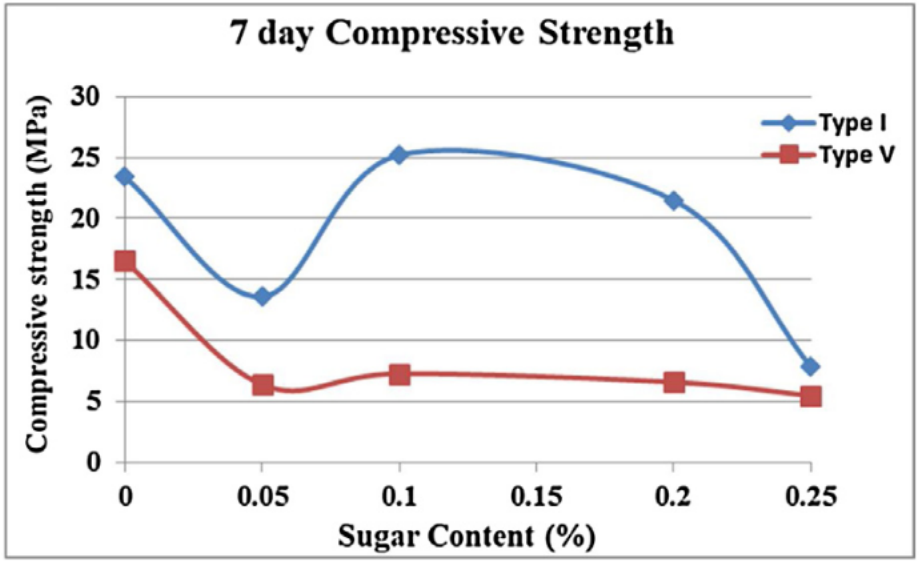
Ahmad et al. [9] reported that the majority of research on the use of sugar as a set retarder concentrated on how long it took for these concretes to set; the impact of adding sugar on strength was not given as much consideration. The suggested dosage of sugar cannot be determined just by the setting phenomenon because there is insufficient data regarding the impact of sugar incorporation on the strength of concrete. Furthermore, the issue of the existing organic/inorganic liquid retarders' short shelf lives necessitates the development of alternative solid type retarders that can address these issues. Thus, the goal of this work was to demonstrate how sugar content affects the setting time and strength of two different types of cement (Type I and Type V), extensively utilized in Saudi Arabia, which led to the choice of the ideal sugar dosage as a substitute retarder. A series of ten mortar combinations were used to investigate the impact of sugar on the microstructure and compressive strength, while ten cement paste samples were examined to determine the influence of sugar dose on the setting time.

Figure 9 displays the data plots illustrating the change in the Type I and Type V cements' 3-day compressive strengths with respect to their sugar content. The data in Fig. 9 show a clear decline in compressive strength with an increase in sugar content. The delayed hydration of cements at a larger dosage of sugar is the cause of the negative effect of sugar on compressive strength at the young age of three days.

Unfortunately, as Fig. 9 illustrates, the impact of sugar concentration on the 7-day compressive strength of Type I and Type V cements differs from that on the 3-day compressive strength. The inclusion of 0.05% sugar significantly reduced the 7-day compressive strength for both types of cements. When sugar content is increased beyond 0.05%, Type V cement's 7-day compressive strength is not significantly affected by it; nevertheless, when sugar content is increased from 0.05% to 0.1% in Type I cement, the cement's 7-day compressive strength increases significantly.

Fig. 9 illustrates the impact of sugar content on 28-day compressive strength. It is evident from the plots of the 28-day compressive strength data that, for both types of cements, there is no discernible decrease in compressive strength up to a 0.1% sugar concentration. Up to a dosage of 0.2%, the compressive strength declined as the sugar concentration increased. Nevertheless, for both varieties of cements, a rise in compressive strength was observed at a 0.2% sugar level.


3 day Compressive Strength
Compressive strength (MPa)
18
16
14
12
10
8
6
4
2
0
0
0.05
0.1
0.15
0.2
0.25
Sugar Content (%)
Type I
Type V


7 day Compressive Strength
Compressive strength (MPa)
30
25
20
15
10
5
0
0
0.05
0.1
0.15
0.2
0.25
Sugar Content (%)
Type I
Type V

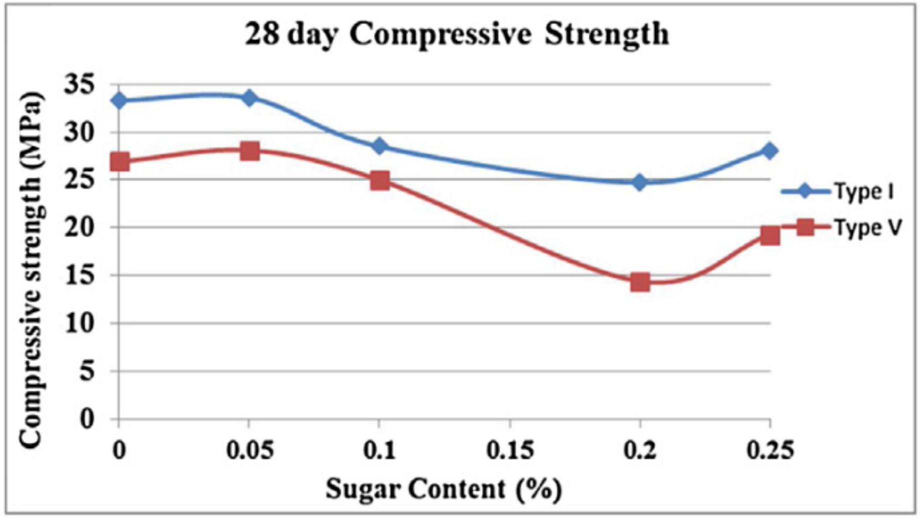

28 day Compressive Strength
Compressive strength (MPa)
35
30
25
20
15
10
5
0
0
0.05
0.1
0.15
0.2
0.25
Sugar Content (%)
Type I
Type V

Figure 9. Test results compressive strength of concrete specimens with Suger [9]

Narender Reddy [10] reported that utilizing waste materials to create new technology has grown popular. It guarantees effective utilization across a range of industries in addition to lowering environmental contamination. The primary component of the sugar industry is sugar, which is used as an admixture in this study. Molasses is a byproduct of this sector. In India, there are approximately 571 sugar factories. Melasses is a byproduct of all industries. As a result, its application in the building sector demonstrates effective by-product utilization. Molasses is the dark brown syrup left over from the refining process. About 50% of molasses is sarcose, 30% are other sugars (such as ash and nitrous), and 20% are water. Molasses functions as an additive that reduces water, so adding molasses will lower the water cement ratio. By dispersing the particles in the concrete and increasing its durability during freezing and thawing, molasses' air-entraining function improves the endurance of concrete.

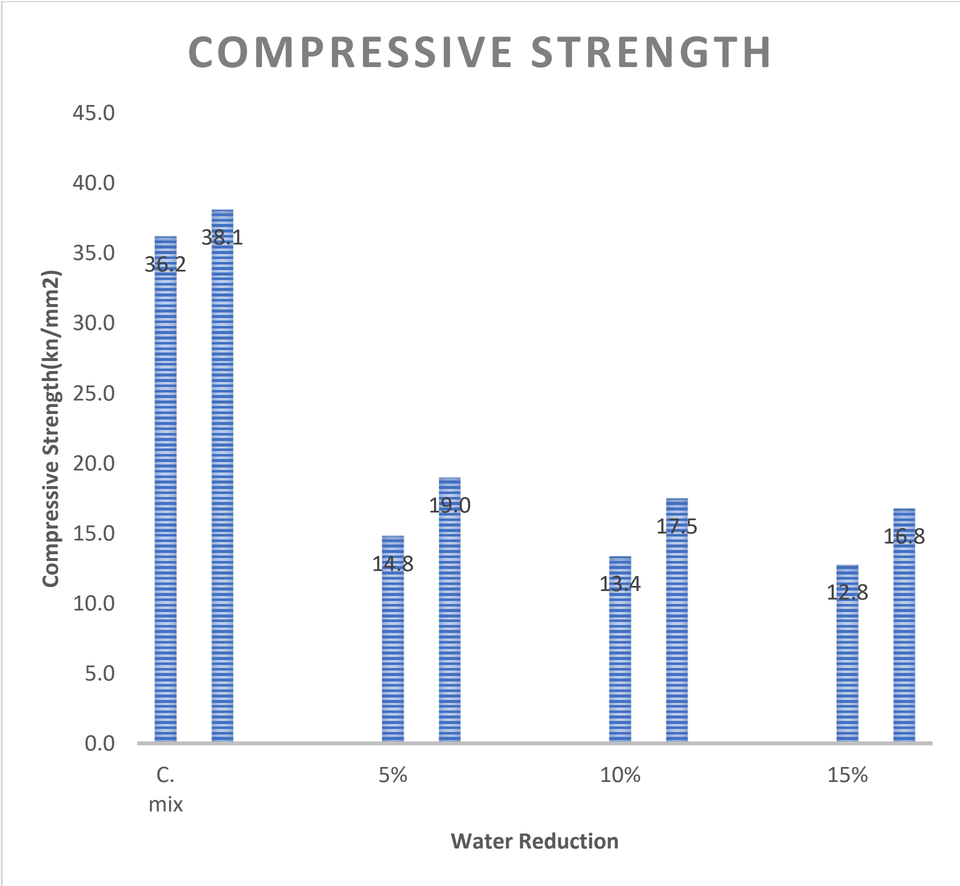


Figure 10. Test results compressive strength of concrete specimens with Suger [10]

Incorporating natural and synthetic latexes into mortar and concrete mixtures dates back to the 20th century. The range and availability of synthetic polymer latexes have significantly expanded since then. In fact, these materials were categorized in ASTM C 1042-85 as non-emulsifiable latexes, which can be used in the opposite direction, and emulsifiable latexes, which should only be used for purposes other than submersion in water or excessive humidity, in recognition of the global development in the areas of elastomeric latexes. Natural latex has several remarkable qualities when compared to its counterpart, but it hasn't gotten as much attention. As an illustration, Kondou, and Bradley [4-6] claim that NRL is better than other elastomeric latexes. It is thought that the polymer layer that lines microcracks and capillary pores in polymeric materials does a great job of reducing fluid flow. Therefore, the goal of this research is to not only identify whether NRL can be applied to concrete, but also how much latex can be added to it without compromising its strength qualities and how concrete grade affects how effective it is.

Considering the results of Ismail et al. [11], it is evident that adding 1.5% of latex to regular and other modified concrete results in a better compressive strength. This 1.5% advantage persisted even with the aggressive solution. Additionally, it has been noted that the compressive strength of regular concrete, which was originally close to 1.5% modified, has severely decreased more than that of other changes. The influence of the latex addition is evident since the changed concrete's compressive strength decreased less than that of the original concrete. This is a result of the standard concrete's curve declining more than the modified concrete's curve. Conversely, regular concrete does not withstand sulfates.

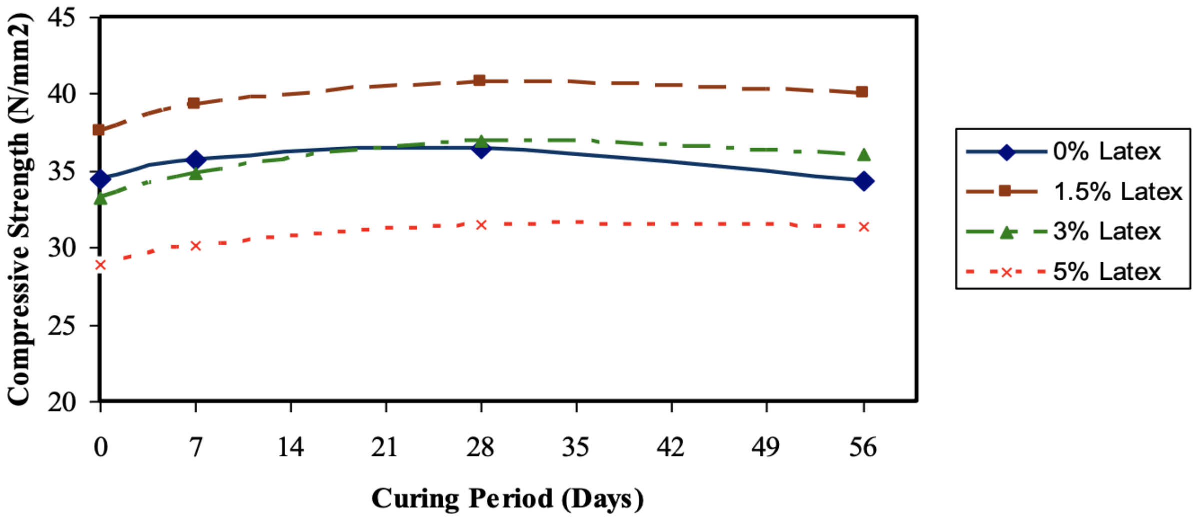


Figure 11. Test results compressive strength of concrete specimens with Latex [11]

The gum Arabic (GA) nodules utilized in the study by Elinwa et al. [12] which procured from a local market in Bauchi, Nigeria's Bauchi State, and were meticulously processed to yield pure GA by eliminating any harmful elements. These are ground using a pestle and mortar after being left to dry for twenty-four hours. A 300 mm sieve was used to sieve it. The sieved sample was put into a liquid preparation vessel in order to create GA for concrete.

As the dosage of GA was increased, so did the compressive strength of GAC. The suggested dosage range for typical concrete operations is 0.50% to 0.75%, with 0.50% being the ideal amount.

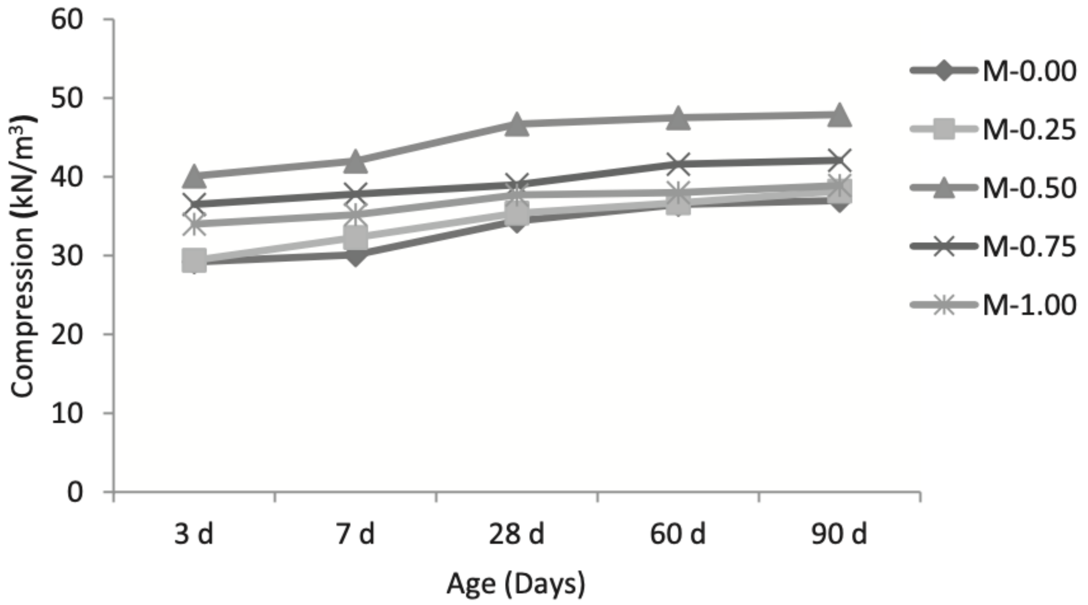
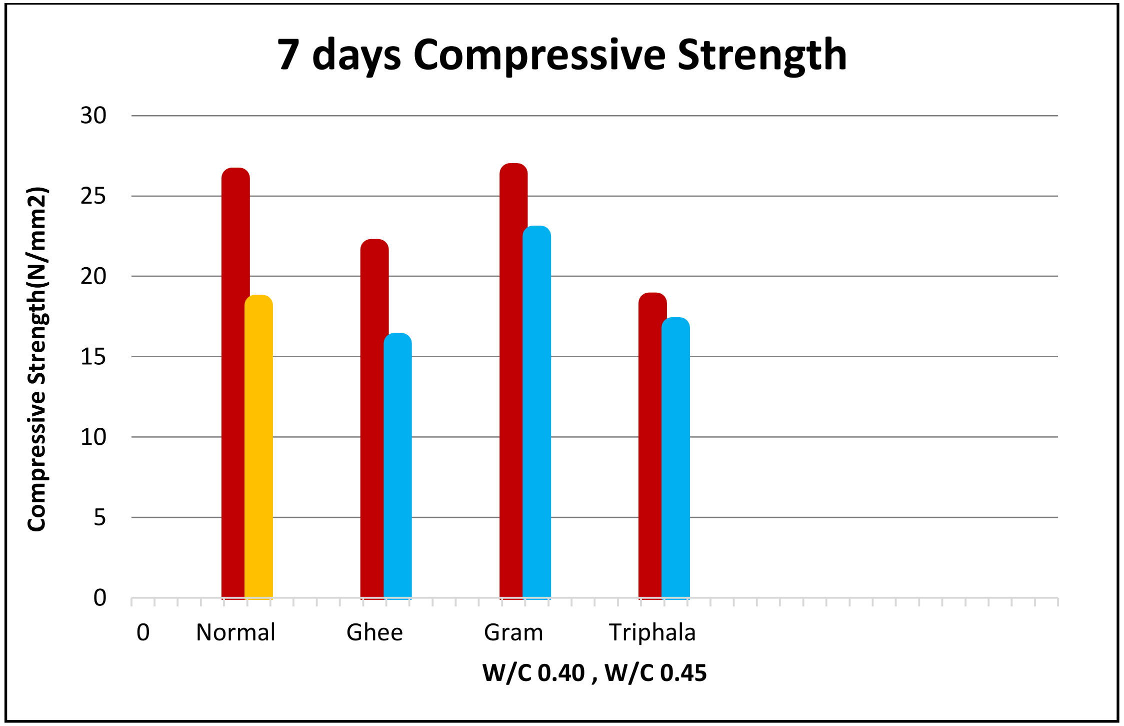


Figure 12. Test results compressive strength of concrete specimens with Gum Arabic [12]

The work by Patel and Deo [13], discusses the suitability of gram flour, ghee, triphala, and naturally occurring organic components as concrete admixtures. Experimental study is done to evaluate the benefits and drawbacks of adding natural organic components to concrete. Examples of workability metrics for new concrete are lump cone and compaction factor; examples of strength parameters for hardened concrete after 7 and 28 days include compressive strength; and cost analysis per N/mm2 with and without natural organic material are investigated. Two cement to water ratios of 0.4, 0.45 and Natural organic elements account for the cement's weight. Concrete containing Gram-flour has higher slump, compaction factor, and compressive strength after 7 and 28 days for both weight-to-cement ratios. Nonetheless, the outcomes of the experiments conducted on Ghee and Triphala are not remarkable and did not have significant consequences.. Natural goods are the source of natural organic resources. In the current investigation, triphala, ghee, and gram flour were added to concrete as admixtures.



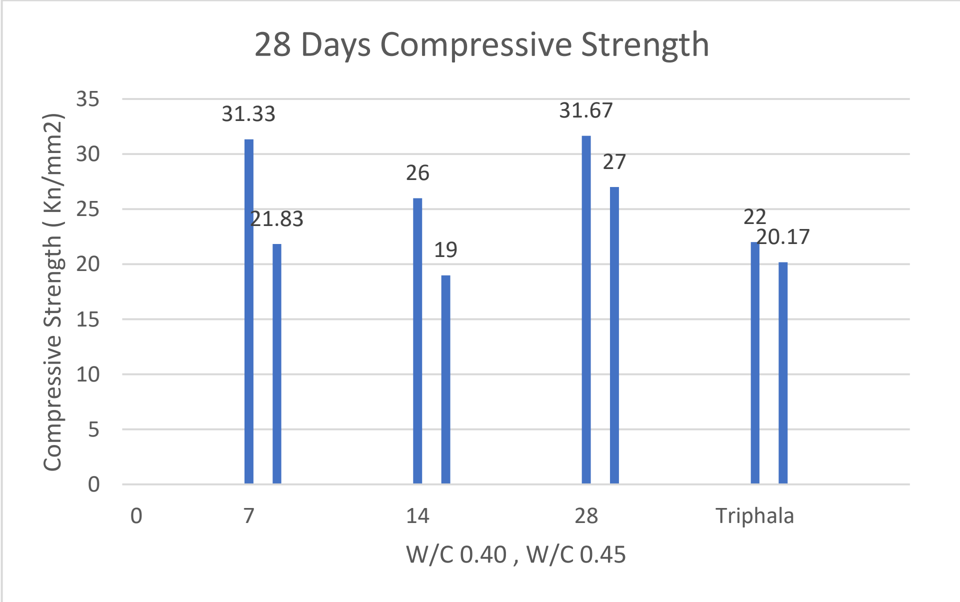


Figure 13. Test results compressive strength of concrete specimens with Ghee, Gram and Triphala [13]

Concrete containing gram flour has a positive effect on compressive strength after seven days. The compressive strengths of TGF-I and TGF-II have increased by 25.34% and 1.84%, respectively. The increase in compressive strength is higher for TGF-I (a higher w/c ratio). Gram flour increased packing (adhesion between aggregate and cement) and functioned as an air entraining agent because of its finer particle size than cement. This is probably the cause of the increase in compressive strength. At 0.45 W/C, the maximum strength gain is achieved. This could suggest that gram functions better at higher W/C ratios.

The CT-I and CT-II samples show the compressive strength of concrete containing triphala. CT-II has a larger reduction in compressive strength (0.4 w/c ratio). The decrease in compressive strength could potentially be attributed to triphala interfering with the hydration reaction.

For both CG-I and CG-II, concrete that has been mixed with ghee has lost some of its compressive strength. CT-II has a larger reduction in compressive strength (0.4 w/c ratio). The likely cause of the decrease in compressive strength could be attributed to ghee's obstruction of cement-aggregate bond formation.

Kassa [14] have used four types of sugars in an experiment. One of the four types of sugar by-products that leave the factory together with bagasse, squeezed mud, and discharge water containing mud is cane molasses, a locally produced substance. It has water, sugar, and non-sugar ingredients. Even if the goal of sugar factories was to create molasses with the lowest possible purity, the majority of the time, it contains some sugar that can function as a retarder admixture. A significant volume of molasses is released annually from sugar plants in Ethiopia as a by-product. Therefore, the purpose of this study is to investigate the possibilities of molasses material for concrete projects. In addition to determining the characteristics of C-25 Concrete, this study attempted to establish an alternative molasses mix ratio for the concrete mix as a retarder. It was discovered that the presence of molasses in concrete greatly increased the compressive strength at later ages while also lengthening the setting time and slowing the rate of strength growth at early ages. Throughout the investigation, it was determined that adding molasses to cement paste could increase its compressive strength at day 28 by 4.5–16.52% while also delaying the paste's setting time by a minimum of 380 minutes and a maximum of 990 minutes. Consequently, molasses could be used to concrete as a traditional retarder additive.

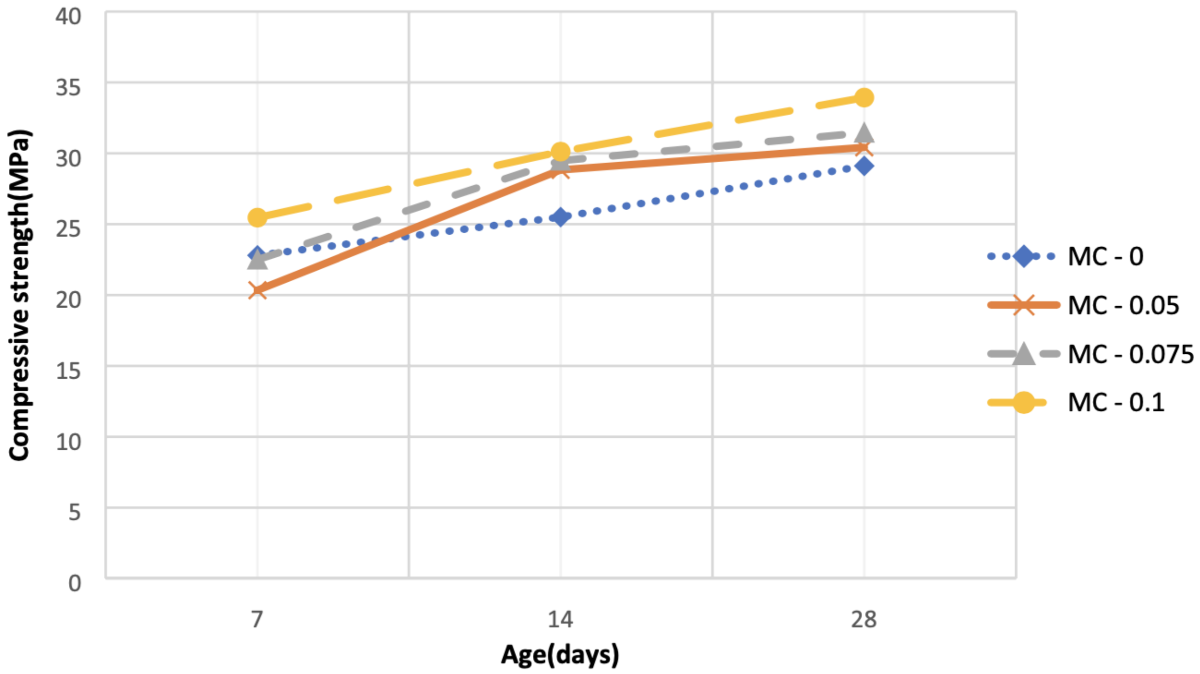


Figure 14. Test results compressive strength of concrete specimens with Suger molasses [14]

Figure 14 displays the development of the concrete samples' compressive strength over 7, 14, and 28 days, together with that of the control sample. The concrete sample with a molasses percentage of 0.1 by weight of cement showed the greatest strength improvement throughout the course of its age; 25.4 MPa, 30.12 MPa, and 33.92 MPa were recorded for 7, 14, and 28 days, respectively. The early compressive strength (7 days) is lower than the standard when the molasses percentage of 0.05 and 0.075 by weight of cement is used; on the other hand, the 28-day strength is higher than the reference. The dose of molasses and the rise in compressive strength after 14 days have an approximately linear relationship. Additionally, the outcome didn't show up until 28 days.

The purpose of the research by Mbugua et al. [15] was to develop Gum Acacia Karroo (GAK) as a set-retarding and water-reducing ingredient for cement mortars. To counteract the increased hydration of cement at elevated temperatures, especially during the day while concreting work is being done, retarding agents are employed in small amounts. However, most retarding admixtures available are expensive and difficult to find, making them unaffordable for Africa's small concrete users. GAK's soluble carbs were investigated as a set-retarding water-lowering ingredient. Using cement pastes containing different concentrations of GAK and Tard CE, a commercial retardant, the amount of setting time was calculated. Compressive strength, bleeding, and flow of cement mortars were examined; an additive-free cement mortar was used as the control. It was discovered that the GAK final setting time was six hours longer than the control one. Compressive strength increased when the water cement ratio was decreased from 0.5 to 0.4. A thermogravimetric study revealed that a greater dosage of GAK produced a lower presents the results of the compressive strength tests for the mortar mixes containing GAK and the control mix (without additive), along with standard errorsThe strength of the mortars decreased as the GAK dosage increased. At all dosages, age-related gains in strength were noted. After two days, the highest value was at the 0.7% dosage; after seven and twenty-eight days, the highest values were at the 0.8 and 0.9% dosages. However, these levels were lower than the control at all ages. After 28 days, a comparison of compressive strength at higher dosages reveals a 4.7% decrease for dosage levels of 0.9% and 1.1% and no appreciable variation in strength for dosage levels of 0.8% and 0.9% (about 0.54% increase).wer hydration rate.

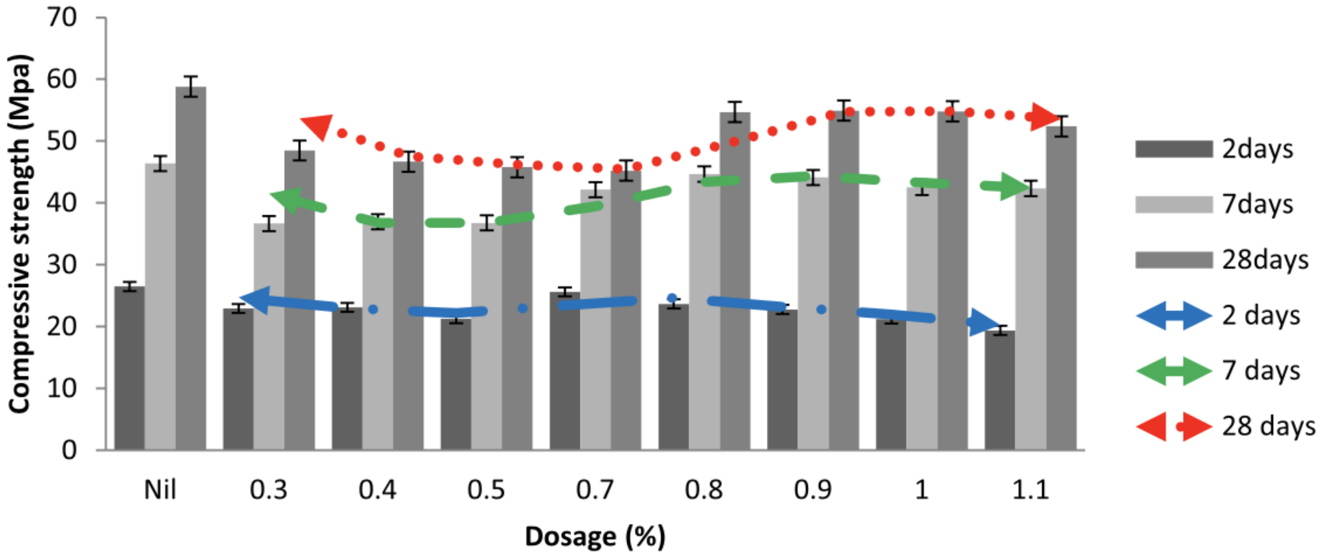


Figure 15. Test results compressive strength of concrete specimens with GAK [15]

Fig. 15 presents the results of the compressive strength tests for the mortar mixes containing GAK and the control mix (without additive), along with standard errors. As the dosage of GAK increased, the mortars' strength reduced. Age-related increases in strength were observed at all dosages. The highest value was at 0.7% dosage after 2 days, while the highest values were at 0.8 and 0.9% dosage after 7 and 28 days. But at every age, these levels were lower than the control. When compressive strength at higher dosages is compared after 28 days, it is evident that there was a 4.7% drop for dosage levels of 0.9% and 1.1% and no discernible difference in strength for dosage levels of 0.8% and 0.9% (about 0.54% increase).

According to Otoko and Ephraim [16], the profusion of palm palms is the main source of lignocellulosic materials in the riverine areas of Nigeria's Niger Delta. The stiffness of the woody cell walls of plants is attributed to lignin, a type of phenolic polymer. Its chemical and physical properties vary based on the plant species and extraction method, and it can be utilized as an emulsifier, binder. It has been demonstrated that lignosulphonates may help cement workability (American Concrete Institute, ACI 1981, El Shereef 1988), alkali lignin can be obtained from palm or black liquor and subjected to sulphonation for the same purpose. But this procedure is difficult and expensive.

Although there are few or no reports of using palm liquor to improve the workability of mortar, the use of black liquor shows that alkali black liquor has no detrimental effects on the durability of concrete or steel corrosion. Microbial communities can be used to cure it. The study by Otoko and Ephraim [16] is on palm liquor consumed in Nigeria in addition to its possible application as a low-cost concrete admixture. This would be a better option than bringing in chemical admixtures with hard-earned foreign currency.

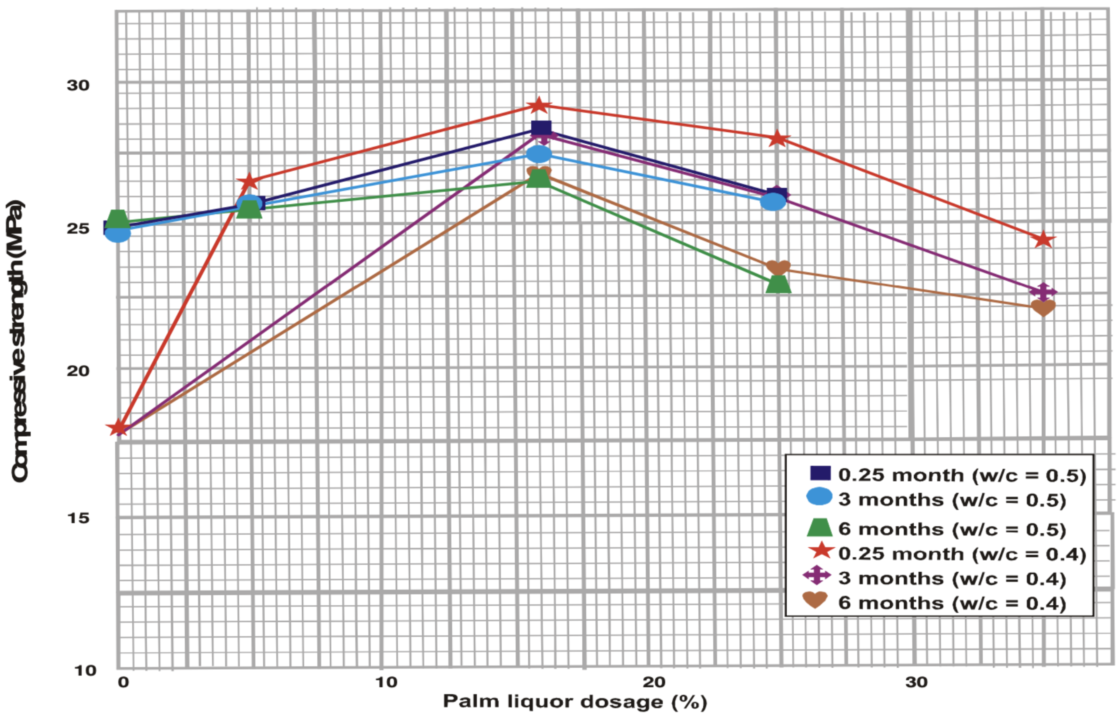


Figure 16. Test results compressive strength of concrete specimens with Palm tree [16]

The effect of aging palm liquor on concrete's compressive strength is illustrated in Fig 16. It unequivocally demonstrates that compressive strength declined with aging. Therefore, it is necessary to set safe limits to guarantee acceptable values for compressive strength.

The objective of the research by Raja Sree and Chandramouli [17] was to explore the possible uses of KADDUKKAI (Terminalia chebula) as a concrete admixture in order to ensure more affordable, long-lasting, and ecologically friendly construction. The constituents of concrete include water, sand, coarse aggregate, and cement. Concrete is one of the most versatile building materials available today; it can be molded to fit any required structural structure. What makes concrete good is determined by the quality of the constituent materials and the mix proportions of each component used. To create high-workability concrete, typically more water is used than is required to hydrate the cement. The amount of water used in concrete has an inverse relationship with its strength. This study aimed to assess the suitability of plant extract as an economical and environmentally friendly concrete admixture.

Herbal admixture: This is the natural admixture that is available locally. The kadukkai is typically employed in medicine. Furthermore, for over 10,000 years, our ancestors have employed a variety of plants as admixtures in their construction to enhance the overall performance of the structure. The use of herbal additive, or kadukkai, will undoubtedly increase the concrete's strength and durability while also having no negative environmental effects.

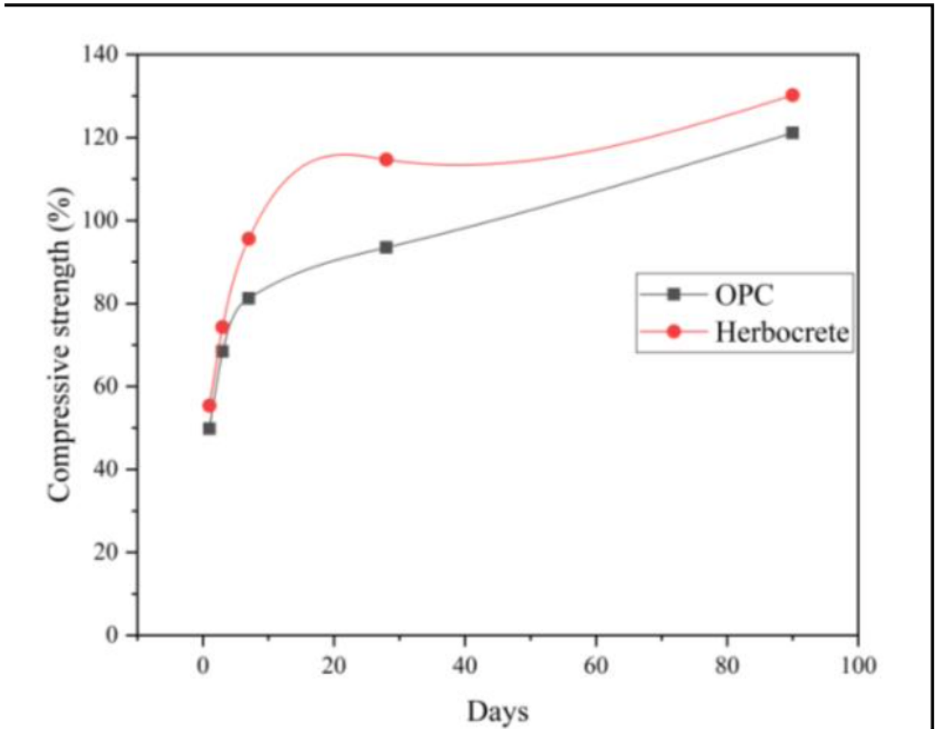


Figure 17. Test results compressive strength of concrete specimens with Herbocrete [17]

Figs. 17, the results show that the addition of Herbocrete affects the concrete mixes' compressive strength. The 28-day cube compressive strength for OPC and Herbocrete was determined to be 93.5 MPa and 114.7 MPa, respectively. The early strength and low early strength development of the concrete result from partially substituting Herbocrete for cement. Relative strength is significantly reduced on day 1 as a result of a dilution effect, and this drop becomes more pronounced and constant as replacement levels increase. But as cure time increases, this strength lowering impact diminishes. Following a 28-day period of moist curing, the 2.5% and 5.0% concrete showed relative strengths of 97%

and 95%, respectively. As a result, the Herbocrete concrete takes longer than the OPC concrete to gain early strength. This is explained by the fact that the OPC hydration produces a pozzolanic reaction between lime and Herbocrete that proceeds more slowly. The findings obtained here broadly concur with the known impact of Herbocrete on the strength of concrete mixes with lower strengths. As the relative strength increases with curing times, the Herbocrete concrete mixes show better strength growth over time than the OPC concrete. All Herbocrete concrete mixes exhibit greater strength than the control concrete after 90 days of curing. Therefore, it was discovered that 35.0% Herbocrete replacement was the ideal amount to generate the most long-term strength.

4. Conclusions

The most favored type of natural additive has an impact on the fresh qualities of mortar and concrete, including workability and setting time, the data show. Some of them function as retarders, lengthening the time it takes for mortar and concrete to set by delaying the hydration of the cement. Examples of natural additives that demonstrate the fresh qualities are palm liquor (PL), mulberry extract, grape extract, pulp black (PB), cactus (OFI), hen egg, cypress tree (CT), water hyacinth (WH), sugar cane juice (SCJ), and hen egg. In addition, these natural additives enhanced the mechanical and durability of mortar and concrete at the ideal dosage that the researchers used. Natural admixtures, such as okra extract (extracted from Abelmoschus esculentus plants), black gram (used as an air-entraining admixture), and blue gum (BG) (used to prevent shrinkage cracking even when concrete is exposed to direct solar heat), act to accelerate and shorten the setting time of cement mortar. The mechanical and durability properties of concrete and mortar are more affected by some natural influences on fresh properties, like hen eggs; nonetheless, data from laboratory and experimental testing on the usage of natural admixtures can be utilized.

These days, eco-efficiency—a methodology that tries to manufacture extremely durable, ecologically friendly concrete while decreasing production costs and environmental load—is the emphasis of concrete construction methods. This paper endeavors to highlight the significance of comprehending natural materials, drawing inspiration from research that has employed these materials in building. The examination of the aforementioned studies led to the conclusion that they demonstrated the importance and validity of emphasizing naturally occurring admixtures that are safe for the environment and can be found in nature. Utilizing some of them as an additive helps with environmental problems because they are environmental issues. According to the findings, organic (natural) admixtures are suitable choices. Because of its nature, which can enhance the mechanical, fresh, and durability qualities of concrete, as well as the fact that using natural admixtures is more environmentally friendly and less expensive than using chemical admixtures, the concrete industry ought to start heading in this direction. Admixture from nature can be made at the same time. Natural additive behavior is strongly influenced by the plant or resource source; green concrete, which is ecologically beneficial, is produced by using natural admixture; advanced technology is not needed to manufacture natural admixture. Nevertheless, a large number of these are wastes that harm the ecosystem. Additionally, testing and approval are required before utilizing natural admixtures in concrete construction, as their behavior varies depending on the plant or resource's origin and the state of the natural components.

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Appendix

Table*: Properties of Concrete studied by the past researchers.

Property Studies / Type of NA	Cons	IST	FST	FL	SL	AR	γc	Abs	Air	CF	CS	STS	FS	Ec	CD	RCP	CA	UPV	LCH	SEM	EDX	XRD	FTIR	C	TG
Cypress tree	[1]	[1]	[1]	[1]	[1]						[1]														
Broiler Hen Egg	[2]	[2]			[2]		[2]				[2]	[2]		[2]							[2]				
Broiler Hen Egg White Albumen and Yellow Yolk								[3]			[3]						[3]								
Rubber Latex										[4]	[4]														
Egg				[5]							[5]	[5]	[5]				[5]								
Molasses		[6]	[6]	[6]			[6]				[6]	[6]													
Arrowroot (Starch)		[7]	[7]		[7]			[7]			[7]				[7]	[7]				[7]					
Laboratory Starch and Arrowroot	[8]	[8]	[8]	[8]				[8]			[8]								[8]	[8]					
Sugar		[9]	[9]								[9]									[9]					
Molasses					[10]		[10]				[10]	[10]					[10]	[10]	[10]						
Cactus Extract	[11]	[11]	[11]		[11]						[11]									[11]			[11]		
Copolymer of Natural Latex Methacrylate (KOLAM) and Copolymer of Natural Latex Styrene (KOLAS)											[12]	[12]	[12]	[12]											
Copolymer of Natural Latex Methacrylate (KOLAM) and Copolymer of											[13]														

Natural Latex Styrene (KOLAS)																									
Copolymer of Natural Rubber Styrene (KOLAS) and Copolymer of Natural Rubber Methacrylate (KOLAM)											[14]									[14]					
Prickly Pear (Opuntia ficus-indica) Mucilage Extract	[15]	[15]	[15]								[15]							[15]							
Sugar		[16]	[16]								[16]														
Sugar		[17]	[17]				[17]	[17]		[17]	[17]		[17]												
Sugar		[18]	[18]		[18]		[18]			[18]	[18]														
Sugarcane Molasses Waste					[19]					[19]															
Latex Admixture						[20]		[20]			[20]	[20]	[20]						[20]						
Swine-waste Bio-char								[21]												[21]			[21]		
Cactus Extract (Opuntia Ficus Indica Extract - Cactace family)	[22]	[22]	[22]		[22]						[22]	[22]	[22]	[22]		[22]	[22]	[22]			[22]		[22]		[22]
Cactus Extract (Nopal Leaves)	[23]						[23]	[23]			[23]		[23]							[23]		[23]	[23]		
Gum Arabic					[24]					[24]															
Molasses	[25]	[25]	[25]	[25]	[25]					[25]	[25]	[25]													
Rubber Latex								[26]			[26]														
Proteins (Gluten From Flour, Casein From Milk,		[27]						[27]	[27]		[27]		[27]												

Purina Protein 500 E)																									
Gum Arabic					[28]		[28]	[28]			[28]									[28]		[28]			
Gram-flour, Ghee and Triphala					[29]					[29]	[29]														
Rubber Latex											[30]	[30]	[30]	[30]				[30]							
Molasses					[31]						[31]														
Aqueous Extract of Okra	[32]	[32]	[32]		[32]			[32]			[32]													[32]	
Rubber Latex								[33]			[33]														
Cane Molasses	[34]	[34]	[34]		[34]						[34]														
Sugar	[35]	[35]	[35]																						
Styrene Butadiene Rubber (SBR) Latex		[36]	[36]		[36]						[36]		[36]	[36]											
Switch Constituent (Sapindus Mukorossi)					[37]						[37]														
Rubber Latex					[38]						[38]	[38]	[38]												
Jaggery powder from Sugar Cane and Egg Albumen& Egg Shell		[39]			[39]		[39]				[39]	[39]	[39]												
Gum Arabic Karroo From Pretoria Botanical Garden (GAKP) and Nelspruit in Mpumalanga (GAKM)		[40]	[40]	[40]							[40]											[40]			[40]
Surfactant Compounds	[41]	[41]	[41]	[41]				[41]	[41]		[41]	[41]							[41]	[41]					

Sugar Cane Molasses	[42]	[42]	[42]		[42]						[42]														
Gum Arabic	[43]	[43]	[43]		[43]						[43]		[43]				[43]	[43]							
Gum Arabic and Calcined Kaolin	[44]	[44]	[44]		[44]			[44]			[44]	[44]	[44]							[44]					
Palm Liquor From the Abundant Palm Trees		[45]	[45]		[45]						[45]	[45]													
Sugar Cane Juice		[46]	[46]		[46]						[46]														
Molasses					[47]						[47]		[47]												
Molasses					[48]						[48]	[48]	[48]												
Rubber Latex		[49]	[49]		[49]					[49]	[49]								[49]	[49]					
Rubber Latex (Styrene Butadiene Rubber -SBR)					[50]				[50]		[50]		[50]	[50]		[50]									
Rubber Latex										[51]	[51]														
Rubber Latex										[52]	[52]														
Rubber Latex											[53]		[53]												
Rubber Latex										[54]	[54]	[54]	[54]												
Rubber Latex										[55]	[55]	[55]													
Rubber Latex								[56]						[56]			[56]								
Rubber Latex (Styrene Butadiene Rubber -SBR)											[57]	[57]	[57]												
Rubber Latex					[58]			[58]			[58]	[58]	[58]						[58]	[58]					
Rubber Latex																[59]									
Sucrose		[60]	[60]	[60]							[60]		[60]												
Terminalia Chebula Powder					[61]						[61]														
Waste Latex Paint	[62]	[62]	[62]		[62]			[62]			[62]	[62]	[62]				[62]								

Polyether Air-entraining Agent (Combining Polyoxyethylene Coconut Amide with Sodium Alcohol Ether Sulphate)									[63]		[63]														
Saponin Air-entraining Agent (Main Chemical Component Being Triterpenoid Saponin)					[64]				[64]		[64]		[64]				[64]								

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