

Effect of Plasticizers on the Properties of Concrete

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Abstract—Concrete is an important material for civil and building construction works. Structural stability is guaranteed by the builders and therefore it is important to take into account the standards, technical specifications and technologies of concrete. In this article, the changes in the properties of concrete and their use on adding plasticizers and the importance of plasticizers were to be told. In which analysis was done on the basis of scientifically valid sources, on the basis of qualitative and quantitative approach method. Plasticizers are used as reducers to reduce the water content to improve the physical properties of concrete. From which it was possible to demonstrate very favorable results from water reducers (plasticizers) that increase mechanical strength when these additives are used in sufficient proportion.

Keywords—Concrete, Density, Granulometry, Plasticizer, Sodium dodecyl benzene sulfonate, Stability and Strength

I. INTRODUCTION

Concrete is a mixture of lime or cement with gravel, sand and water which is a material used in the construction of buildings and civil works; it hardens once it dries and solidifies and increases its resistance [1]. On the other hand, it is well known that plasticizers are organic compounds that contribute to optimize the design of concrete in order to obtain the properties required for construction by reducing the need for water and cement [2]. These additives reduce the viscosity of the cement paste.

With the ever-increasing times of construction, technical specifications, regulatory requirements and modern styles have placed demands from design to completion and delivery of buildings to achieve safe and sustainable buildings/ structures. It is a process in which concrete plays an important role due to its own characteristics.

It should also be noted that cracks and crevices on concrete are some of the intrinsic characteristics

of concrete. Due to which the physical and structural properties of concrete are affected. That is, they can affect the durability and stability of concrete. Therefore, with the help of preventive measures of the factors causing these effects, their effects can be reduced and their presence can be avoided.

The main objective of this work is to improve the quality and properties of concrete in construction works with the help of additional input of plasticizer. Because plasticizer is such an essential compound, the addition of which can provide better condition of quality and stability of concrete. achieve safer and more sustainable buildings. It is a process in which concrete plays an important role due to its own characteristics. It should also be noted that cracks and crevices in concrete are present.

II. METHODOLOGICAL APPROACH

The data was filtered according to the criteria established by the researchers for which the methodology developed was qualitative for analysis. This qualitative criterion is related to an investigative approach to building knowledge and understanding of the studied phenomenon [3], a phenomenon defined as the action of plasticizers on the quality of concrete used in construction. [4]. Within this methodological framework, the article applied a deductive method that began with the observation of general phenomena, up to the verification of particular truths involved in the general situation [5], Which means the process based on the first level of knowledge according to the secondary sources of information. A documentary approach was considered [6], which allows researchers to become familiar with the phenomena under study based on a bibliographic review of sources related to topics of interest related to plasticizers and concrete in construction. their applications [7].

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A. Search and collection of information:-

In Figure 1 tools were implemented for the synthesis and consolidation of information associated with variables considered important in the material under study; Allowing the data collected in consulted sources to be contrasted with the analysis sheet. The analyzed variables were the components of the plasticizer, the dosage of the plasticizer in the concrete mix and the strength properties of the concrete with the plasticizer.

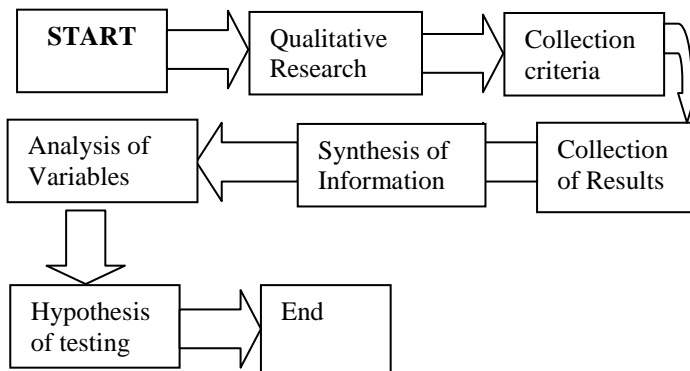


Fig.1 Methodological process of the research

III. MATERIALS

A. Components of concrete:-

The composition formula of concrete is basically a combination of binder (cement), aggregate (composite material like gravel and sand) and water. The characteristics can be modified using chemical additives such as plasticizers and curing agents. It should be noted that by varying the proportion of the above components, concrete obtains different properties, either as lightweight concrete (density of about 1800 kg/m³), normal concrete (density of about 2200 kg/m³) and heavy concrete. Concrete (density over 3200 kg/m²) [8]. Essentially, concrete offers very good resistance to compressive stress; However, in order to obtain greater resistance to bending and/or traction, it is associated with steel structures, giving rise to the so-called reinforced concrete; The following advantages of concrete have been highlighted [8]:

- High stability and strength.
- This building provides high quality which is used.

- It is outstanding for its versatility, as it can be used in all types of manufactured and fixed.
- It provides seismic safety.
- It has insulating protection, which means that those using it are well insulated not only thermally but also acoustically.
- It is easily available in the market.

The strength of a concrete is influenced by other factors such as water content, total granulometry, and homogenization of the mix, water/cement ratio, and organic admixture, among other factors [9–11]. The dosage of aggregates or materials required to obtain specific strength is presented in Table 1. Concrete may vary according to certain functions or regions; Therefore, it is imperative to highlight the characteristic to indicate the availability of materials with respect to their gradation, physical and chemical properties or their combination [11].

TABLE 1: CONCRETE DOSAGES FOR DIFFERENT STRENGTHS [10].

pounds square (PSI) resistance required	per inch	Cement (Kg)	Sand (m3)	Gravel (m3)	Water (litres)
3200		420	0.67	0.67	250
3000		350	0.56	0.84	180
2500		300	0.48	0.95	170
2100		300	0.71	0.71	170
2000		260	0.63	0.84	170
1500		210	0.50	1.00	160

B. Plasticizers

Plasticizers for concrete belong to the group of chemical impurities for construction, which reduce the amount of water required to obtain a certain consistency in concrete. In other words, the plasticizers mix and form the cement paste rapidly by coating the cement particles and making them repel each other. When particles repel each other, the overall resistance to flow is reduced (friction is

reduced), resulting in the elimination of micro-flocculi, leading to the release and better distribution of water, [2] ; Table 2 shows the typical chemical composition typically present in these additives.

TABLE 2: CHEMICAL COMPOSITION OF THE PLASTICIZER [12]

Component	Chemical formula	Weight %
Nonoxynol-9	$C_{23}H_{40}O_5$	10
Sodium dodecylbenzenesulfonate	$C_{18}H_{29}NaO_3S$	10
Triethanolamine	$C_6H_{15}NO_3$	10
Water	H_2O	70

Concrete admixtures help to reduce cement consumption and increase strength [12]; Technically, most commercial admixtures are based on surfactants such as sodium dodecylbenzene sulfonate [13] specially designed to facilitate the production of precast concrete with cement hydration reaction accelerators such as triethanolamine (2, 2', 2) which acts as an air-enclosure. β -nitrilotriethanol) [13] and a non-ionic agent such as 9-nonoxynol, to keep the mix moist during the concrete block compaction process. The action of these admixtures allows plasticizing and improving the appearance and moldability of fresh concrete mixes and their dispersion properties, allowing rapid de moulding Press [12] with higher durability of molds due to reduction in friction coefficient and increase in compressive strength. Consequently, water-reducing admixtures improve the strength of hardened concrete without increasing the cement content [14]. Water-reducing admixtures are used to reduce the amount of water mixed by 5% to 10% compared to unmixed concrete, while maintaining the same slump. Concrete with a water-reducing admixture is more workable and can improve the concrete's pumpability, making the concrete more cohesive and less likely to break during placement. By increasing compressive strength and improving workability through the use of water-reducing admixtures, concrete manufacturers can design mixes with less amount of cement and, therefore, a more economical concrete [14].

IV. RESULTS AND DISCUSSIONS

In previous results, water management is present as a major factor in the production of concrete mix, as it is a variable that affects its characteristics in the fresh and hardened states [15]; In the fresh state it positively or negatively affects its transport and location, and in the solid state it affects its stability over time.

In terms of water management, It is common that in construction sites especially those of small size or in some informal areas, special attention is paid to timing of their transportation, In order to achieve acceptable workability of the mixes by adding water and it Can go placed on site, but negatively affects important characteristics such as compressive strength and durability in the future, especially when the content of atmospheric agents such as CO₂ in the world and, in particular, in congested urban centers, as [15].

As per the decades mentioned above, it is worth noting that water management is affected by physical factors, as more weight directly affects density and more weight and density lead to more resistance which is essential for compressive strength [15]. Given that plasticizing additives are not commonly used in small or unauthorized manufacturing to improve the workability of JJ Mixes, it is confusing that instead of adding water when mixing, community manual companies and union techniques are used. is done. Let us use it because, as shown in this work, it is additional fluid, although it lubricates the paste and thus promotes greater initial fluidity, affecting the hardened material mechanics and stability [15].

In line with results shown in other experiments, it was observed that at seven days, [16] the compressive strength of the mix with the maximum dose of plasticizer was significantly higher than the strength of the standard mix. It should be noted that at twenty-eight days, the two powers were equal; However, for ages greater than twenty-eight days, [16] the strength of the mix with the plasticizer was slightly higher than that of the standard mix. Other observations indicated that the standard mix achieved slightly higher strength values in contrast to the concrete mix with additional dosages of plasticizers, with compressive strength values equal to and exceeding 250 kg/cm and 280 kg/cm for

both cases. was higher with age 28 days respectively [16].

It is worth noting that commercial plasticizing admixtures have an effect on lightweight concrete blocks in two ways: a) it favors a greater development of the hydration reaction of the cement due to its accelerated effect and its effect on the amount of water used for incorporation reduces , and wetting, which is reflected in a significant increase in compressive strength, and b) it modifies the preferential orientation of the crystalline structures of the aggregate [12].

Finally, experience shows that the dosage of the plasticizer certainly presents an important result in terms of the compressive strength of concrete, as stated [16] taking into account the technical instructions of the mix manufacturers. Importantly, it was observed that the use of higher than recommended doses was not producing a favorable effect on the final values, in fact it was observed that in both cases, the standard mixture was found to be more effective than the highly concentrated mixture in the long run, which gives better results. verified by [16] ; In this regard, the results related to the compressive strength at 28 days setting in terms of water/cement (W/C) and cement used, as shown in Table 3 [17]. 0.25 W/C ratio, 9.5 mm maximum aggregate size and 960 kg/m³ cement achieves highest compressive strength of 556 kg/cm² at 28 days setting. It has been demonstrated that for normal concrete without plasticizers, the compressive strength should reach 70% of the value for which it was designed at seven days of setting, increasing to 100% at twenty-eight days of setting; However, when additives such as plasticizers are used, this rule may vary, [16] according to the responses obtained from the incorporation of these new generation materials.

TABLE 3> COMPRESSIVE STRENGTH AT 28 DAYS [17].

W/C	Maximum aggregate size (mm)	Cement quantity (Kg/m ³)	Average strength (Kg/cm ²)
0.20	9.50	1300	550
0.25	19.50	960	434
0.25	19.10	1040	529

0.25	9.50	960	556
0.30	19.10	800	412

V. CONCLUSIONS

Establishing the achromatism point or range of use of the plasticizer is of utmost importance, since the benefits are estimated according to the type of lozenge, in other words, it is imperative to optimize their operation. When selecting a plasticizer, it is important to take into account other parameters that affect compressive strength, such as the ability to maintain plasticity without breaking during setting, the development of early strength, a greater or lesser adhesive effect, and the material quality and so on. The plasticizers are not necessarily identical as their lozenges depend on the characteristics of the material and concrete in general. Nor is there an ideal or perfect plasticizer; Rather suitable or sterilized plasticizers are called depending on the type of cement, operating and working point conditions as well as concrete characteristics. Progress in the specific part of the design for the quality of concrete involves the use of a variety of cocktails similar to plasticizers and curing agents. The use of plasticizers generally improves the physical and structural properties of concrete, as well as increasing the profitability of the project; We have learned from experiences that the results have been positive with respect to the compressive strength of concrete.

At the design stage of a construction project today, various alternatives must be considered in the design of concrete to obtain substantial financial benefits and provide greater technical benefits from the use of plasticizers. With a view to improve the quality of these ingredients while preparing concrete mix and for future research work it is proposed to change the additives of plasticizer combination to improve other physical properties of concrete like strength and elasticity, scale improvement can be done and it can be ensured.

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