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# Study the Effect of Adding Super Plasticizers (Sikament_NN) on the Properties of Hardened Concrete and comparing it with Grade 40 using Wadan Sand

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***Abstract:*** ***The basic components of the concrete mixture are cement, aggregates (sand and gravel) and water. And in some other cases, there may be other components of the concrete mixture besides the main components, which are chemical additives which are used for the purpose of improving some of the properties of concrete. This research dealt with the study of mechanical properties of modified concrete by adding Super Plasticizers (SP) type of Sikament_NN and its effect on determining the changes occurring in the resistance to pressure and indirect tension of concrete mixtures taking into account the following variables and influences: - Type of concrete used in this work ordinary concrete with grade 40 and modified concrete in addition. And doses of Sikament_NN were (0.5 - 1.5 - 2.5 and 3.5) % of the weight of cement (added to the mixing water). Under the influence of immersion treatment ages 7 and 28 days.***

***Keywords: Concrete, Grade 40, Super Plasticizers (SP), Sikament_NN, Wadan sand***

## I. INTRODUCTION

The technology of manufacturing concrete developed in terms of increasing its resistance to pressure and became what is known in the seventies as high-resistance concrete by the discovery of some chemicals and chemical compounds called additives (ADMIXTURES), which are of multiple types and uses. It can be said that additives are a substance other than cement, fine and coarse aggregates and water that is used as a component or a fourth element in concrete and is added to the mixing water or after mixing of fresh concrete sometimes in order to improve or give fresh or hardened concrete certain characteristics. However, the discovery of additives and the increase in interest in them produced what is now known as high-potency concrete. In the late last decade, research on these additives increased in order to increase the durability of concrete and as a result of the development in the science of chemistry and physics and understanding the nature of the relationship between the components of concrete and by the effect of these sciences on this relationship was discovered Some chemicals that have improved the operation of concrete and increase its resistance. Scientists have reached using advanced technology for mixing and using small amounts of water by adding these chemicals called super plasticizers. Super plasticizers (SP) reduce the amount of water added to concrete, and many materials are included in this name, as each material specifies the minimum and maximum permissible limits and the amount of adding these materials in concrete mixes is estimated in proportions of the weight of the cement.

## II. MATERIALS USED

1) *Portland Cement:* The fineness test was conducted for a weight of 100 gm, and the results were in compliance with both American and British specifications.

TABLE I. Result of fineness test

| Based on American specifications | | |
|---|---|---|
| Sample weight | The percentage retained on a sieve #200 (%) | Allowed limits |
| 100 gm | 19.1% | < 22% |
| Based on British specifications | | |
| Sample weight | The percentage retained on a sieve #170 (%) | Allowed limits |
| 100 gm | 8% | <10% |

2) *Water:* The water used in these experiments is the water of the College of Engineering Technology, Hun, and this water was used in previous experiments.

3) *Fine aggregate (Sand):* The used sand was subjected to a sieve analysis test and a volumetric increase test, and the results were as follows:

Table II
Results of the volume increase test for sand

| Water added to dry sand weight % | Increase in volume % |
|---|---|
| 5 | 0.0042 |
| 10 | 0.0039 |
| 15 | 0.0002 |
| 20 | 0 |
| 25 | 0 |

Table III
Result of sieve analysis test for fine aggregate

| Sieve number | Reserved weight (gm) | Cumulative weight (gm) | Cumulative reserved **(%)** | Pass **(%)** |
|---|---|---|---|---|
| 5 | 3.1 | 3.1 | 0.154 | 99.85 |
| 2.5 | 3.7 | 6.8 | 0.339 | 99.66 |
| 1.25 | 9.1 | 15.9 | 0.794 | 99.21 |
| 0.63 | 1088.2 | 1104.1 | 55.149 | 44.85 |
| 0.31 | 370 | 1474.1 | 73.631 | 26.37 |
| 0.16 | 353 | 1827.1 | 91.263 | 8.7 |
| Pan | 174.9 | 2002 | | |

4) *Aggregates (Gravel):* The rubble of Al-Jufrah quarries was used in the city of Sukna in particular, which has the advantage of being of high quality aggregate compared to other types in the regions of Libya. In this study, some experiments were conducted as follows:

Table IV
Results of tests for aggregates (GRAVEL)

| Type of test | Result |
|---|---|
| Absorption % | 1.4 |
| Specific weight | 2.6 |
| Volumetric weight (for rammed aggregates) kg / m3 | 1310 |
| Volumetric weight (for bulk aggregates) kg/$m^3$ | 1250 |
| Abrasion % | 18.4 |

Table V
Result of sieve analysis test for aggregete

| Sieve number | Reserved weight (gm) | Cumulative weight (gm) | Cumulative reserved **(%)** | Pass **(%)** |
|---|---|---|---|---|
| 40 | 0 | 0 | 0 | 100 |
| 20 | 50 | 2.5 | 2.5 | 97.5 |
| 10 | 1250 | 62.4 | 64.9 | 35.1 |
| 5 | 702 | 35.1 | 100 | 0 |
| Pan | 0 | - | - | |
| | 2002 | | | |

5) *Sikament-NN:* It is an additive to concrete to improve its mechanical properties, especially pressure resistance, as it gives high-efficiency concrete and is considered to reduce water content and increases workability to a great degree. The material can also be described as a strong plasticizing fluid that has the dual effect of producing a quality concrete with high fluidity. In addition to high-efficiency water content reducing agent to improve hardening speed and increase early and final stress in accordance with American and British specifications. The technical data for this article are listed as follows:

Table VI
Characteristics of Sikament-NN

| | |
|---|---|
| Type | Naphthalene Formaldehyde Sulphonate (NFS) |
| Color | Dark brown |
| Specific density | 1.20 kg / liter |
| PH value | ± 0.17 |
| Packing | 5 kg or 20 kg |
| Storage | Store away from frost and in the shade |
| Validity | For one year from the date of production, if it is stored in the correct way and in its original unopened package |
| Transportation | It is not dangerous to transport it |
| Toxicity | Nontoxic, according to prevailing health and safety rules |

The article defines how to use and apply as follows:

a) *Dosage:* The dosage ranges between (0.6-3) % by weight of the cement according to the workability and the required strength. Sikament_NN is compatible with all types of Portland cement, including sulfate resistant cement (S.R.C).

b) *Distribution:* Sikament_NN is added to the water for mixing before it is added to the aggregate, or as in most cases it is added separately to the fresh concrete where the effect of the plasticizer is clearly visible, and in the case of ready-made concrete, Sikament_NN is added to the concrete immediately before it is emptied from the mixing period 3 and after that.

c) *Recommendations for Use:* Do not pour the remnants of the substance into waterways or soil, but dispose of them according to local laws. If skin contact occurs, wash immediately with soap and water. If contact occurs with eyes or mucous membranes, rinse with warm water and consult a doctor without delay.


Fig 1 Sikament-NN Packing 5 kg

## III. MIXING MATERIALS

Table VII
The proportions of mixing materials for used concrete mixes

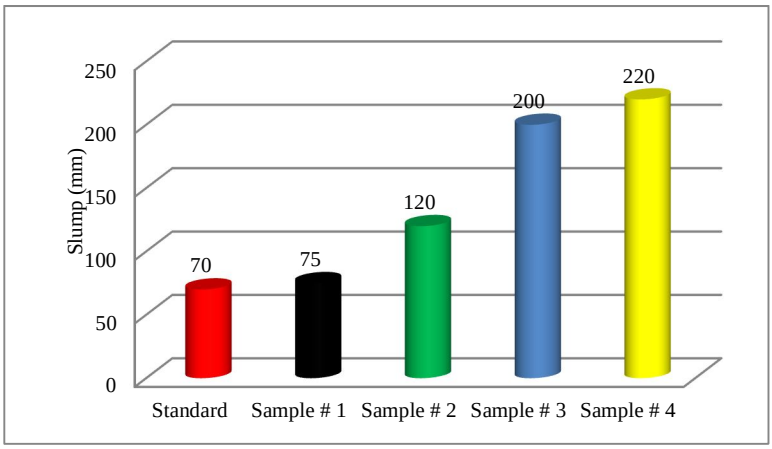
| mixtur | Sikament_NN/cement | Cement $Kg/m^3$ | Sand $Kg/m^3$ | Aggregate $Kg/m^3$ | W $Kg/m^3$ | w/c |
|---|---|---|---|---|---|---|
| Standard | 0 | 400 | 800 | 1200 | 244 | 0.61 |
| 1 | 0.5 | 400 | 800 | 1200 | 196 | 0.49 |
| 2 | 1.5 | 400 | 800 | 1200 | 172 | 0.43 |
| 3 | 2.5 | 400 | 800 | 1200 | 164 | 0.41 |
| 4 | 3.5 | 400 | 800 | 1200 | 156 | 0.39 |

## IV. RESULTS

### *A. Slump Test for Fresh Concrete*

Graph 1, shows the result of the slump test for fresh concrete. It has been shown that the addition of the plasticizer Sikament_NN increases the amount of settling of fresh concrete. In the standard sample, the amount of slump was 70 mm and in sample No. 1 the slump increased to mm75. Moreover, the slump increased more in sample No. 2 when the slump was 120 mm. The slump values represented in the standard sample, sample No.1 and No.2 fall under the plastic limits. And it is considered the best consistency for fresh concrete. As for sample No. 3, record the amount of subsidence 200 mm and it is considered wet. The decline was highest in sample No. 4 as it was 220 mm, which is a sloppy consistency, as shown in Figure Graph 1.

The reason for the increase in the amount of drop is because the plasticizer Sikament_NN works to increase the fluidity and fluidity of fresh concrete. That is, an increase in workability with a 20% reduction in the water content at each percentage of the plasticizer added to the mixture. We notice that the texture is very loose in sample No. 4, which has a plasticizer ratio of 3.5% of the cement weight, so this percentage is outside the permissible limits for the plasticizer Sikament_NN. Whereas, the limits stipulate (0.6% to 3%) of the cement weight, when the percentage exceeds 3%, the concrete weakens and the risk of granular separation and exudation or bleeding increases, which is the accumulation of water on top of the concrete surface, making its outer surface porous, weak and brittle due to the increase in the fluidity of the mixture and the decrease of this percentage About 0.6%, as in sample No. 1, works to reduce the characteristics of using the material, such as pressure resistance, for example, 100% after 16 hours, and others.



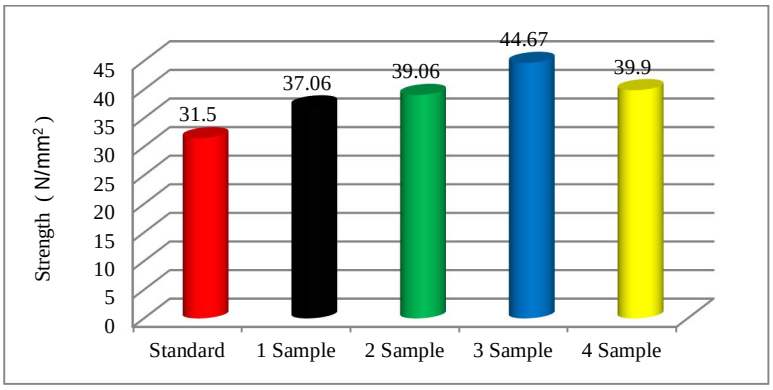

Graph 1 Results of slump test for fresh concrete

Photo 1 slump test for fresh concrete for sample 1 and sample 4

### *B. Compressive Strength Test*

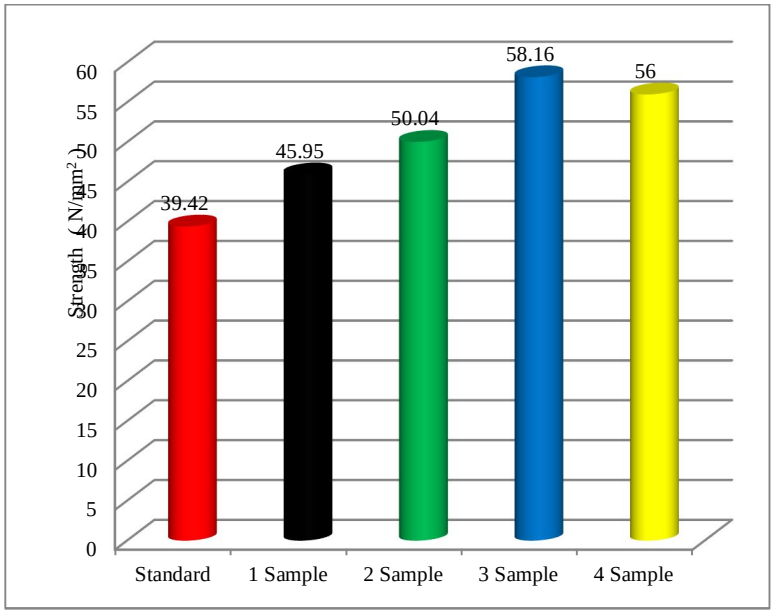
1) *Results of Compressive Strength tests for cubes at the age of 7 Days:* After performing compressive strength tests on different sample cubes at the age of 7 days, we found out that the pressure resistance of the standard sample is 31.5 N/mm2, while the compressive strength increased significantly in sample 1 to give 37.06 N/mm2. Strength was recorded 39.06 N/mm2 for sample 2, while in sample 3 the pressure resistance was recorded as its highest value, N/mm2 was 44.67. In sample 4, we notice a decrease in the amount of pressure resistance, which gave 39.9 N/mm2, as shown in Graph 2.

Looking at these values, notice a gradual increase in the amount of strength from the standard sample to the sample 3, according to the increase in the percentage of the plasticizer Sikament_NN. The specifications set the range for plasticizer use from 0.6% to 3% of the weight of the cement in the sample. This percentage was 0.5% in sample 1, 1.5% in sample 2, and 2.5% in sample 3, which gave the highest value of pressure resistance 3.5%. In sample 4, in which the strength resistance began to drop below its maximum value. The reason for this decrease is due to the fact that this percentage exceeds the permissible limits of the material. Therefore, the increase of this material beyond the permissible limits negatively affects the strength resistance of the concrete as the fluidity and fluidity of the mixture increases, which leads to an increase in the risks of granular separation, exudation or bleeding.




Graph 2: Results of Compressive strength tests at the age of 7 days

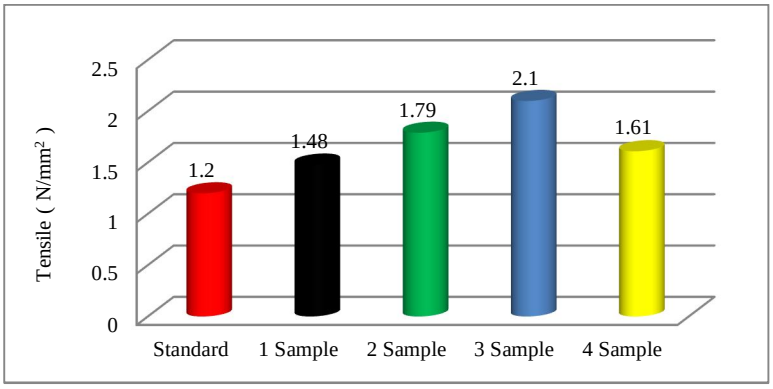
2) *Results of Compressive Strength tests for Cubes at the Age of 28 Days:* After the age of 28 days of immersion treatment in water, a strength test was performed. The strength resistance of the Standard sample was recorded 39.4 N/mm$^2$ and it was noted that this value increased to become 45.95 N/mm$^2$ for sample 1. And continuing to rise in the amount of strength value of sample 2 to give 50.04 N/mm$^2$ to while sample 3, in which the compressive strength of concrete was recorded its highest value 58.16 N/mm$^2$. A clear decrease in the amount of compression resistance is observed in sample 4, as it gave 56 N/mm$^2$ as shown in Graph 3. From the above it is clear that the amount of strength resistance at the age of 28 days is greater than what it is at the age of 7 days for all samples in general. As it gradually increases from the standard sample to sample 3, it then decreases in sample 4. This discrepancy in the values is due to the gradual increase in the percentage of the plasticizer, Sikament_N in different samples and by exceeding this percentage from the stipulated limits, this negatively affects the strength resistance of the concrete. So, its value decreases as happened in sample 4 and increases in decline with the increase of the risk of granular separation and perfusion. The more this percentage exceeds the recommended limits.




Graph 3: Results of Compressive strength tests at the age of 28 days

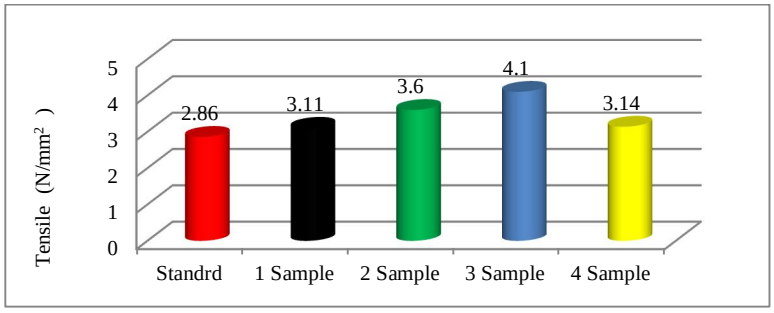
*C. Indirect Tensile Tests*

*1) Results of Indirect Tensile tests of Cylinders at the Age of 7 Days:* It is known that concrete has weak tensile strength, as the value of the tensile strength of concrete ranges from 8% to 12% of the compressive strength. After performing an indirect tensile test for the different samples, the results showed that there was a gradual increase in tensile strength, reaching its highest values, which was returned to the decrease. Where the tensile strength of the standard sample was 1.2 N/mm$^2$ and this value increased to become 1.48 N/mm$^2$ for sample 1. Sample 2 recorded 1.79 N/mm$^2$. Sample 3 recorded the highest value of tensile strength, which was 2.1 N/mm$^2$. From the foregoing, it is noticed that there is a marked decrease in the result of sample No. 4 which gave 1.61 N/mm$^2$, as shown in Graph 4.




Graph 4: Results of indirect tensile tests at the age of 7 days

*2) Results of Indirect Tensile tests of Cylinders at the age of 28 Days:* Through the obtained results, it is clear that the tensile strength at this age 28 days is greater than the resistance obtained at the age of 7 days. It gave a value of 2.86 N/mm$^2$ to the standard sample. Then, a rise in the amount of resistance is observed to become 3.11 N/mm$^2$ in sample 1 and it was recorded 3.6 N/mm$^2$ in sample 2. Looking at sample 3, the indirect tensile strength of it was recorded the highest value was 4.1 N/mm$^2$ While a clear decrease in the amount of tensile strength is observed in sample 4 as it gave 3.14 N/mm$^2$ as shown in Graph 5.




Graph 5: Results of indirect tensile tests at the age of 28 days

## V. CONCLUSION

*A.* The compressive and tensile strength of concrete modified by adding Sikament_NN) is higher than the compressive and tensile strength of reference concrete (standard), which suggests that high doses of SP are necessary to produce concrete of high strength.

*B.* The addition of Sikament_NN to the concrete mixture reduces the water content by about 20% and increases the elasticity of the texture from 75 to 200 millimeters.

*C.* The increased fluidity and fluidity of the mixture results because the plasticizer atoms bind themselves around the cement grains during the primary hydrogenation reactions in which the internal particles are less attracted, forming similar charges, resulting in the dissociation of the cement grains due to the repulsion.

*D.* 2. In general, Super Plasticizers (SP) are considered highly durable and, in contrast to economic factors, excessive doses of (Sikament_NN) in the concrete mixture are not desirable as they lead to significant loosening of the cement, which increases the risk of granular separation, exudation or bleeding. While doses less than the lowest permissible limit lose the advantages of using the substance, and these limits range from (0.6% to 3%) of the weight of the cement.

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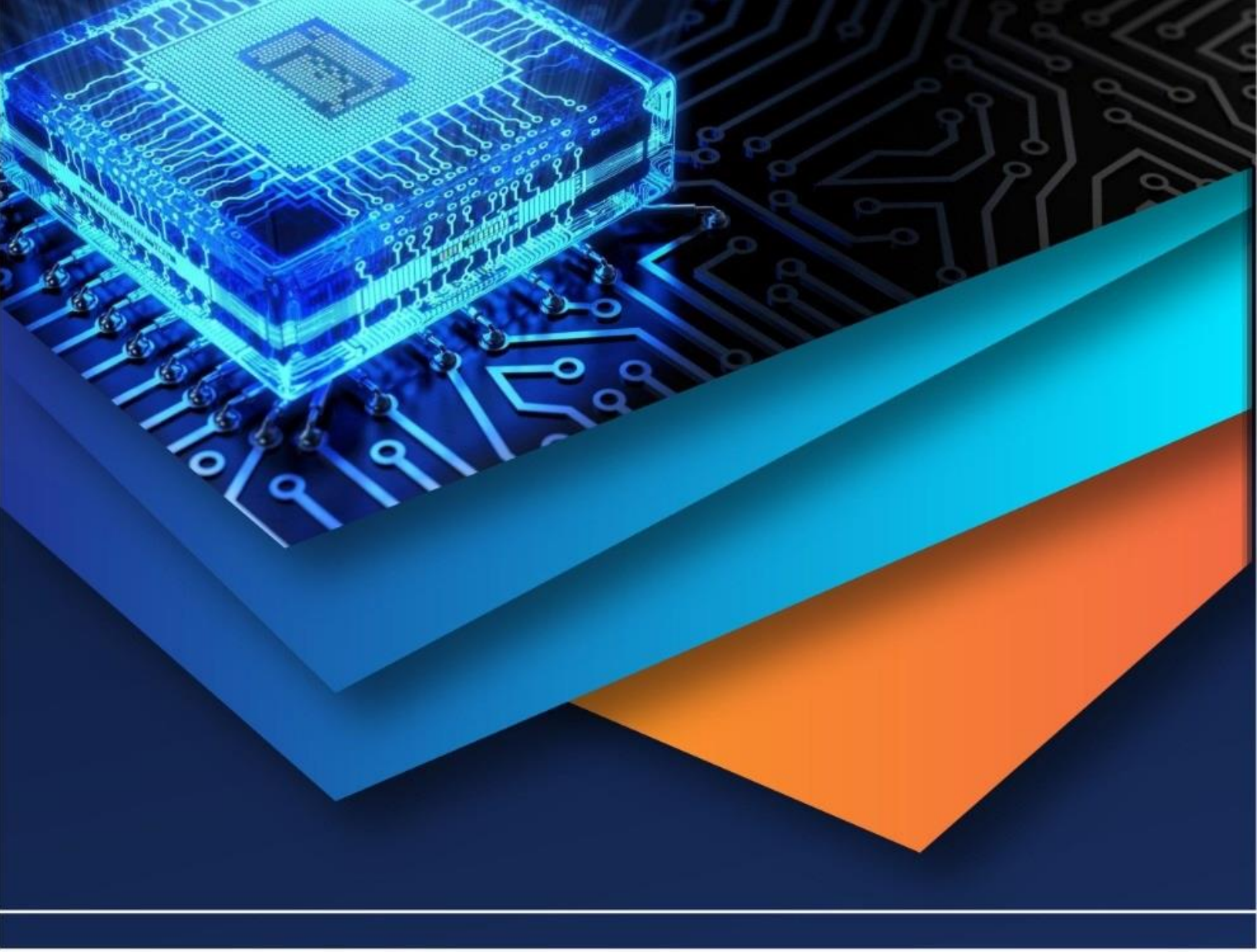

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