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An Investigation on Tribological Properties of hbn Nanoparticles Additive in Castor & Mahua Oil Blend.

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Abstract: In this Paper effect of addition with the nanopartical Hexagonal boron nitrate (hBN) in Castor and Mahua oil blend for improve the tribological properties of lubricants. Research on biolubricant in the field of automotive applications with experimentation on four ball tester for anti wear characteristics with various blends of castor and mahua oil have been studied in this work. Effect of addition with the nanopartical Hexagonal boron nitrate (hBN) in Castor and Mahua oil blend for improve the tribological properties of lubricants. These nanoparticle were added in blended oil at different proportions (0.5, 1, and 2 wt. %). This investigation is useful for comparing the effect of additives on bio lubricants properties like wear, coefficient of friction. The evaluation of tribological properties test was calculated on a four ball oil testing machine according to ASTM D 4172. Result proves that the each set of Nanoparticle significantly lowers the friction coefficient and wear of friction pairs. The wear surfaces were analyses by scanning images of electron microscope (SEM).
Keywords: Castor oil, mahua oil, hBN nanoparicles, Friction coefficient, Lubricating oil, nanoparticles, SEM &Wear scar diameter etc

I. INTRODUCTION

Nanotechnology is being with success utilized in several fields, as well as mechanical engineering especially. a major range of investigations are reported on the impact of nanoparticles as oil additives. Several of the reports show that the addition of nanoparticles is effective in reducing friction and wear even for concentrations below 1%wt. Besides, most of the researches reports the employment of antimonial or antimonial compound [nanoparticles as additive, among that, nano-additives containing atomic number 29 have received special attention as a result of their outstanding results Tribological properties of stuff additives supported metallic element, atomic number 29 and Co nanoparticles that were another separately and combined in pairs to a oil. Nano-additives containing atomic number 29 reduced additional considerably friction and wear compared to the opposite nanoparticles; once another separately. as an example atomic number 29 nanoparticles presence reduced friction by 49%, metallic element reduced by 39% and Co up to twenty compared with the stuff while not additives; and, once another in pairs,

Combinations, Fe-Cu and Co-Cu, given friction reduction up to fifty three, while Fe-Co reduced by three hundred and sixty five days. As given in different works, attributed the potency of antimonial nanoparticles to their deposition in worn surfaces forming a skinny layer, typically softer than the substrate. Capable of reducing friction through a smaller slippy resistance and of protective the substrate from wear by preventing the metal-to-metal contact. The presence of nanoparticles between rubbing surfaces is additionally given in several investigations mutually of the most reasons for friction reduction. varied of the nanoparticles investigated have a sphere-like shape; thus, their presence up-to-date space might turn out a ball bearing impact that would modification the friction characteristic from slippy to rolling, reducing friction. Nanoparticles composition, shape, size and concentration area unit vital characteristics to see friction and wear behavior, though concentration influence isn't clear. In literature, it's potential to seek out reports that evaluated variable concentrations with best results at concentrations below a hundred and twenty fifth and on top of a pair of indicating that there's not a perfect concentration for nanoparticles. in addition, it absolutely was not ascertained a predictable relationship between concentration and therefore the nano-additive influence in friction and wear. These observations result in the conclusion that every reasonably nanoparticles should be evaluated considering the mentioned characteristics – composition, shape, size and concentration –, besides others, like application conditions (temperature, contact pressure, slippy speed) and therefore the stuff within which nano-additive are another. Most of the researches that reported improvement in tribological properties used mineral and polyalphaolefin (PAO) lubricants in their tests.

On the opposite hand, there area unit a lower range of papers that investigates the employment of nanoparticles as additives in organic compound oils and biolubricants. It would be attributed to results made therefore far: despite of some smart results, most of them report injurious effects within the tribological properties. This negative impact is associated to polar nature of those base stocks [11]. one in every of the most characteristics of polar compounds is their sorption capability on antimonial surfaces; the attraction between polar molecules and antimonial surfaces ends up in a skinny oil film that stops metal-to-metal contact. a number of the mechanisms that area unit attributed to undesirable results with polar compounds area unit associated with the actual fact that the antimonial nanoparticles would even be attracted by the polar molecules. Covering them with associate degree oil film preventing their perform as ball-bearing and their deposition. Besides, the addition of nanoparticles might disrupt the film formation by preventing the uniform sorption in rubbing surfaces, reducing the surfaces protection usually seen with polar oils; and therefore the presence between contact areas manufacturing a 3rd body impact rather than a rolling one. The aim of this work was to research the tribological properties of base oils with and while not atomic number 29 nano-additive. Friction tests were administered during a tribometer with pin-on-disk configuration beneath varied experimental conditions (load, temperature and slippy speed) and wear experiments were performed in pin-on-disk and four-ball configuration, covering 2 experimental conditions due their completely different contact areas. Mineral and artificial base oils were chosen, the primary with low-polarity and therefore the different a polar compound. This works aims to gift scenery, as complete as potential, of the employment of the Nano-additive, reckoning on temperature, slippy speed, contact pressure, form of oil and compound.

II. EXPERIMENTAL DETAILS

The material properties like, nanoparticles composition, base oil characteristics and tribometer specimen's composition are described on Table 1. The lubricants composition and identification are described on Table 2.

A. Nanoparticle Additives Use In Castor And Mahua Oil Blend.

Additive plays several roles in lubricating oil. These primarily include enhancing the existing desirable properties, suppressing the existing undesirable properties, and imparting new properties. As per objective of the research we have most selected anti-wear additives are molybdenum disulfide powder and graphite. While selection of additive first thing is considered is that the additive should be inorganic compound because inorganic compound shows excellent tribological properties when they used as an additive. Along with inorganic compound the most important point is that solid lubricant shows better tribological properties at extreme conditions.

Fig. 1 hBN nanoparticles

The particle size is the main task because particle size plays an important role in lubrication. With the selection of particle sizes we have selected 0.5micron & 1micron particle sizes powders of additive.

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Table No.1 Properties of h-BN additive

Properties	Specifications
Formula	H-bn
Colour	White
Crystallie Form	Hexagonal
Melting Point (°c)	1185
Density (kg/m^3)	5.06

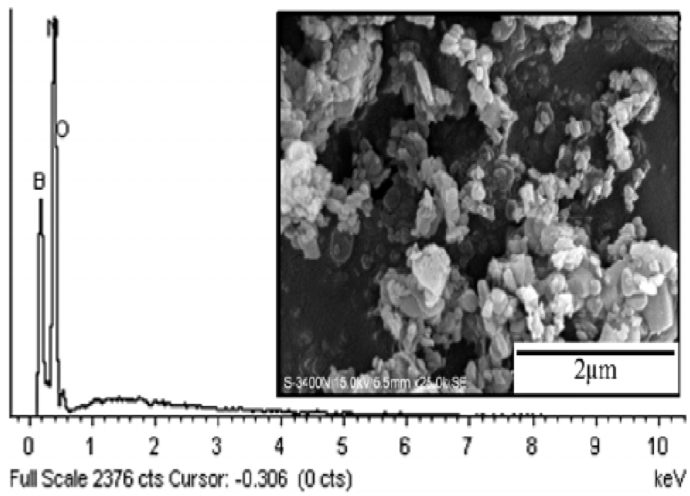

Fig. No.2 EDX spectrum and SEM micrograph of hBN nanoparticles

The design of experiment was done on the basis of factorial design. In that used three different additives having three particle sizes in three different proportions.

B. Base oil

1) *Castor Oil 65% +Mahua Oil 35%:* Blend of castor oil & Mahua oil is used as base oil for the experimentation as this blend is found out optimum for the range of castor and mahua oil blends among the pure castor oil, 15%, 25%, 35% and 45% Mahua oil in Castor oil Blends by the experimental wear tests performed over Four ball tester.
2) *Design of Experiment:* hBN Nanoparticles with particle size 0.8µ & 1µ with wt% of hBN 0.5%, 1% & 2% is selected for experimentation. Apparatus used for experiments is ducom four ball tester.

Table no.2 Design of Experiment

Sample No	% of Mahua oil in Castor oil	hBN size (µ)	hBN %
1	35% Mahua blend oil	0.8	0.5
2	35% Mahua blend oil	0.8	1
3	35% Mahua blend oil	0.8	2
4	35% Mahua blend oil	1	0.5
5	35% Mahua blend oil	1	1
6	35% Mahua	1	2

Testing For Castor Oil 65% +Mahua Oil 35%

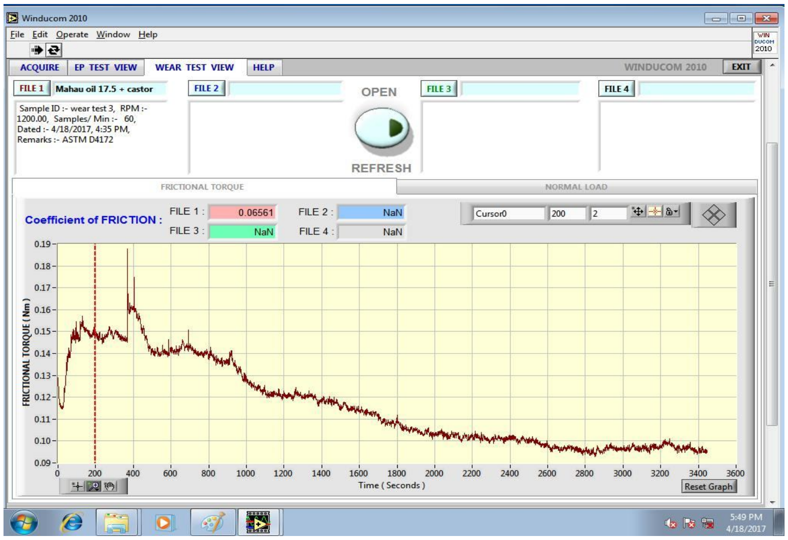

Fig. No. 3 Graph no 7.4 Graph of Frictional Torque Vs Time Castor Oil 65% +Mahua Oil 35%

Value of COF and WSD is shown in result table No. 3

Table No. 3 Observation table for Antiwear for castor + mahua oil

Test No	Test Configuration	MAJOR	MINOR	MEAN	AREA	COF
1	Castor Oil 65% +mahua oil 35%	220	207	214	0.036	0.06561

C. Apparatus

A magnetic stirrer ASMS 84 was used for mixing of nanoparticles in Castor and Mahua oil, Four Ball Tester TR-30L-IAS (MFG. by DUCOM, Bangalore, India) was used for performed wear and friction test at Pravara Rural Engineering College, Loni. Ahmednagar Maharashtra .

Performing Experieriments on Four ball tester as per Standard Wear test test ASTM D4172 B.

Frictional Torque Vs Time graph for the above configuration the comparison graph for tests is shown in fig.

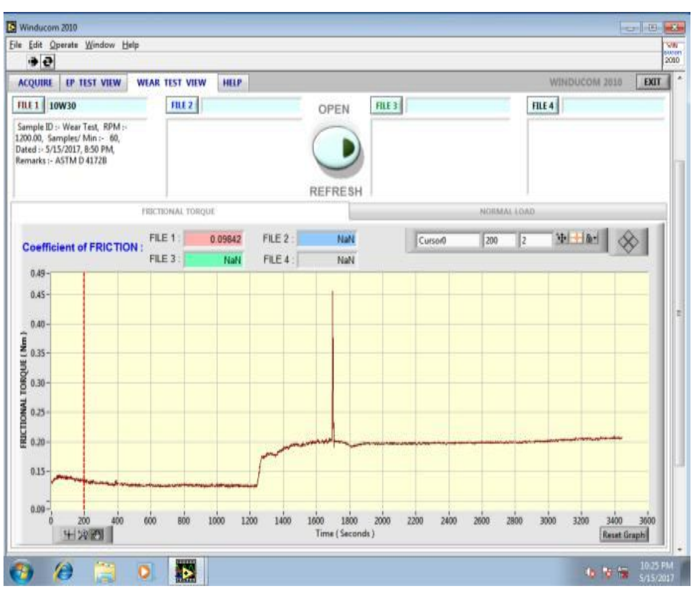

Fig.4: Graph of frictional torque (Nm) Vs time (sec) for Engine oil SAE 10W30

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Graph shows frictional Torque Vs Time graph for Engine oil SAE 10W30 oil.
COF tested on engine shows 0.09842 and Wear scar diameter 561 µ

D. Testing for the hBN nanoparticle addition with particle size 0.8µ and wt% of 0.5%, 1% & 2%.

Fig. No. 5 Comparison graph of 0.5%,1% & 2% h-BN nano particles of 0.8µ with mahua with Pure Castor oil 65% & Mahua Oil 35%

The uniqueness of this study exists in the fact that low-cost and environmental friendly hBN nanoparticles, dispersed in conventional oil, could potentially enhance the oil properties performance. This promising technology has an even greater impact on fuel consumption and engine durability for a greener future. Besides, good lubrication and thermal conductivity properties, which can simultaneously improve oil properties, performance and boost heat transfer in engines, were the key factors for using hBN nanoparticles.

Table No.4 Wear Test readings for wt% 0.5%,1% & 2% h-BN nano particles of 0.8µ Pure Castor oil 65% & Mahua Oil 35%

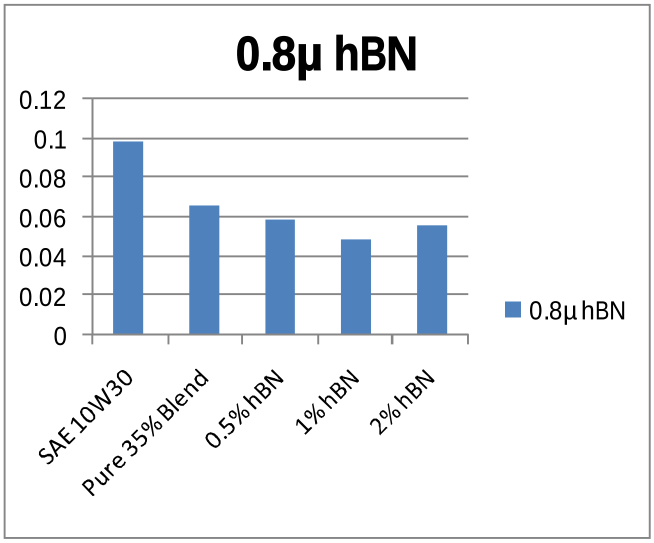


Fig. 6 Chart of COF of hBN 0.8µ size & SAE 10W30, 0%, 0.5%, 1% & 2% wt% hBN

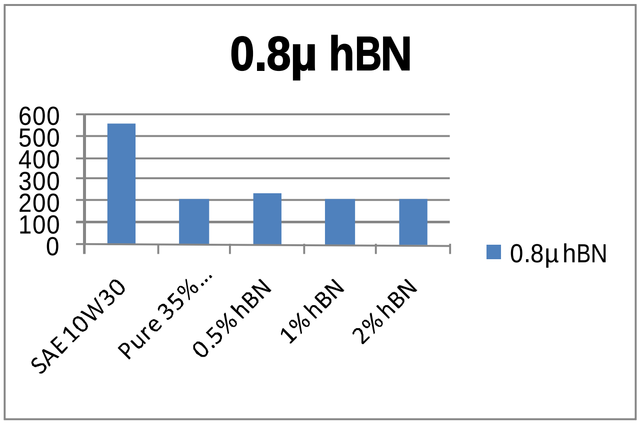


Fig. 7 Chart of Avg. WSD hBN 0.8µ size & SAE 10W30, 0.5%, 1% & 2% wt% hBN

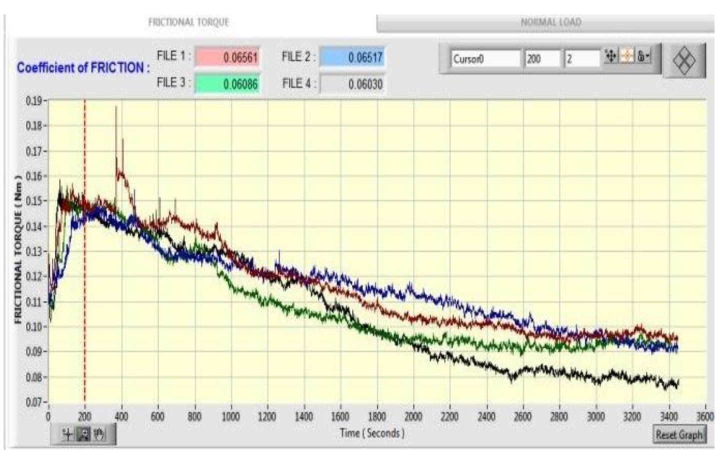
E. Result table

From Table No. 4 it is observed that with 0.8µ, 0.5%, 1% & 2%h-BN Nanoparticles added with 35% mahua oil blend it shows coefficient of friction drops up to 1% wt% of hBN from 0.06561 to 0.04852 nearly 50% lower than SAE 10W30 oil and with 2% wt% hBN it increases to 0.05549 There is no significant effect on WSD of balls however it is highest to 241 with 0.5% wt % hBN in pure blended oil And lowest 212 with 2% wt% hBN 63% lower than SAE 10W30 oil

Table no. 7.11 Result table for Comparison of 0.8µ hBN Wear Data

			Readings				
Sr. No.	Sample Name	hBN 0.8 µ %	Major Wear scar dia. (mm)	Min. Wear scar dia (mm)	Avg. Wear scar dia. (mm)	Area (mm^2)	COF
1	Mahau oil 35% + castor oil 65%	0%	220	207	214	0.036	0.06561
2	Mahau oil 35% + castor oil 65% + hBN 0.8 µ	0.5%	250	232	241	0.046	0.05879
3		1%	230	201	216	0.036	0.04852
4		2%	221	204	212	0.035	0.05549

Testing for the hBN nanoparticle addition with particle size 1µ and wt% of 0.5%, 1% & 2% hBN



Graph no.8 Comparison graph of 0.5%, 1% & 2% h-BN nano particles of 1 µ with mahua with Pure Castor oil 65% & Mahua Oil 35%

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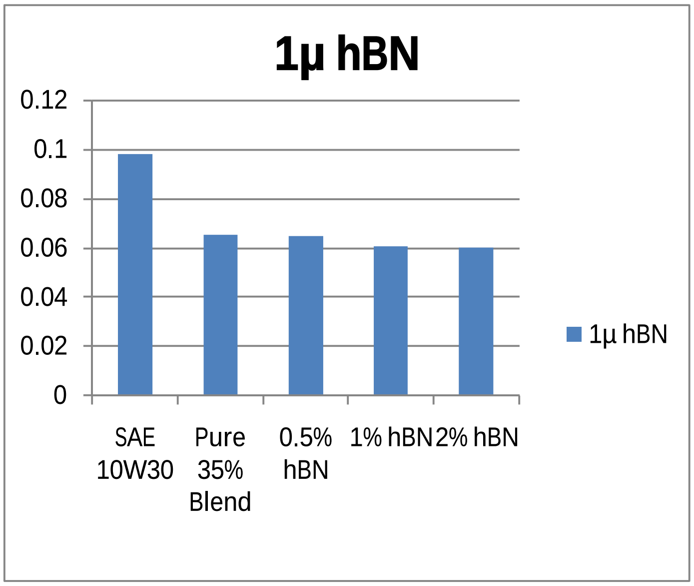

Fig.9 Chart of COF of 1µ size & SAE 10W30, 0%, 0.5%, 1% & 2% wt% hBN

Table No. 6 Wear test readings for 1µ size & 0%, 0.5%, 1% & 2% wt% hBN

			Readings				
Sr. No.	Sample Name	hBN 1 µ %	Major Wear scar dia. (mm)	Min. Wear scar dia (mm)	Avg. Wear scar dia. (mm)	Area (mm^2)	COF
1	Mahau oil 35% + castor oil 65%	0%	220	207	214	0.036	0.06561
2	Mahau oil 35% + castor oil 65% + hBN 1 µ	0.5%	230	207	218	0.037	0.06517
3		1%	238	230	234	0.043	0.06086
4		2%	237	211	224	0.039	0.06030

From graph 6 it is observed that with 0.5%, 1 µ, 1% & 2% h-BN powder added with 35% mahua oil blend oil it shows coefficient of friction drops continuously as wt % of hBN increased from 0% to 2% COF reduce from 0.06561 to 0.0603 shows 39% lower COF than SAE
10W30 OIL. WSD shows highest 234 in 1% wt% hBN and lowest in pure 35% Mahua oil blend shows 58% lower WSD value than SAE 10W30 oil.

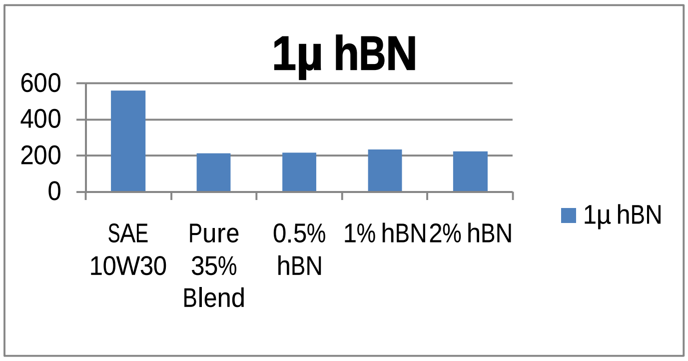

Fig. 10 Chart of WSD of 1µ size & SAE 10W30, 0%, 0.5%, 1% & 2% wt% Hbn

Observation table for COF and WSD of balls have benn shown in Table No.

VII. CONCLUSION

Castor and mahua oil blends shows 35% lower coefficient of friction than Engine oil SAE 10W30.

0.8µ hBN nanoparticle WT% 1% when mixed with Castor and Mahua oil blend shows lower coefficient of friction and wear scar diameter.

hBN nano particles with different micron size and varying addition percentage shows different characteristics with various sizes of 0.8 & 1 micron

All size hBN decreased the average friction coefficient and wear with respect to base oil.

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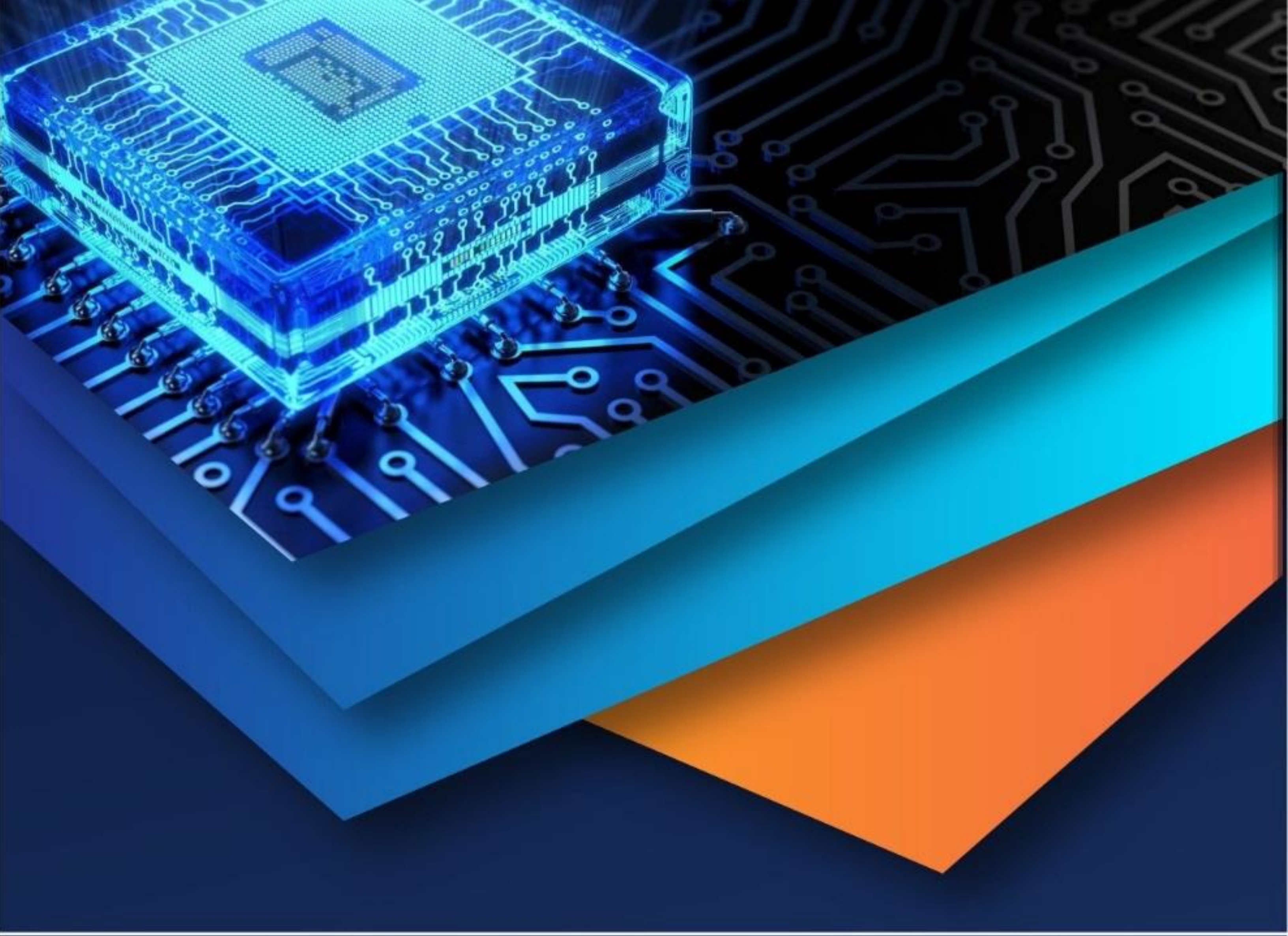

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