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Performance Analysis of CI Engine Fueled With Turmeric Leaf Oil Assisted by Magnetic Fuel Energizer

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Abstract: ***Turmeric leaf oil has shown as potential bio-fuel in these recent years. Properties like higher calorific value and low viscosity are the properties which are similar to the conventional diesel. This paper explains an experimental study about performance analysis of CI engine fueled with turmeric leaf oil along with magnetic fuel energizer. From the turmeric waste leaves, oil is extracted by steam distillation process. Three blends of turmeric leaf oil with diesel was prepared and also 1 and 2 magnetic fuel energizers are used to check performance of single cylinder 4 stroke with water cooled coupled to eddy current dynamometer loading with computerized result display. It has been observed that B10 and B20 blend performed well during part but overall performance of B30 with 2 Magnetizer was found better among other blends.***

Keywords: Turmeric Leaf oil, alternate fuel, biodiesel, diesel engine, magnetic fuel energizer, performance.

I. INTRODUCTION

Rudolf Diesel completely trusted that the use of a biomass fuel to be the genuine eventual fate of his motor. He needed to give agriculturists the chance to create their own particular fuel. Biodiesel can be expressed as a fuel that is comprised of a mono alkyl ester of a long chain of unsaturated fats that are gotten either from vegetable oil or creature fat. Vegetable oils have great start quality as they have since quite a while ago anchored structures which are not expanded. Conversely, the higher synthesis of oxygen content, carbon buildup and bigger atomic mass influences the warming to estimation of biodiesels essentially lower than diesel. They have higher blaze point and are around 10% denser than diesel, making them safe to store. Be that as it may, these have higher icy direct causing them toward thicken or even stop at low surrounding temperatures. Their poor unpredictability because of higher consistency is in charge of their lower cetane numbers. Further, biodiesels are biodegradable and lessen the CO_2 cycle. Likewise, they don't contain sulfur and any cancer-causing agents, in this manner they are not hurtful to living creatures. A related issue could be that, developing yields requires parcel of time and high speculation and transportation to neighborhood stations which makes the more costly than diesel.

Most powers for inward burning motors are fluid, however fluid fills don't combust until the point when they are vaporized and blended with air. Most emanations from engine vehicles comprise of unburned hydrocarbon, carbon monoxide, and oxides of nitrogen. Unburned hydrocarbon and oxides of nitrogen respond in the environment and make brown haze. Exhaust cloud is the prime reason for eye and throat disturbance, poisonous odors, plant harm and diminished perceivability. Oxides of nitrogen are additionally poisonous. For the most part, powers for inward ignition motor are compound of particles. Every particle comprises of various molecules made up of number of core and electrons. Attractive developments as of now exist in their atoms and in this manner, in them as of now have positive and negative electrical charges. Be that as it may, these particles have not been realigned, the fuel isn't effectively interlocked with oxygen amid ignition, the fuel atom or hydrocarbon chains must be ionized and realigned. The ionization and realignment is accomplished through the use of attractive field made by 'Magnetizer'. The ionization fuel likewise breaks down the carbon develop in carburetor, planes, and fuel injector and ignition chamber, subsequently keeping the motors clear condition.

II. OBJECTIVES

A. It is proposed to use Turmeric Leaf Oil in the CI engine.
B. Magnetizer is particularly effective for improving the combustion efficiency of fuel.

C. Evaluation of biofuel properties.
D. Evaluation of performance and emission characteristicsof biofuel in diesel engine.
E. By using Magnetizer, combustion efficiency of fuel will be tested.

III. TURMERIC LEAF OIL

A. Extraction of Turmeric Leaf Oil

1) *Steam Distillation:* Steam Distillation is the most popular method which is used to extract and separate essential oils from plants for use in natural products. This happens when the steam vaporizes the plant material's volatile compounds, which go through a condensation and collection process.
2) *Steam Distillation Process:* A large container called a Still, which is generally made up of stainless steel, containing the plant material has steam passed to it. With the help of inlet, steam is injected to the plant material containing the desired oils, which releases the plant's aromatic molecules and turns them into vapor. The vaporized plant compounds travels to the Condenser. Here, two separate pipes aremade it to pass the hot water to exit and for cold water enter into the Condenser. Thus, vapor cools back into the liquid form. The fragrant fluid result drops from the condenser and gathers inside a repository underneath it, which is known as Separator. Since water and oil don't blend, the fundamental oil oats over the water. From here, it is redirected.Some of the fundamental oils are much heavier than water, for example clove basic oil, so they are found at the base of the separator.

B. Turmeric Leaf Biodiesel

1) Preparation of Turmeric Leaf Biodiesel

Biodiesel can be produced from vegetables oil, animal oil or fats and waste oils. There are mainly three routes to produce biodiesel from fats and oil.

a) Base catalyzed transesterification of oil
b) Direct corrosive catalyzed transesterification of oil.
c) Conversion of oil to its unsaturated fats and after that to biodiesel.

All biodiesel are generated by base catalyzed transesterification as it is the most efficient process requiring just low temperature and weights and delivering a 98% transformation yield. A transesterification process is the reaction of triglyceride i.e., fat or oil with liquor to form esters and glycerol. A triglyceride has a glycerineparticlesas its base with three long chain unsaturated fats connected. The qualities of the fat are dictated by the idea of unsaturated fats joined to the glycerine. The idea of the unsaturated fats can thus influence the qualities of the biodiesel. During the esterification procedure, the triglyceride is responded with liquor within the sight of an impetus, generally a solid basic like sodium hydroxide. The liquor responds with the unsaturated fats to form the mono-alkyl ester, or biodiesel and unrefined glycerol. In most creation methanol or ethanol is the liquor utilized where methanol produces methyl esters, and ethanol produces ethyl esters and is base catalyzed by either potassium or sodium hydroxide. Potassium hydroxide has been observed to be more appropriate for ethyl ester biodiesel generation either base can be utilized for the methyl ester. A typical result of the transesterification procedure is Rape Methyl Ester (RME) delivered from crude rapeseed oil responded with methanol.

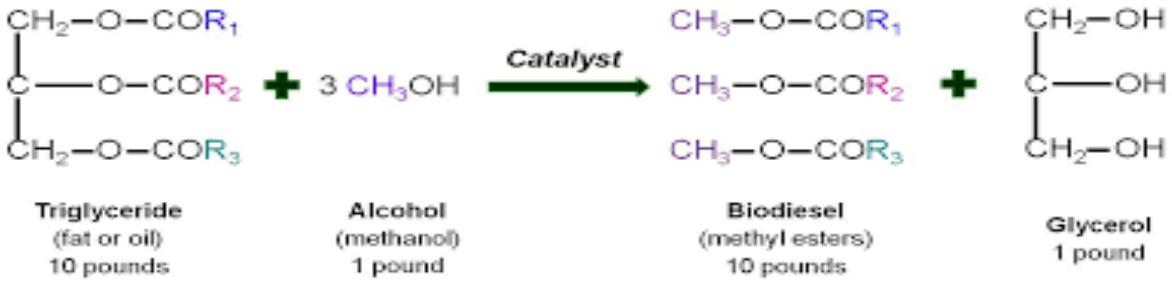

Figure.1: Chemical reaction for Methyl esters biodiesel

The products of the reaction are the biodiesel itself and glycerol. A successful transesterification reaction is signified by the separation of the ester and glycerol layers after the reaction time. The heavier, co-product, glycerol settles out and may be sold as it is or it may be purified for use in other industries, e.g. the pharmaceutical, cosmetics, etc.

C. Production of Biodiesel

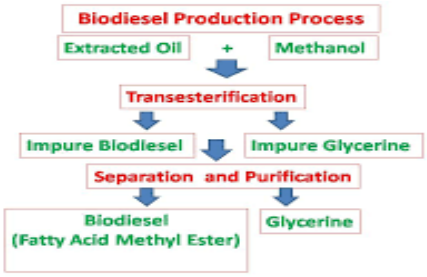

Figure 2: Biodiesel Production Process

D. Transesterification Process

The steps involved in the trans-esterification process are as follows: It consists of two methods. They are:

1) *Free fatty acid:* Weigh about 4 grams of NaOH using weighing machine. Measure 1 litre of distilled water into one litre standard flask. Using a glass rod to break the NaOH flakes and dissolve it by constant and uniform stirring. Take 25ml of 0.1N NaOH solution prepared transfer into a clean and dry burette. Take 50ml of Isopropyl alcohol in a clean and dry 250ml conical flask and then add 10gm of parent oil to flask. Add few drops of NaOH solution to the above flask and shake well. Heat the above mixture to about 60^{o}C.Titrate against 0.1N NaOH from the burette.Titrate, with shaking, with the NaOH solution to the end point of the indicator, the pink color persisting for at least 10sec.The free fatty acid value is calculated by the formula : 28.2xNxV/M

   Where, V is the number of ml of NaOH solution , N is the normality, M is the mass in ml of the sample
2) *Mixing of alcohol and catalyst:* A specified amount of methanol is added with a measured quantity of NaOH which acts as catalyst, into a flask.
3) *Reaction:* This mixture is then added into a closed reaction vessel and the respective oil is added and heated to 60-80^{o}C. This reaction converts the fats into the esters. Once in a while, an additional measure of fuel can be included request to guarantee finish transformation of fats to esters.
4) *Separation of biodiesel and glycerin:* After the completion of reaction, two products exist: biodiesel and glycerin. The quantity of glycerin varies as per the kind and quantity of vegetable oil.
5) *Removal of alcohol:* The mixture of biodiesel and glycerin is heated up to 60^{o}C, thus producing the steams, which separates the amount of glycerol from the mixture. The methanol is sufficiently dry in order to recirculate it back into the reaction.
6) *Glycerin neutralization:* The glycerin byproduct contains unwanted quantity of catalyst and soap and needs to be neutralized with an acid.
7) *Methyl ester water wash:* This is the final phase which ensures the complete removal of unwanted contents from the biodiesel, so as to make it compatible with the diesel engine. The single phase method is usedwhenthe free fatty acids (FFA) amount in oil is below 4%. This involves a measured amount of alcohol as methanol and the catalyst NaOH and the mixture is heated and maintained at 65^{o}C. If fatty acids is greater than 4%, double phase method is used. It involves mixture of H_2SO_4 and methanol to be taken and added and supplied to esterification process first and then it is heated and maintained at 65-80^{o}c. This is then passed onto and previous process is carried out.
8) *Magnetic Fuel Energizer:* Magnetic fuel energizer is used to maximize the mileage by using less diesel fuel. In other words, magnetic fuelenergizer able to reduce the diesel consumption in the diesel engine.Magnetic Fuel Saver is a device which is used to alter atomic construction and organize fuel molecules (fuel quality) so that proper combustion happens in I.C. engine/automobile.

E. Working ofMagnetic Fuel Energizer:

Diesel fuels is in the form of liquid when it's in the oil tank and the important point is fuel will only combust when they are vaporized and mixed with the air. Thus, something has to be done to break the particles into finer tiny particles to improve the combustion. Magnets help to ionize the fuel. Fuel is basically from the groupings of hydrocarbons. Whenthe molecules of hydrocarbon flowing through a magnetic field, it changes their orientation and molecules of hydrocarbon change their configuration.

Thus, thisresults in changes of molecule configuration and weaken the intermolecular force between the molecules.This has the effect of ensuring that the fuel actively interlocks with the oxygen, producing a more complete burn in the combustion chamber. In other words, magnetic field actually disperses themolecules into more tiny particles and making the fuel less viscous. Figure 3 shows,how magnets help to disperse the molecules. Emission is another hot topic of diesel engine. Emission of dangerous gaseous such as oxides of nitrogen and oxides of sulphur is the result of incomplete combustion in the combustion chamber.The result is higher engine output, better fuel economy and a reduction in the hydrocarbons, carbon monoxide and oxides of nitrogen that are emitted through the exhaust. The ionization of the fuel also helps to dissolve the carbon build-up in carburetor jets, fuel injectors and combustion chambers, thereby keeping the engine in a cleaner condition. Thus, magnetic field can improve the combustion level.

Figure 3: Disperse of molecules using Magnetic Fuel Energizer

IV. MATERIALS AND METHODS

Experiment is done on single cylinder, 4 stroke, water cooled with eddy current dynamometer loading computerized diesel engine. It is used for evaluation of performance characteristics of Turmeric leaf biodiesel blend with diesel which can be used as an alternative fuel. Fuel supply is assisted by external device called as Magnetic fuel energizer.The performance of turmeric leaf biodiesel with magnetizer and without magnetizer at different loads are evaluated.

A. Installation of Magnetic Fuel Energizer

In this experiment we installed the fuel energizer on inlet pipe of diesel engine as shown in Fig. 4 to get maximum effect.

Figure 4.1: Fuel Line with 1 Magnetic fuel Energizer

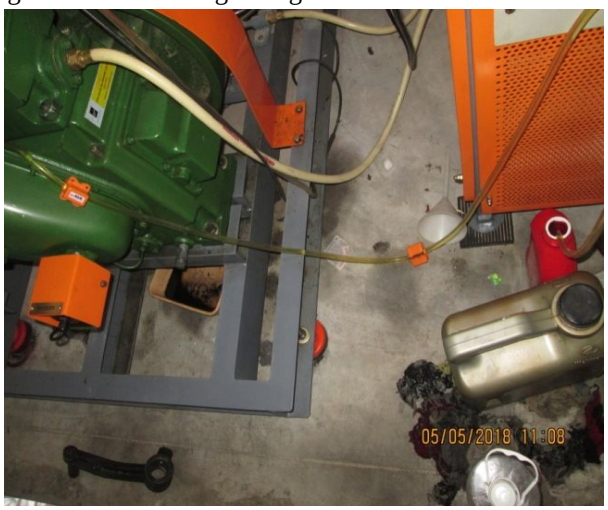

Figure 4.2: Fuel Line with 2 Magnetic fuel Energizer

Figure 4: Installation of Magnetic fuel Energizer

Engine Specification

Make:	Kirloskar
Engine rated power:	3.500KW
Engine rated speed:	1500rpm
Diameter of the cylinder:	87.5mm
Clearance volume:	210.00mm
Number of cylinders:	1

Orifice diameter: 20mm
Dynamometer: 1mm
Arm length: 150mm
Fuel rate: 15cc
Sensor:

B. Results

Table 1: Comparison of Properties of Turmeric Leaf Biodiesel blends with diesel:

Properties	Diesel	B100	B10	B20	B30
Density (kg/mm^3)	0.842	0.850	0.825	0.828	0.830
Kinematic Viscosity (mm^2/s) at 40^{0}C	2.5	1.058	2.152	2.042	1.913
Flash point (^{0}c)	70	55	65	50	50
Fire point (^{0}C)	78	60	70	60	65
Calorific value (MJ/Kg)	44000	33050.41	41612.54	42361.72	43431.90

1) Brake power

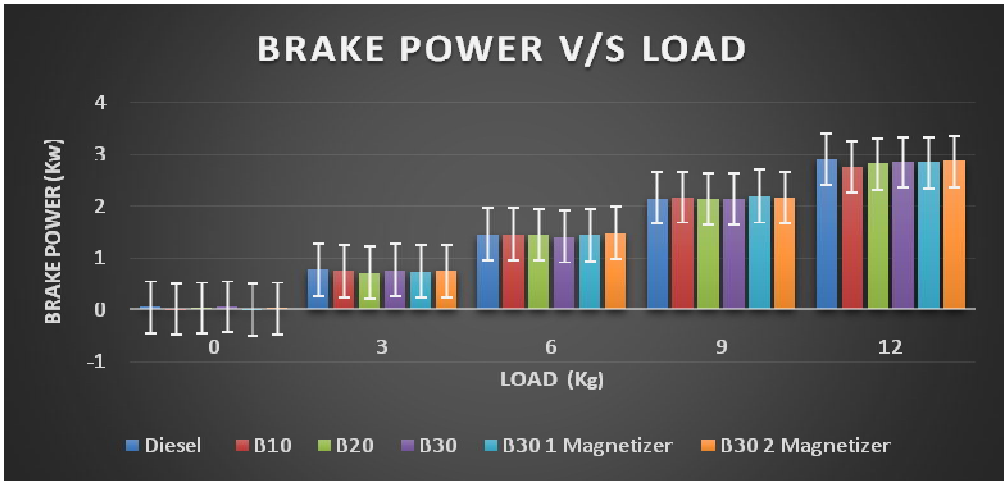

Figure 5: Variation of Brake Power with Load

The variation of brake power with load for different fuels is presented in the figure 5. In this graph brake power is increased with increased in load. The maximum brake power is found in Diesel as compared to other blend fuels.

2) Brake Thermal Efficiency

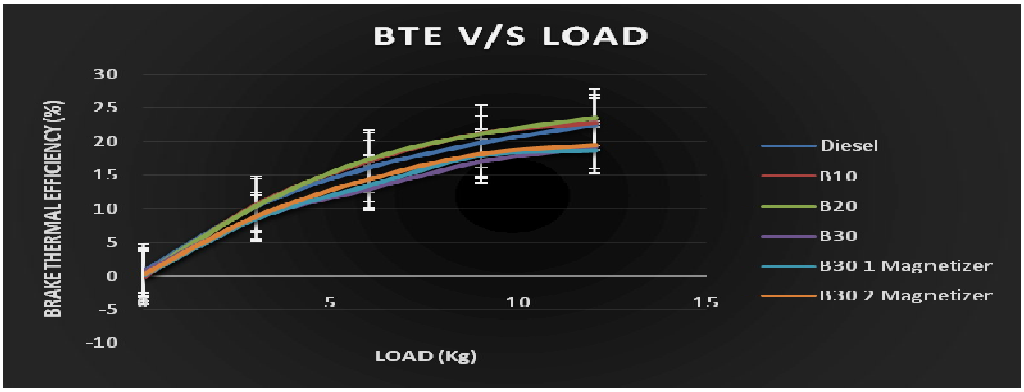

Figure 6: Variation of Brake Thermal efficiency with Load

The variation of brake thermal efficiency with load for different loads is presented in figure 6. In all cases, brake thermal efficiency is increased with increase in load. This was due to reduction in heat loss and increase in power with increase in load. The maximum brake thermal efficiency obtained is for B20, B10 and is higher than that of diesel. The brake thermal efficiency obtained for B30, B30 with 1 Magnetizer and B30 with 2 Magnetizer is less than diesel. This lower brake thermal efficiency obtained could be due to increase in fuel consumption when compared to B10 and B20.

3) Indicated Thermal Efficiency

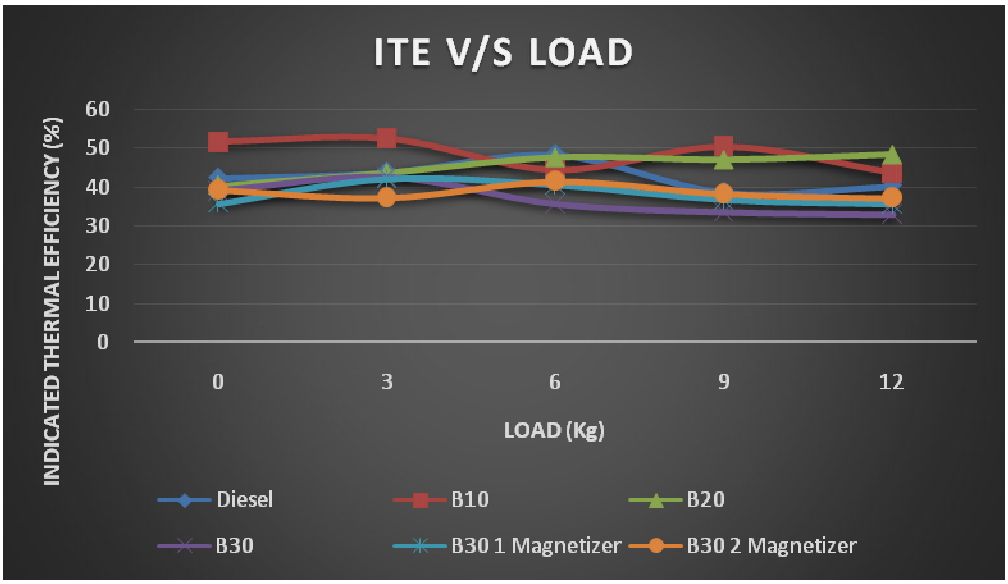

Figure 7: Variation of Indicated Thermal efficiency with Load

The variation of Indicated thermal efficiency with load for different fuels is presented in figure 7. In all cases, indicated thermal efficiency is increased and decreased with an increase in load. This was due to reduction in heat loss and increase in power with increase in load. The maximum indicated thermal efficiency obtained is for B20, B10 and is higher than that of diesel. The indicated thermal efficiency obtained for B30, B30 with 1 Magnetizer and B30 with 2 Magnetizer is less than diesel. This lower indicated thermal efficiency obtained could be due to increase in fuel consumption as compared to B20 and B10.

4) Specific Fuel Consumption

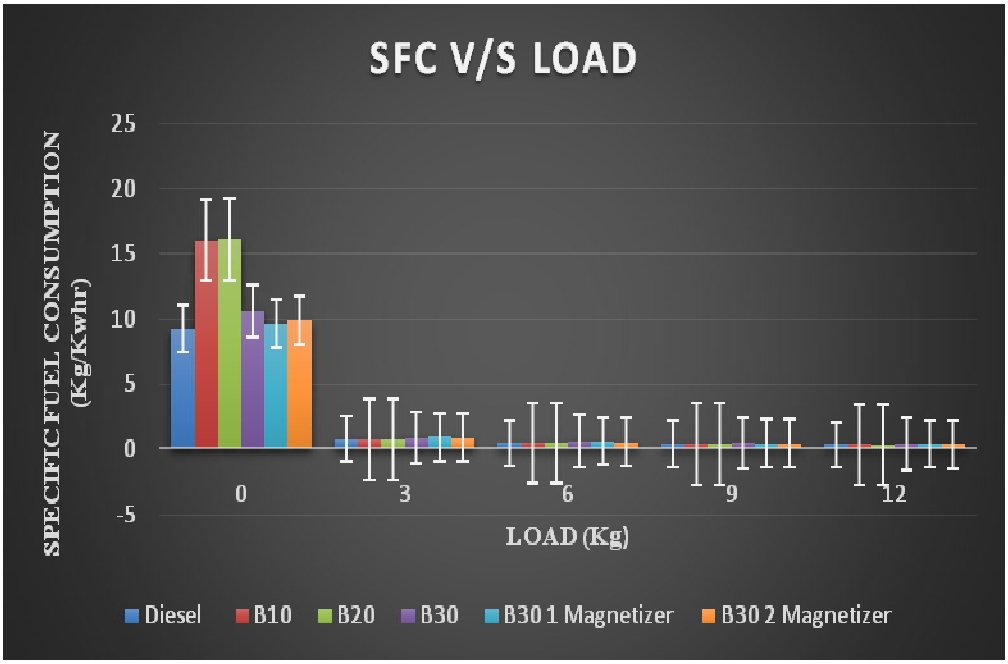

Figure 8: Variation of Brake Specific Fuel Consumption with Load

The variation of specific fuel consumption with load for different loads is presented in figure 8. Brake-specific fuel consumption (BSFC) is the ratio between mass fuel consumption and brake effective power, and for a given fuel, it is inversely proportional to thermal efficiency.BSFC decreased sharply with increase in load for all fuels.The main reason for this could be that the percent increase in fuel required to operate the engine is less than the percent increase in brake power, because relatively less portion of the heat is lost at higher loads.The maximum BSFC was found in B10 and B20 and it is much higher than the diesel B30, B30 with 1 magnetizer and B30 with 2 Magnetizer.

V. CONCLUSION

With the obtained results for experimentation following conclusion can be drawn: Turmeric leaf oil with B10 and B20 blend has shown highest indicated thermal efficiency as compared to other blends. Turmeric leaf oil with B30 blend has shown less specific fuel consumption for the same output during part and full load. Addition of 2 magnetizer with B30 blend has improved the brake power due to efficient combustion process. Blend B30 with 2 magnetizer has performed well during part load and full load condition. Turmeric leaf oil has emerged as one alternate fuel for diesel with optimum B30 blend with 2magnetizer.

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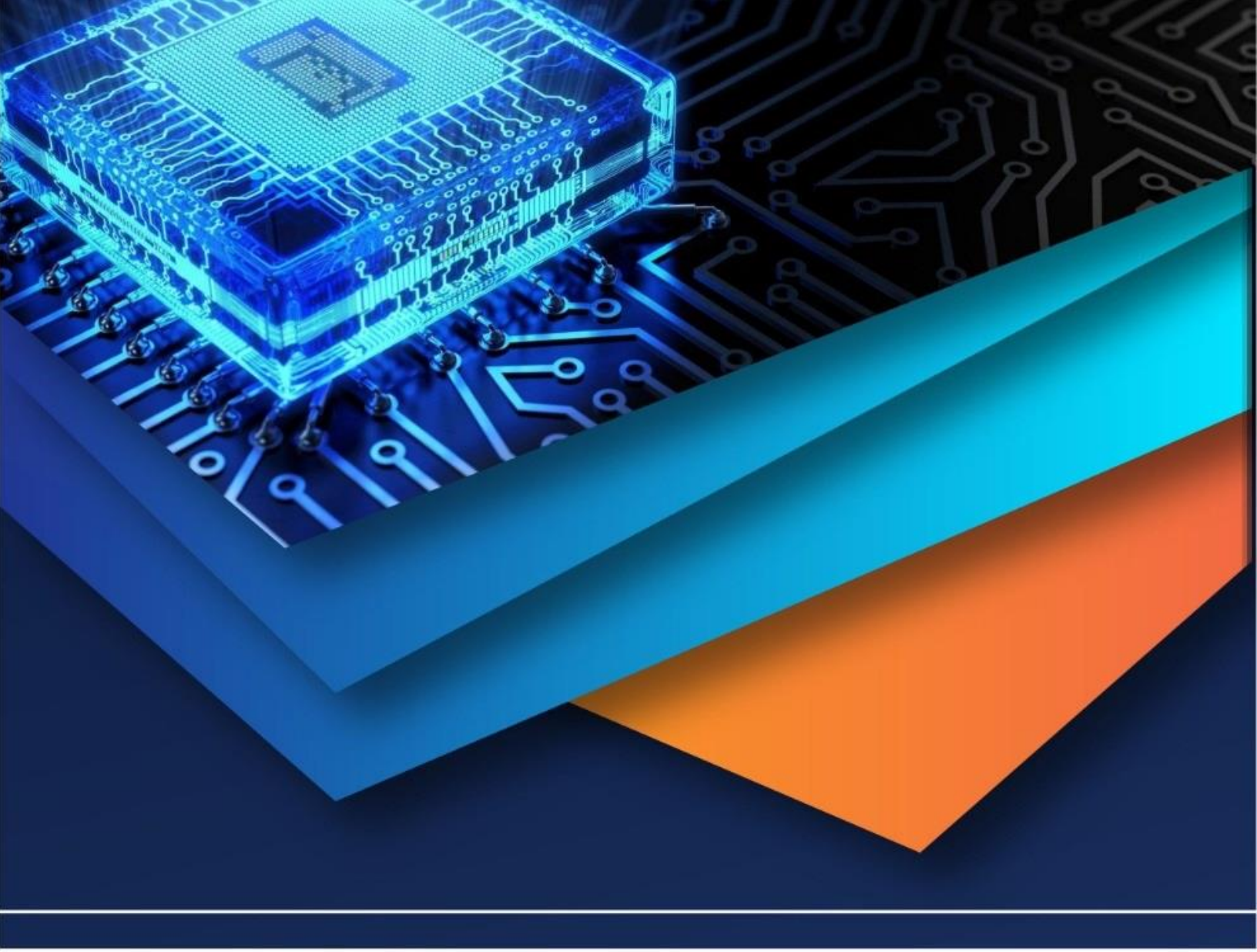

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