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Performance Analysis of 4 Stroke Compression Ignition Engine by Using Diesel and Biodiesel Blend of Hingot Oil

Mr. Akash Singh Raikwar[1], Mr. Amit Agarwal[2], Dr. Amit Pal[3]
[1]Department of Mechanical Engineering, SRCEM Bamore, Morena)
[2]Department of Mechanical Engineering, SRCEM Bamore, Morena)
3Department of Mechanical Engineering, Delhi Technical University, Delhi India

Abstract : Looking to present scenario of rapidly increases the pollution in our country and worldwide too the need of some clean and non toxic fuels which helps the environment from the pollution, also the rise of petroleum is hike day by day and we all know petroleum is limited we can't have petroleum after next 50 year if the same rate of consumption is continue so for a future we needs some alternatives of petroleum, there are lot of alternative fuels is discovered in present days out of which biodiesel is most convenient fuel from our society. Biodiesel is clean, non toxic, biodegradable and environment friendly alternative fuels Since biodiesel is produce from the vegetable oil or animal fats hence its generally renewable fuels.

In this paper I have tested the performance of compressed ignition engine in varying load conditionby using biodiesel which is produced in a laboratory of Delhi Technological University, Delhi from a seed of Hingot (Balanitesaegyptiaca Del.) by Mechanical stirring method, testing is done with the diesel blend which have different properties at B0, B10, B20 and B30. Among the all blends, the the specific fuel consumption, brake specific fuel consumption and brake thermal efficiency is calculate and compare with the all samples of blends.

Keyword: Biodiesel, Performance test, Brake power, Blend, Brake thermal efficiency

I. TRODUCTION

Compressed Ignition Engine is a type of IC Engine which is generally used for a run heavy engine and generator and uses Diesel a fuel in this if we use the blend of biodiesel in place of pure biodiesel without any modification in engine then it run smoothly up to a certain percentage of biodiesel in diesel called blend. There aremany of past experiments says that CI engine run smoothly with biodiesel blends. Gopal el al.[1] performed experiments on a constant speed single cylinder, 4 stroke ,air cooled diesel engine for agriculture purpose used to test the fuel. Raw material used for biodiesel production was waste cooking oil which was collected from difference sources, specific energy consumption changes with increase in blends due to the lower value of biodiesel. Shahidet al.[2]observed B100 is also used an engine but B20 are increases the fuel consumption and 10% decreases the brake thermal efficiency. Zakira el al.[3] also used Waste cooking oil for producing biodiesel and perform the test at B20, B40, B60, B80 and B100 and observed the lowest BHP. Higher BHP obtained when engine was fueled by blends with low biodiesel contained also it was found that average brake specific fuel consumption of B100 is 9.45% higher than diesel fuel. Sharmaet al [4] uses WCO for produce biodiesel, B20 and B40 blend result the brake thermal efficiency is higher with respect to diesel at higher load, this is due to better combustion of biodiesel blends due to present of extra amount of oxygen, in case of brake specific fuel values are higher at the beginning due to higher viscosity. Srinivas et al. [5] observed at B20 blend brake thermal efficiency is 37.855% and it is 0.275% less than of standard diesel operation. Rao et al.[5] used cooking methyl ester UCME which has low calorif value than that of biodiesel hence specific fuel consumption is slightly higher than that of biodiesel for UCME and its blends. Brake thermal efficiency of UCME and its blend is lower than pure diesel. Algasim et al.[6] used turbocharged diesel engine for testing, standard diesel produced the higher brake torque and power at the engine for all engine speeds. This is due to lower calorific value of the biodiesel compare to standard value, at full load operation, the lowest specific fuel consumption was for the standard diesel compare to biodiesel.

II. PERFORMANCE TESTING

A. Engine test setup

The setup of engine is consist of single cylinder, four stroke, kirloskar diesel engine connected to an eddy current dynamometer for loading. The setup has stand-alone panel box consisting of air box, two fuel tanks for duel fuel testing, fuel measuring unit, manometer, transmitters for air and fuel flow measurements, process indicator and engine indicator. Rotameters are provided for cooling water and calorimeter water flow measurement. The setup enables study of engine of engine performance various parameters like brake power, indicated power, frictional power, break mean effective pressure (BMEP), indicated mean effective pressure (IMEP), indicating thermal efficiency, mechanical efficiency, volumetric efficiency, specific fuel consumption, air/fuel ratio and heat balance. The aim of these experiments is to study the effects of various parameters on performance of kirloskar engine for different blends of diesel and biodiesel.

B. Engine Specifications

Table:1Constructional Specifications of engine test setup.

S.No.	Component	Specifications
1.	Product	Kirloskar engine test setup 1 cylinder, 4stroke diesel engine.
2.	Product code	234
3.	Engine	Make kirloskar, type 1 cylinder, 4 stroke diesel, water cooled, power 3.5kW at 1500rpm, stroke 110mm, bore 87.5mm. 661cc CR17.5
4.	Dynamometer	Type eddy current, water cooled with loading unit
5.	Propeller shaft	With universal joint
6.	Air box	M S fabricated with orifice meter and manometer
7.	Fuel tank	Capacity 15L with glass fuel metering column
8.	Calorimeter	Type pipe in pipe
9.	piezo powering unit	Make cuadra, Model AX-409
10.	Digital milivoltmeter	Range 0-500mV, panel mounted
11.	Load indicator	Digital, range 0-50Kg, Supply 230V AC
12.	Load sensor	Load cell, type strain gauge, range 0-50Kg
13.	Rotameter	Engine cooling 40-400LPH: calorimeter 25-250LPH

Table: 2 Technical Specifications of engine test setup.

S.No.	Component	Specifications
1.	Number of cylinder	1
2.	Number of stroke	4
3.	Fuel	HS diesel
4.	Rated power	3.5KW @ 1500rpm
5.	Cylinder diameter	87.5mm
6.	Stroke length	110mm
7.	Connecting rod length	234mm
8.	Compression ratio varies	12 to 18:1
9.	Orifice diameter	20mm
10.	Dynamometer arm length	185mm

C. Preparation of Blends

Three different blends of biodiesel were prepared as explained below:

1) B10 (10% biodiesel + 90% diesel): To make a sample 500ml of B10, 450ml pure diesel was mixed in 50ml of biodiesel prepared from vegetable oil in a beaker.
2) B20 (20% biodiesel + 80% diesel): To make a sample 500ml of B20, 400ml pure diesel was mixed in 100ml of biodiesel prepared from vegetable oil in a beaker.
3) B30 (30% biodiesel + 70% diesel): To make a sample 500ml of B30, 350ml pure diesel was mixed in 150ml of biodiesel prepared from vegetable oil in a beaker.

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Density of pure diesel=811Kg/m^3
Density of biodiesel=859.7Kg/m^3

Table: 3 Description of diesel, biodiesel and different blends of biodiesel

Type of blend	Amount of biodiesel (ml)	Amount of pure diesel (ml)	Resultant density (Kg/m^3)
Diesel	0	500	811
Biodiesel	500	0	859.7
B10	50	450	816.7
B20	100	400	820.3
B30	150	350	826.9

Table:4Properties of diesel, biodiesel and different blends of biodiesel

Type of blend	Viscosity of biodiesel (mPa.s)	Kinematics viscosity of pure diesel (mm^2/s)	Resultant density (Kg/m^3)
Diesel B0	2.4811	3.0593	811
Biodiesel B100	4.6340	5.3905	859.7
B10	2.5500	3.1222	816.7
B20	2.6487	3.2288	820.3
B30	2.7689	3.3066	826.9

D. Performance Evaluations

All the experiments were performed on a single cylinder, 4 stroke kirloskar diesel engine. There were two separate fuel inlet arrangement is available in a setup, one for the diesel and another for biodiesel blend. Fuel was supplied to the engine from an outside tank. A 5-10min warm up period is provided from first run data collection. Initial engine is started with the diesel and then after 5-10min. period blend is use. The gap of 4-5min. was provided between the two consecutive runs for accurate data obtaining. Engine speed, specific fuel consumptions, brake power, heat balance etc. were measure during each run. During load test take rpm constant (1500rpm) and load on engine varied from 0 to 12kg by adjusting the load knob provided on the control panel of the test ring. The tests were performed with pure diesel (B0)and biodiesel blends (B10, B20, B30)

E. Pure diesel: B0, Biodiesel Blend: B10, Biodiesel Blend: B20 and Biodiesel Blend: B30

Engine performance parameters obtained from performance testing in single cylinder four stroke CI Engine against different loads for pure diesel ie B0 and Biodiesel Blend B10, B20 and B30

III. RESULTS AND DISCUSSION

A. Brake thermal efficiency vs Brake Power for Diesel and Biodiesel Blends

From the fig. it is observed that Brake thermal efficiency BTHE for both pure diesel and biodiesel blends increases with increase in brake power. Also the efficiency of biodiesel blends is more than pure diesel i.e. B0 and maximum is observed in the blend of B10. The reason is that is presence of more oxygen in biodiesel blends compare to pure diesel. With further increases the percentage of biodiesel in the blend a slight decreases in BTHE is seen in a fig. The reason for the decreases in BTHE in high % blend B20, B30 may be due to less volatility of biodiesel as compare to pure diesel B0.The maximum brake thermal efficiency is achieved 33.67 at a brake power of 2.79kW for B10. The value of BTHE for pure diesel B0 at a same load is obtained 32.46%. A condition of minimum load of BTHE is minimum 11.73% for B0 and 13.01% for B10. The variation of BTHE vs BP for different blends of diesel and pure diesel is shown in fig.1

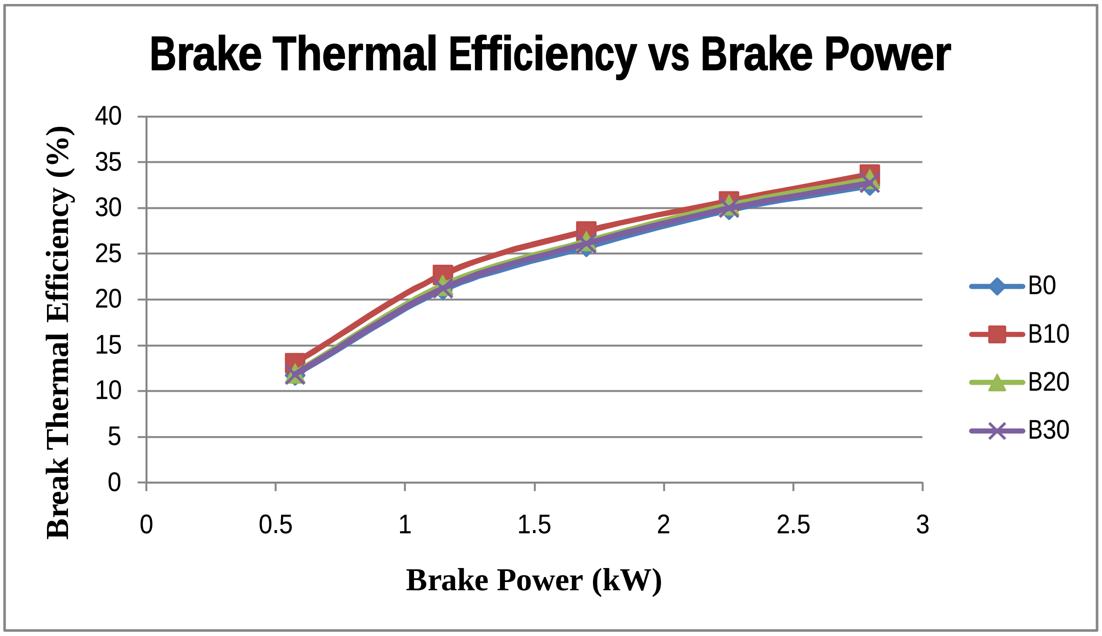

Fig.1 Brake thermal efficiency vs Brake Power for diesel and biodiesel blends

B. Brake Specific Fuel Consumption Vs Brake Power For Diesel And Biodiesel Blends

From the fig. it is observed that Brake specific fuel consumption BSFC for both pure diesel and biodiesel blends decreases with increase in brake power. As we know the total fuel consumption increases with increases the percentage of biodiesel increases in blends of biodiesel the reason is that biodiesel has low calorific value as compare to pure diesel so more fuel is induced in blends of biodiesel. Thus BSFC increases with increases in biodiesel percentage in blend.

It is Also observed from the fig that Brake specific fuel consumption BSFC for blends B10, B20, B30 at the maximum brake power of 2.79kW is 0.257, 0.261, 0.264 (in kg/kW-h) respectively. And for the minimum load (brake power 0.574kW) BSFC is observed for B10, B20, B30 is 0.661, 0.722, 0.731 (in kg/kW-h) respectively. The variation of BSFC vs BP for different blends of diesel and pure diesel is shown in fig.2

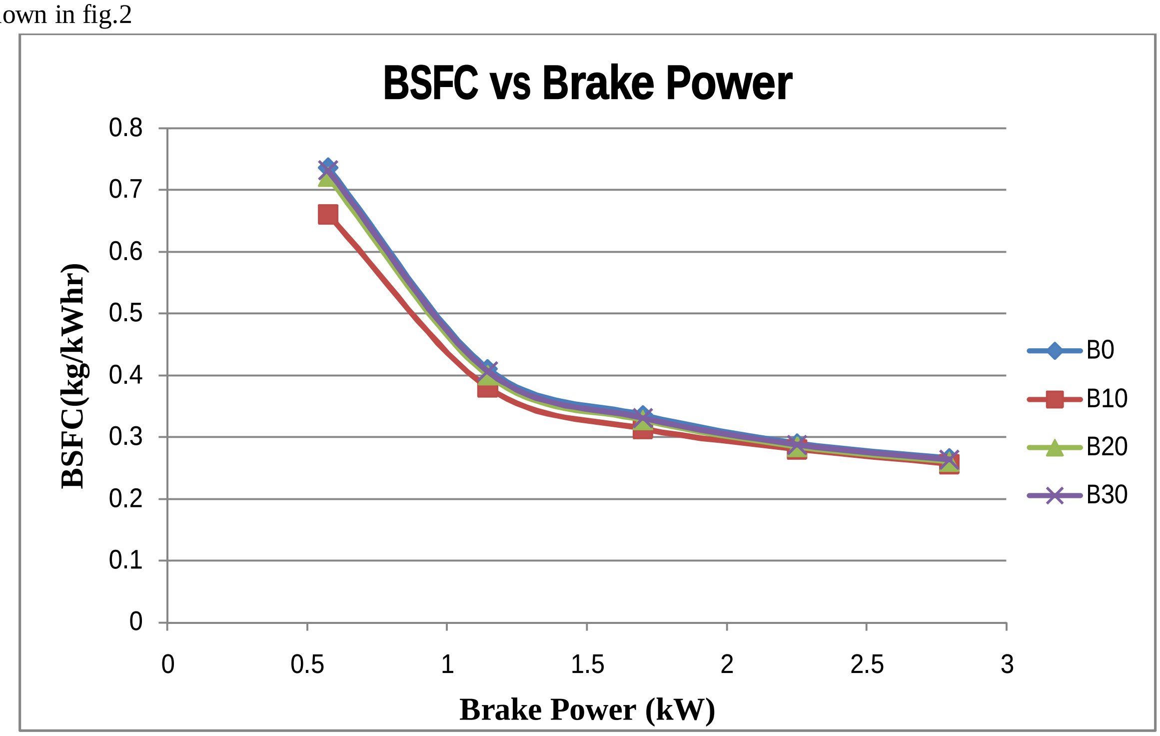

Fig.2 Brake specific fuel consumption vs Brake Power for diesel and biodiesel blends

C. Brake Specific Energy Consumption Vs Brake Power For Diesel And Biodiesel Blends

The concept of brake specific energy consumption BSEC is same as brake specific fuel consumption BSFC because in mathematical expression of BSEC is the product of BSFC and calorific value of fuel. So the variation of BSFC and BSEC is same. BSEC is also increases with increases of percentage of biodiesel in blend.It is Also observed from the fig that Brake specific energy consumption BSEC for blends B10, B20, B30 at the maximum brake power of 2.79kW is 10.687, 10.855, 10.991 (in MJ/kW-h) respectively. And for the minimum load (brake power 0.574kW) BSFC is observed for B10, B20, B30 is 27.519, 30.078, 30.508 (in MJ/kW-h) respectively. The variation of BSFC vs BP for different blends of diesel and pure diesel is shown in fig.18

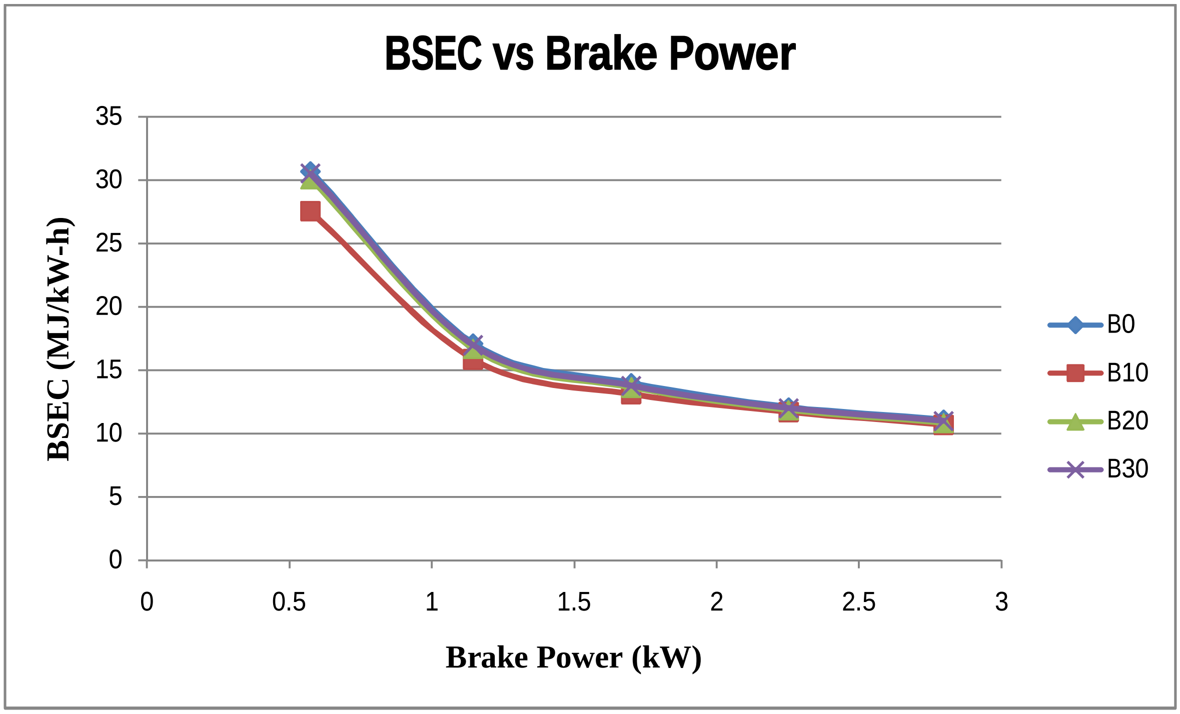

Fig.3 Brake specific energy consumption vs Brake Power for diesel and biodiesel blends

IV. CONCLUSION

A. Following Conclusion Has Been Made From The Experiments

1) For the engine performance testing it can be concluded that the performance parameter for blend of Hingot Biodiesel have gave better results than that of pure diesel without modification in engine setup.
2) The BTHE increases with increases brake power from low to high. This variation is shows because of better combustion biodiesel blends compare to pure diesel.
3) The BSFC decreases with increases in brake power. The BSFC is increases with increases in percentage of biodiesel in blend.
4) The BSEC also decreases with increases in brake power. The BSEC is increases with increases in percentage of biodiesel in blend just like BSFC.
5) It is also observed that BSEC and BSFC curves obtained by B20, B30 are very similar to pure diesel performed on the same engine at same load. Finally it can be concluded that the Hingot is also a one of the seed identified from which a biodiesel is also produced. Blend of Hingot Biodiesel is an industrial viable substitute for diesel engine.

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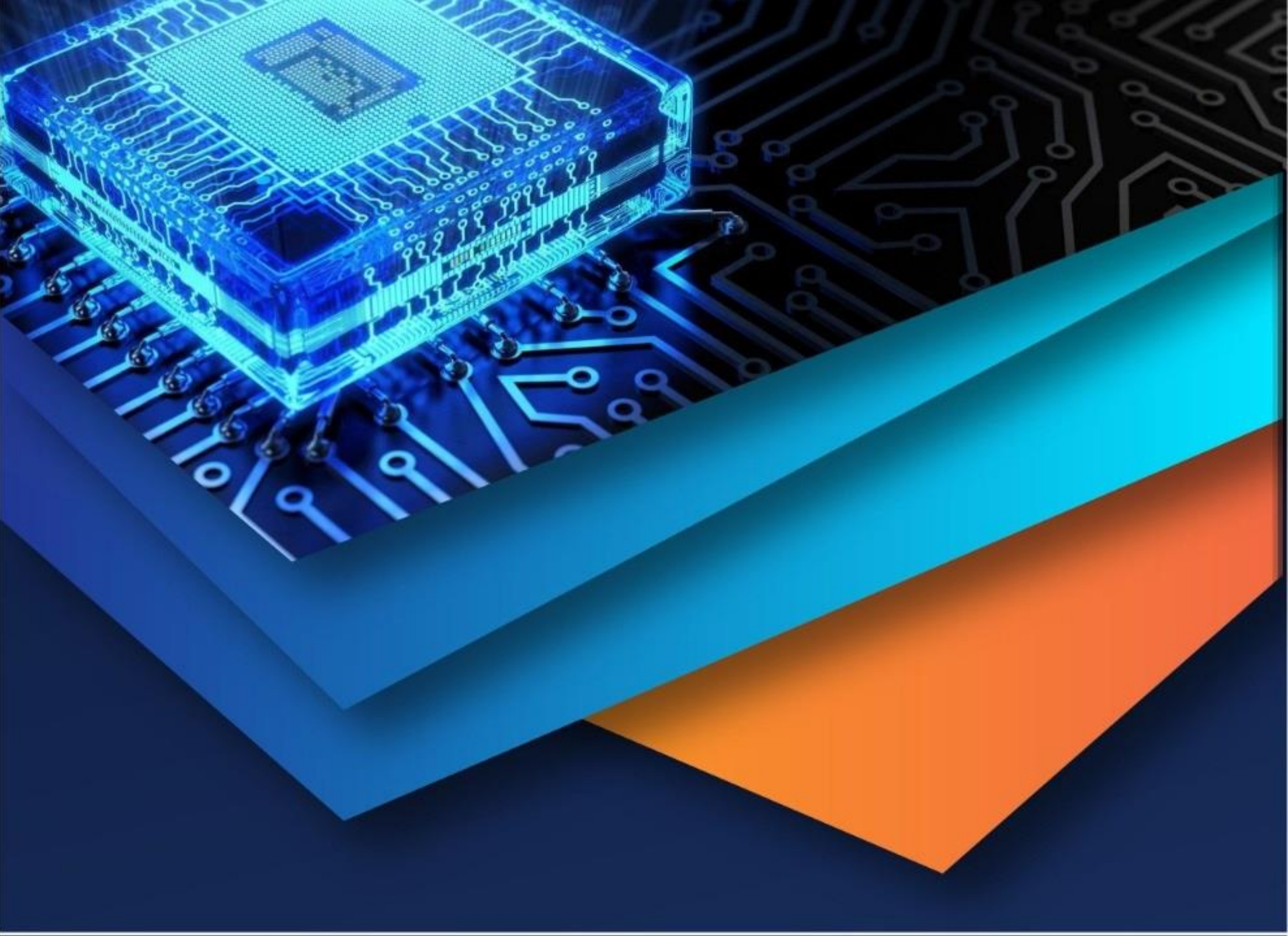

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