

# Effect of Normal, Beak and Tangential Grooves on Piston Crown of D.I. Diesel Engine with Blends of B10, B20 and B30 Apricot Bio-Diesel

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*Abstract* - Due to the rapid depletion of natural resources, which are ridiculously expensive for the common consumer, the value of petroleum fuels often rises, especially in India. Therefore, the importance of other fuel engines to be used in CI. Much researches were conducted on alternative fuels. Intensive research is being conducted within the area of improving the thermal efficiency of engines. This shows that in an exceedingly naturally aspirated internal-combustion engine, only one-third of the warmth supplied is converted to figure. Many methods are recommended by some experts and researchers to boost engine performance characteristics. the aim of this study is to extend the swirl effect within the cylinder, improve performance and reduce emissions. In DI diesel engines, vortices can increase the blending speed of fuel and air. The vortex interaction with the squish flow caused by compression increases the extent of turbulence within the combustion bowl and promotes mixing. it's clear that the effect of shape has little effect on the initial airflow during inspiratory and compression strokes. However, because the piston moves towards top spatial relation (TDC), the form of the bowl incorporates a significant effect on air flow, improving spraying, mixing and burning. In CI, the engine piston shape of the top was a flat and concave combustion chamber, and therefore the engine was powered by this shape. However, the air-fuel ratio mixture can't be mixed properly here. To avoid this, I changed the form of the piston.

*Index Terms* - *D.I. Diesel Engine, Bio- Diesel, Apricot oil, Normal Piston, Beak Grooved Piston, Tangential Grooved Piston, B10, B20 and B30*

## INTRODUCTION

Energy is the most important aspect of economic and social development to improve quality of life. Most of the world's current energy sources are based on fossil fuels and will eventually run out unless we develop technologies that can use alternative fuels to supply energy [1]. Global energy consumption is increasing faster than population growth. Crude oil and petroleum products of this century are considered to be extremely rare and expensive. The daily fuel

consumption of the engine has improved and this will continue for years [2]. However, fuel demand is increasing rapidly due to the significant increase in the number of vehicles. Due to high energy consumption in developing countries, especially in Asia, this growth forecast is expected to increase by up to 1.5% by 2030.

Increasing energy demand has forced major fuel energy exporters around the world to find alternative fuels that are independent of fossil fuel-based products. Sustainability is a major issue leading to the fact that the energy sector is not fully developed, so various authorities are being called upon to use new renewable energy sources [3]. Biodiesel is one of the future success alternative fuels to solve this problem. Biodiesel is renewable, biodegradable, non-toxic and has properties very similar to diesel fuel. It can be made from both vegetable oils and animal fats. However, these oils can't be used directly as fuel due to high viscosity. In order to reduce viscosity, it is necessary to produce biodiesel to the transesterification process to remove glycerin from the product and ester [9]. Biodiesel can work with compressed ignition machinery, with or without modification as well as petroleum diesel. In addition, biodiesel is more effective in engine deductions, costs, and availability. If burned, biodiesel produces harmful contaminants for human health. In addition, it provides superior lubricants compared to diesel fuel. However, it is important to consider the performance and emission characteristics of the biodiesel fuel engine. In general, combustion of biodiesel fuel in a compression ignition (CI) engine produces less smoke, particulate matter, carbon monoxide, and hydrocarbons [8].

## Objective of The Study:

The main purpose of this project is to study performance technologies to improve eddy in order to improve engine performance and reduce emissions in single-cylinder direct injection (DI) diesel engines. Changes have been made to the piston crown to achieve swirl strength in the cylinder. To increase the twist, a series of tests such as normal, beak and tangential grooves were performed on the piston crown and

the results were compared to beak grooved and tangential grooved piston values and apricot as a biodiesel blend. The blend was obtained by blending diesel and esterified apricot kernel oil in the following ratios: B10 and D90 indicate that apricot biodiesel is 10% and diesel is 90%. Similarly, B20 & D80, B30 & D70 were made. Performance parameters such as braking efficiency, fuel consumption rate, and braking power have been determined.

### Need of Alternative Fuels

Alternative fuels come from sources other than petroleum. Many of them are domestic and some come from renewable resources. The number of vehicles is increasing day by day, which means that fossil fuel consumption is also increasing exponentially. So far, we have relied on fossil fuels made from hydrocarbons that produce large amounts of non-renewable and harmful emissions. Alternative renewable fuels are urgently needed as hydrocarbon fuel reserves are rapidly depleted due to population explosions and technological improvements using higher fuel energy consumption. Organizations such as governments and environmental controls impose additional taxes and fines not only on automakers, but also on customers who violate car emission standards. To avoid all these problems, such alternatives to harmful emissions are needed and the fuel is essentially renewable.

### Engine Specifications

| ENGINE             | FOUR STROKE SINGLE CYLINDER |
|--------------------|-----------------------------|
| BHP                | 5 HP                        |
| SPEED              | 1500 RPM                    |
| FUEL               | DIESEL                      |
| BORE DIA           | 80 MM                       |
| STROKE LENGTH      | 110 MM                      |
| METHOD OF COOLING  | WATER COOLED                |
| METHOD OF IGNITION | COMPRESSION IGNITION        |

EXPERIMENTAL SETUP



Figure 2.1 Image of Normal, Beak and Tangential Grooved Pistons Before Placing in to Cylinder



Figure 2.2 Experimental Setup

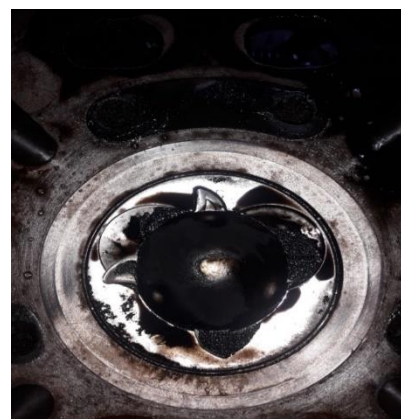


Figure 2.3 Normal, Modified Beak and Tangential Grooved Pistons After Combustion

The piston crown of 80 mm diameter is modified by producing four grooves. In the present experiment, Beak Grooves of inner diameter 29.35 mm and outer 39.44 mm is produced on piston of 80 mm diameter and maintaining a depth of 1.5 mm at outer and 2 mm at inner in each groove for Beak Grooved

Piston and Tangential Grooved with width of 8 mm and depth of 2 mm is produced on piston of 80 mm diameter and maintaining constant depth of 2 mm for Tangential Grooved Piston.

### RESULTS AND DISCUSSIONS

The tests were carried by the modified Beak and Tangential grooved piston with a blend of B-10, B-20 & B-30 with a load

such as 2,4,6,8 and 10 kgs. Compared to Normal, Beak & Tangential grooved piston at full load of Bio-Diesel (B-20) reduction of brake specific fuel consumption in Beak, Tangential grooved piston is observed and at full load of Bio-Diesel (B-20) increase of brake thermal efficiency in Beak, Tangential grooved piston is observed.

| S No | load(kg) | Engine speed in rpm | Time taken for 20cc of fuel in sec | Total mass of fuel consumption kg/hr | Brake power kW | Brake specific fuel consumption Kg/kWh | Brake mean effective pressure | Indicated power | Brake thermal efficiency | Indicated thermal efficiency | Mechanical efficiency |
|------|----------|---------------------|------------------------------------|--------------------------------------|----------------|--|-------------------------------|-----------------|--------------------------|------------------------------|-----------------------|
| 1    | 0        | 1500                | 136                                | 0.4341                               | 0              | 0                                      | 0                             | 0               | 0                        | 0                            | 0                     |
| 2    | 2        | 1500                | 136                                | 0.4341                               | 0.24           | 1.8087                                 | 555877.244                    | 1.48            | 4.68                     | 28.87                        | 16.2162               |
| 3    | 4        | 1500                | 112                                | 0.5271                               | 0.74           | 0.7126                                 | 1713028.37                    | 1.9796          | 11.88                    | 31.81                        | 37.3611               |
| 4    | 6        | 1500                | 96                                 | 0.615                                | 1.233          | 0.4989                                 | 2855124.49                    | 2.4727          | 16.97                    | 34.05                        | 49.8524               |
| 5    | 8        | 1500                | 88                                 | 0.6709                               | 1.726          | 0.3887                                 | 3997220.61                    | 2.9658          | 21.78                    | 37.44                        | 58.1900               |
| 6    | 10       | 1500                | 80                                 | 0.7268                               | 2.219          | 0.2785                                 | 5139316.73                    | 3.4589          | 26.59                    | 40.83                        | 66.5276               |

Table: 3.1 Normal Piston with only Diesel

| S No | Applied load kg | Engine speed in rpm | Time taken for 20cc of fuel in sec | Total mass of fuel consumption kg/s | Brake power | Brake specific fuel consumption | Brake mean effective pressure | Indicated power | Brake thermal efficiency | Indicated thermal efficiency | Mechanical efficiency |
|------|-----------------|---------------------|------------------------------------|-------------------------------------|-------------|---------------------------------|-------------------------------|-----------------|--------------------------|------------------------------|-----------------------|
| 1    | 0               | 1500                | 132                                | 0.4472                              | 0           | 0                               | 0                             | 0               | 0                        | 0                            | 0                     |
| 2    | 2               | 1500                | 116                                | 0.5089                              | 0.24        | 2.12                            | 555877.244                    | 1.52            | 3.99                     | 25.3                         | 15.7895               |
| 3    | 4               | 1500                | 100                                | 0.5904                              | 0.74        | 0.7982                          | 1713028.37                    | 2.0196          | 10.61                    | 28.97                        | 36.6211               |
| 4    | 6               | 1500                | 92                                 | 0.6417                              | 1.233       | 0.5205                          | 2855124.49                    | 2.5127          | 16.27                    | 33.16                        | 49.0588               |
| 5    | 8               | 1500                | 84                                 | 0.7768                              | 1.726       | 0.4501                          | 3997220.61                    | 3.0058          | 18.81                    | 32.77                        | 57.4157               |
| 6    | 10              | 1500                | 76                                 | 0.9119                              | 2.219       | 0.3797                          | 5139316.73                    | 3.4989          | 21.35                    | 37.35                        | 65.7726               |

Table:3.2 Normal Piston with Apricot B-30%

| S No | Applied load kg | Engine speed in rpm | Time taken for 20cc of fuel in sec | Total mass of fuel consumption kg/s | Brake power | Brake specific fuel consumption | Brake mean effective pressure | Indicated power | Brake thermal efficiency | Indicated thermal efficiency | Mechanical efficiency |
|------|-----------------|---------------------|------------------------------------|-------------------------------------|-------------|---------------------------------|-------------------------------|-----------------|--------------------------|------------------------------|-----------------------|
| 1    | 0               | 1500                | 124                                | 0.4761                              | 0           | 0                               | 0                             | 0               | 0                        | 0                            | 0                     |
| 2    | 2               | 1500                | 124                                | 0.4761                              | 0.24        | 1.9837                          | 555877.244                    | 1.39            | 4.26                     | 24.73                        | 17.2662               |
| 3    | 4               | 1500                | 104                                | 0.5676                              | 0.74        | 0.7674                          | 1713028.37                    | 1.8896          | 11.03                    | 28.19                        | 39.1406               |
| 4    | 6               | 1500                | 100                                | 0.5904                              | 1.233       | 0.4789                          | 2855124.49                    | 2.3827          | 17.68                    | 34.18                        | 51.7354               |
| 5    | 8               | 1500                | 92                                 | 0.6417                              | 1.726       | 0.3718                          | 3997220.61                    | 2.8758          | 22.78                    | 37.96                        | 60.0111               |
| 6    | 10              | 1500                | 84                                 | 0.693                               | 2.219       | 0.2647                          | 5139316.73                    | 3.3689          | 27.88                    | 41.74                        | 68.2868               |

Table:3.3 Normal Piston With Apricot B-20%

| S | Applied | Engine | Time | Total mass | Brake | Brake | Brake | Indicated | Brake | Indicated | Mechanical |
|---|---------|--------|------|------------|-------|-------|-------|-----------|-------|-----------|------------|
|---|---------|--------|------|------------|-------|-------|-------|-----------|-------|-----------|------------|

| No | load kg | speed in rpm | taken for 20cc of fuel in sec | of fuel consumption kg/s | power | specific fuel consumption | mean effective pressure | power  | thermal efficiency | thermal efficiency | efficiency |
|----|---------|--------------|-------------------------------|--------------------------|-------|---------------------------|-------------------------|--------|--------------------|--------------------|------------|
| 1  | 0       | 1500         | 140                           | 0.4217                   | 0     | 0                         | 0                       | 0      | 0                  | 0                  | 0          |
| 2  | 2       | 1500         | 116                           | 0.5089                   | 0.24  | 2.1204                    | 555877.244              | 1.5    | 3.99               | 24.96              | 16.0000    |
| 3  | 4       | 1500         | 104                           | 0.5676                   | 0.74  | 0.7674                    | 1713028.37              | 1.9996 | 11.03              | 29.84              | 36.9874    |
| 4  | 6       | 1500         | 92                            | 0.6417                   | 1.233 | 0.5205                    | 2855124.49              | 2.4927 | 16.27              | 32.9               | 49.4524    |
| 5  | 8       | 1500         | 76                            | 0.7768                   | 1.726 | 0.4501                    | 3997220.61              | 2.9858 | 18.81              | 32.55              | 57.8003    |
| 6  | 10      | 1500         | 60                            | 0.9119                   | 2.219 | 0.3797                    | 5139316.73              | 3.4789 | 21.35              | 35.96              | 66.1482    |

**Table:3.4 Normal Piston With Apricot B-10%**

| S No | Applied load kg | Engine speed in rpm | Time taken for 20cc of fuel in sec | Total mass of fuel consumption kg/hr | Brake power | Brake specific fuel consumption | Brake mean effective pressure | Indicated power | Brake thermal efficiency | Indicated thermal efficiency | Mechanical efficiency |
|------|-----------------|---------------------|------------------------------------|--------------------------------------|-------------|---------------------------------|-------------------------------|-----------------|--------------------------|------------------------------|-----------------------|
| 1    | 0               | 1500                | 144                                | 0.41                                 | 0           | 0                               | 0                             | 0               | 0                        | 0                            | 0                     |
| 2    | 2               | 1500                | 160                                | 0.3690                               | 0.24        | 1.5375                          | 555877.2438                   | 1.04            | 5.5093                   | 23.8737                      | 23.0769               |
| 3    | 4               | 1500                | 128                                | 0.4613                               | 0.7396      | 0.6236                          | 1713028.373                   | 1.5396          | 13.5823                  | 28.2739                      | 48.0385               |
| 4    | 6               | 1500                | 112                                | 0.5271                               | 1.2327      | 0.4276                          | 2855124.493                   | 2.0327          | 19.8081                  | 32.6632                      | 60.6435               |
| 5    | 8               | 1500                | 108                                | 0.5467                               | 1.7258      | 0.3168                          | 3997220.614                   | 2.5258          | 26.7412                  | 39.1372                      | 68.3269               |
| 6    | 10              | 1500                | 104                                | 0.5663                               | 2.2189      | 0.206                           | 5139316.73                    | 3.0189          | 33.6743                  | 45.6112                      | 76.0103               |

**Table:3.5 Beak Grooved Piston with Diesel**

| S No | Applied load kg | Engine speed in rpm | Time taken for 20cc of fuel in sec | Total mass of fuel consumption kg/s | Brake power | Brake specific fuel consumption | Brake mean effective pressure | Indicated power | Brake thermal efficiency | Indicated thermal efficiency | Mechanical efficiency |
|------|-----------------|---------------------|------------------------------------|-------------------------------------|-------------|---------------------------------|-------------------------------|-----------------|--------------------------|------------------------------|-----------------------|
| 1    | 0               | 1500                | 148                                | 0.3989                              | 0           | 0                               | 0                             | 0               | 0                        | 0                            | 0                     |
| 2    | 2               | 1500                | 148                                | 0.3989                              | 0.24        | 1.6622                          | 555877.2438                   | 1.52            | 5.0961                   | 32.2755                      | 15.7895               |
| 3    | 4               | 1500                | 116                                | 0.5090                              | 0.7396      | 0.6882                          | 1713028.373                   | 2.0196          | 12.3090                  | 33.6117                      | 36.6211               |
| 4    | 6               | 1500                | 104                                | 0.5677                              | 1.2327      | 0.4605                          | 2855124.493                   | 2.5127          | 18.3932                  | 37.4922                      | 49.0588               |
| 5    | 8               | 1500                | 100                                | 0.5904                              | 1.7258      | 0.3421                          | 3997220.614                   | 3.0058          | 24.7604                  | 43.1248                      | 57.4157               |
| 6    | 10              | 1500                | 96                                 | 0.6131                              | 2.2189      | 0.2237                          | 5139316.73                    | 3.4989          | 31.1276                  | 48.7574                      | 65.7726               |

**Table: 3.6 Beak Grooved Piston with Apricot B-30%**

| S No | Applied load kg | Engine speed in rpm | Time taken for 20cc of fuel in sec | Total mass of fuel consumption kg/s | Brake power | Brake specific fuel consumption | Brake mean effective pressure | Indicated power | Brake thermal efficiency | Indicated thermal efficiency | Mechanical efficiency |
|------|-----------------|---------------------|------------------------------------|-------------------------------------|-------------|---------------------------------|-------------------------------|-----------------|--------------------------|------------------------------|-----------------------|
| 1    | 0               | 1500                | 144                                | 0.41                                | 0           | 0                               | 0                             | 0               | 0                        | 0                            | 0                     |
| 2    | 2               | 1500                | 164                                | 0.3600                              | 0.24        | 1.5000                          | 555877.2438                   | 2.04            | 5.6471                   | 48.0000                      | 11.7647               |
| 3    | 4               | 1500                | 148                                | 0.3989                              | 0.7396      | 0.5394                          | 1713028.373                   | 2.5396          | 15.7046                  | 53.9255                      | 29.1227               |
| 4    | 6               | 1500                | 132                                | 0.4473                              | 1.2327      | 0.3628                          | 2855124.493                   | 3.0327          | 23.3453                  | 57.4342                      | 40.6469               |
| 5    | 8               | 1500                | 100                                | 0.5904                              | 1.7258      | 0.3421                          | 3997220.614                   | 3.5258          | 24.7604                  | 50.5854                      | 48.9478               |
| 6    | 10              | 1500                | 68                                 | 0.7335                              | 2.2189      | 0.3214                          | 5139316.73                    | 4.0189          | 26.1755                  | 60.9429                      | 57.2487               |

Table:3.7 Beak Grooved Piston with Apricot B-20%

| S No | Applied load kg | Engine speed in rpm | Time taken for 20cc of fuel in sec | Total mass of fuel consumption kg/s | Brake power | Brake specific fuel consumption | Brake mean effective pressure | Indicated power | Brake thermal efficiency | Indicated thermal efficiency | Mechanical efficiency |
|------|-----------------|---------------------|------------------------------------|-------------------------------------|-------------|---------------------------------|-------------------------------|-----------------|--------------------------|------------------------------|-----------------------|
| 1    | 0               | 1500                | 156                                | 0.3785                              | 0           | 0                               | 0                             | 0               | 0                        | 0                            | 0                     |
| 2    | 2               | 1500                | 156                                | 0.3785                              | 0.24        | 1.5769                          | 555877.2438                   | 1.94            | 5.3716                   | 43.4204                      | 12.3711               |
| 3    | 4               | 1500                | 132                                | 0.4473                              | 0.7396      | 0.6047                          | 1713028.373                   | 2.4396          | 14.0068                  | 46.2019                      | 30.3164               |
| 4    | 6               | 1500                | 120                                | 0.4920                              | 1.2327      | 0.3991                          | 2855124.493                   | 2.9327          | 21.2230                  | 50.4912                      | 42.0329               |
| 5    | 8               | 1500                | 104                                | 0.5677                              | 1.7258      | 0.3289                          | 3997220.614                   | 3.4258          | 25.7508                  | 51.1167                      | 50.3766               |
| 6    | 10              | 1500                | 88                                 | 0.6434                              | 2.2189      | 0.2587                          | 5139316.73                    | 3.9189          | 30.2786                  | 51.7422                      | 58.7203               |

Table:3.8 Beak Grooved Piston with Apricot B-10%

| S No | Applied load kg | Engine speed in rpm | Time taken for 20cc of fuel in sec | Total mass of fuel consumption kg/hr | Brake power | Brake specific fuel consumption | Brake mean effective pressure | Indicated power | Brake thermal efficiency | Indicated thermal efficiency | Mechanical efficiency |
|------|-----------------|---------------------|------------------------------------|--------------------------------------|-------------|---------------------------------|-------------------------------|-----------------|--------------------------|------------------------------|-----------------------|
| 1    | 0               | 1500                | 192                                | 0.3075                               | 0           | 0                               | 0                             | 0               | 0                        | 0                            | 0                     |
| 2    | 2               | 1500                | 204                                | 0.2894                               | 0.24        | 1.2059                          | 555877.2438                   | 2.54            | 7.0244                   | 74.3415                      | 9.4488                |
| 3    | 4               | 1500                | 188                                | 0.3140                               | 0.7396      | 0.4246                          | 1713028.373                   | 3.0396          | 19.9490                  | 81.9863                      | 24.3321               |
| 4    | 6               | 1500                | 176                                | 0.3355                               | 1.2327      | 0.2721                          | 2855124.493                   | 2.5327          | 31.1270                  | 63.9534                      | 48.6714               |
| 5    | 8               | 1500                | 168                                | 0.3514                               | 1.7258      | 0.2036                          | 3997220.614                   | 4.0258          | 41.5975                  | 97.0351                      | 42.8685               |
| 6    | 10              | 1500                | 160                                | 0.3673                               | 2.2189      | 0.1351                          | 5139316.73                    | 5.5189          | 52.068                   | 130.1168                     | 73.0107               |

Table: 3.9 Tangential Grooved Piston with only Diesel

| S No | Applied load kg | Engine speed in rpm | Time taken for 20cc of fuel in sec | Total mass of fuel consumption kg/s | Brake power | Brake specific fuel consumption | Brake mean effective pressure | Indicated power | Brake thermal efficiency | Indicated thermal efficiency | Mechanical efficiency |
|------|-----------------|---------------------|------------------------------------|-------------------------------------|-------------|---------------------------------|-------------------------------|-----------------|--------------------------|------------------------------|-----------------------|
| 1    | 0               | 1500                | 200                                | 0.2952                              | 0           | 0                               | 0                             | 0               | 0                        | 0                            | 0                     |
| 2    | 2               | 1500                | 200                                | 0.2952                              | 0.24        | 1.2300                          | 555877.2438                   | 2.64            | 6.8867                   | 75.7532                      | 9.0909                |
| 3    | 4               | 1500                | 200                                | 0.2952                              | 0.7396      | 0.3991                          | 1713028.373                   | 3.1396          | 21.2224                  | 90.0890                      | 23.5571               |
| 4    | 6               | 1500                | 176                                | 0.3355                              | 1.2327      | 0.2721                          | 2855124.493                   | 3.6327          | 31.1270                  | 91.7296                      | 33.9334               |
| 5    | 8               | 1500                | 160                                | 0.3690                              | 1.725       | 0.2138                          | 3997220.                      | 4.1258          | 39.6166                  | 94.7099                      | 41.8295               |

|   |    |      |     |        |        |        |            |        |         |         |         |
|---|----|------|-----|--------|--------|--------|------------|--------|---------|---------|---------|
|   |    |      |     |        | 8      |        | 614        |        |         |         |         |
| 6 | 10 | 1500 | 144 | 0.4025 | 2.2189 | 0.1555 | 5139316.73 | 4.6189 | 48.1062 | 97.6902 | 49.7256 |

**Table: 3.10 Tangential Grooved Piston with Apricot B-30%**

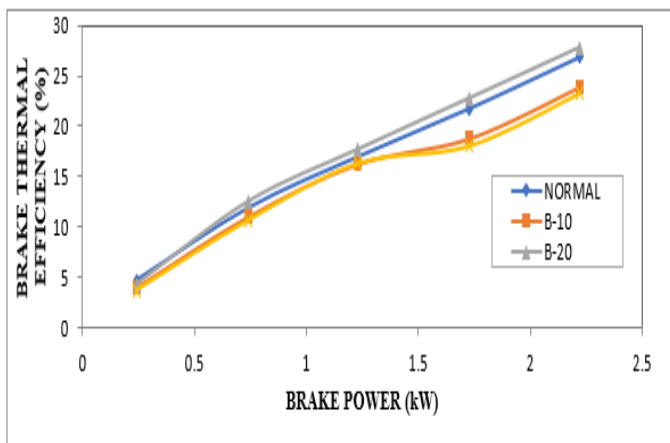
| S No | Applied load kg | Engine speed in rpm | Time taken for 20cc of fuel in sec | Total mass of fuel consumption kg/s | Brake power | Brake specific fuel consumption | Brake mean effective pressure | Indicated power | Brake thermal efficiency | Indicated thermal efficiency | Mechanical efficiency |
|------|-----------------|---------------------|------------------------------------|-------------------------------------|-------------|---------------------------------|-------------------------------|-----------------|--------------------------|------------------------------|-----------------------|
| 1    | 0               | 1500                | 204                                | 0.2894                              | 0           | 0                               | 0                             | 0               | 0                        | 0                            | 0                     |
| 2    | 2               | 1500                | 204                                | 0.2894                              | 0.24        | 1.2059                          | 555877.2438                   | 3.24            | 7.0244                   | 94.8293                      | 7.4074                |
| 3    | 4               | 1500                | 188                                | 0.3140                              | 0.7396      | 0.4246                          | 1713028.373                   | 3.7396          | 19.9490                  | 100.8673                     | 19.7775               |
| 4    | 6               | 1500                | 176                                | 0.3355                              | 1.2327      | 0.2721                          | 2855124.493                   | 4.2327          | 31.1270                  | 106.8802                     | 29.1233               |
| 5    | 8               | 1500                | 164                                | 0.3600                              | 1.7258      | 0.2086                          | 3997220.614                   | 4.7258          | 40.6071                  | 111.1953                     | 36.5187               |
| 6    | 10              | 1500                | 152                                | 0.3845                              | 2.2189      | 0.1451                          | 5139316.73                    | 5.2189          | 50.0872                  | 112.8931                     | 43.9141               |

**Table: 3.11 Tangential Grooved Piston with Apricot B-20%**

| S No | Applied load kg | Engine speed in rpm | Time taken for 20cc of fuel in sec | Total mass of fuel consumption kg/s | Brake power | Brake specific fuel consumption | Brake mean effective pressure | Indicated power | Brake thermal efficiency | Indicated thermal efficiency | Mechanical efficiency |
|------|-----------------|---------------------|------------------------------------|-------------------------------------|-------------|---------------------------------|-------------------------------|-----------------|--------------------------|------------------------------|-----------------------|
| 1    | 0               | 1500                | 196                                | 0.3012                              | 0           | 0                               | 0                             | 0               | 0                        | 0                            | 0                     |
| 2    | 2               | 1500                | 192                                | 0.3075                              | 0.24        | 1.2813                          | 555877.2438                   | 2.82            | 6.6112                   | 77.6815                      | 8.5106                |
| 3    | 4               | 1500                | 172                                | 0.3433                              | 0.7396      | 0.4641                          | 1713028.373                   | 3.3196          | 18.2512                  | 81.9184                      | 22.2798               |
| 4    | 6               | 1500                | 152                                | 0.3884                              | 1.2327      | 0.3151                          | 2855124.493                   | 3.8127          | 26.8824                  | 83.1464                      | 32.3314               |
| 5    | 8               | 1500                | 136                                | 0.4341                              | 1.7258      | 0.2515                          | 3997220.614                   | 4.3058          | 33.6741                  | 84.0156                      | 40.0808               |
| 6    | 10              | 1500                | 120                                | 0.4798                              | 2.2189      | 0.1879                          | 5139316.73                    | 4.7989          | 40.4658                  | 84.8848                      | 47.8302               |

**Table: 3s.12 Tangential Grooved Piston with Apricot B-10%**

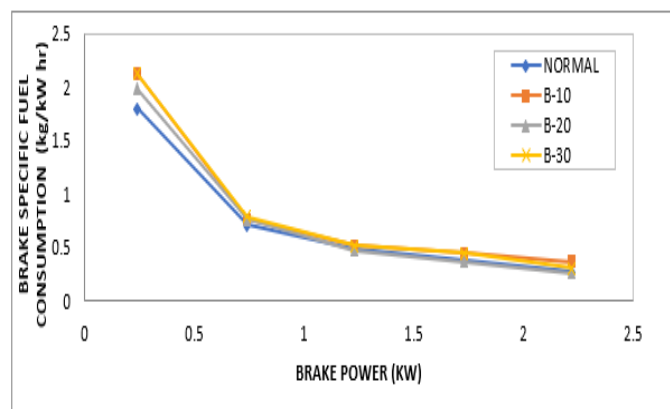
### 3.1 NORMAL PISTON WITH BLENDS OF B-10, B-20 AND B-30.



#### 3.1.1 Brake thermal efficiency:

Fig- 3.1 Variation of Brake thermal efficiency with respect to Brake power at various blends

The brake thermal efficiency with brake power will conduct a performance test on normal piston with Diesel and Bio-Diesel blends. The brake thermal efficiency for the normal piston with full load is 26.59%. The brake thermal efficiency for the normal piston with B-10, B-20 and B-30 full load is 21.35%.27.88% and 21.35%. Comparison of normal piston and B-20 the brake thermal efficiency will increases up to 1.29%.



#### 3.1.2 Brake specific fuel consumption:

Fig- 3.2 Variation of Brake specific fuel consumption with respect to Brake power at various blends

The brake specific fuel consumption with brake power is conducted with a performance test on normal piston and Diesel and Bio-Diesel blends. The brake specific fuel consumption for the normal piston with full load is 0.2785 kg/kW hr. The brake specific fuel consumption for the normal piston with B-10, B-20 and B-30 with full load is 0.3797 kg/kW hr, 0.2647 kg/kW hr and 0.3197 kg/ kW hr. Comparison of normal piston and B-20 the brake specific fuel consumption is decreases up to 0.0138 kg/ kW hr.

### 3.2 BEAK GROOVED PISTON WITH BLENDS B-10, B-20 AND B-30.

#### 3.2.1 Brake thermal efficiency:

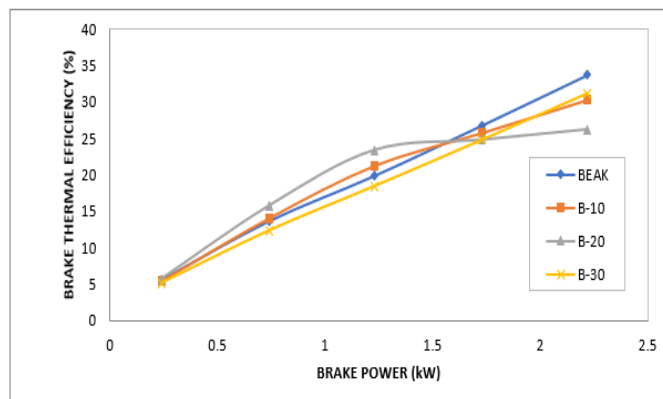
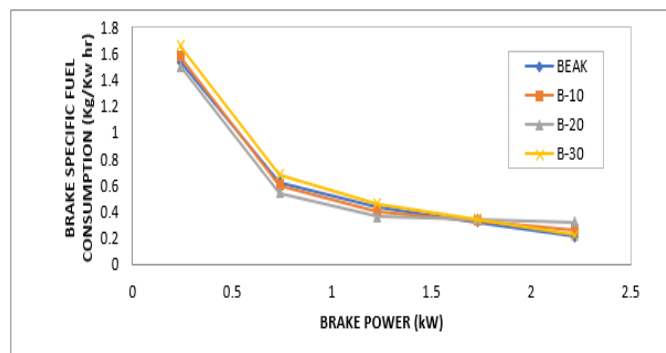


Fig- 3.1 Variation of Brake thermal efficiency with respect to Brake power at various blends

The brake thermal efficiency with brake power will conduct a performance test on beak grooved piston and Diesel and Bio-Diesel blends. The brake thermal efficiency for the beak grooved piston with full load is 33.67%. The brake thermal efficiency for the beak grooved piston with B-10, B-20 and B-30 with full load is 30.27%, 26.18% and 31.13%. Comparison of beak grooved piston and B-30 the brake thermal efficiency will decrease up to 2.54%.



#### 3.2.2 Brake specific fuel consumption:

Fig- 3.2 Variation of Brake specific fuel consumption with respect to Brake power at various blends

The brake specific fuel consumption with brake power is conducted with a performance test on beak grooved piston and Diesel and Bio-Diesel blends. The brake specific fuel consumption for the beak grooved piston with full load is 0.206kg/ kW hr. The brake specific fuel consumption for the beak grooved piston with B-10, B-20 and B-30 with full load is 0.2587 kg/kW hr, 0.3214 kg/kW hr and 0.2237 kg/ kW hr. Comparison of beak grooved piston and B-20 the brake specific fuel consumption is increased up to 0.1154 kg/ kW hr.

### 3.3 TANGENTIAL GROOVED PISTON WITH BLENDS B-10, B-20 AND B-30.

#### 3.3.1 Brake thermal efficiency

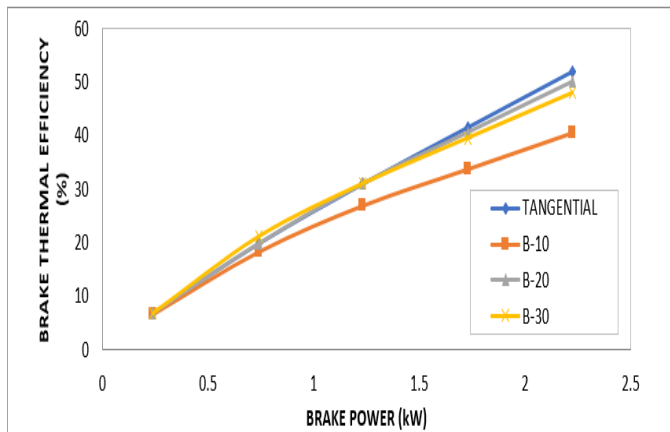


Fig- 3.6 Variation of Brake thermal efficiency with respect to Brake power at various blends

The brake thermal efficiency with brake power will conduct a performance test on tangential grooved piston and Diesel and Bio-Diesel blends. The brake thermal efficiency for the tangential piston with full load is 52.07%. The brake thermal efficiency for the tangential grooved piston with B-10, B-20 and B-30 with full load is 40.47%, 50.09% and 48.11%. Comparison of tangential grooved piston and B-30 the brake thermal efficiency will decrease up to 1.98%.

#### 3.3.2 Brake specific fuel consumption:

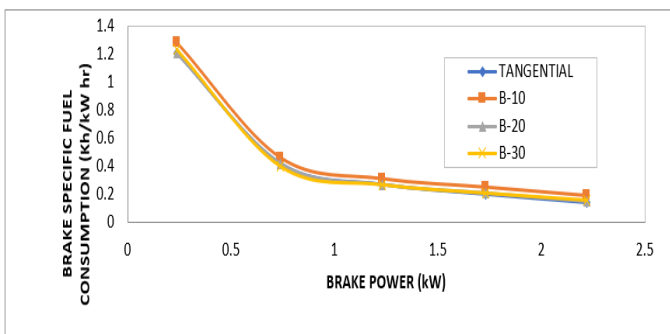


Fig- 3.7 Variation of Brake specific fuel consumption with respect to Brake power at various blends

The brake specific fuel consumption with brake power is conducted with a performance test on tangential grooved piston and Diesel and Bio-Diesel blends. The brake specific fuel consumption for the tangential grooved piston with full load is 0.1351 kg/ kW hr. The brake specific fuel consumption for the tangential grooved piston with B-10, B-20 and B-30 with full load is 0.1879 kg/kW hr, 0.1451 kg/kW hr and 0.1555 kg/ kW hr. Comparison of tangential grooved piston and B-20 the brake specific fuel consumption is increased up to 0.01 kg/ kW hr.

#### CONCLUSION

Based on the experimental results for the normal piston engine with tangential grooved piston configuration, the following conclusions are drawn:

- Compared to Normal & Beak grooved piston at full load of Bio-Diesel (B-30) the brake thermal efficiency in Beak grooved piston increased up to 1.29%.
- Compared to Normal & Beak grooved piston at full load of Bio-Diesel (B-20) the brake specific fuel consumption in Beak grooved piston is decreased up to 0.0567 kg/kW hr.
- Compared to normal & Tangential grooved piston at full load of Bio-Diesel (B-20) the brake thermal efficiency in Tangential grooved piston increased up to 22.20%.
- Compared to normal & Tangential grooved piston at full load of Bio-Diesel (B-20) the brake specific fuel consumption in Tangential grooved piston is decreased up to 0.1196 kg/kW hr.
- Compared to Tangential & Beak grooved piston at full load of Bio-Diesel (B-20) the brake thermal efficiency in Tangential grooved piston increased up to 23.91%.
- Compared to Tangential & Beak grooved piston at full load of Bio-Diesel (B-20) the brake specific fuel consumption in Tangential grooved piston is decreased up to 0.1763 kg/kW hr.

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