ABSTRACT

The rapid decrease in fossil fuel reserves, ecological differences, and strict emission regulations have necessitated the need for alternative fuel like biodiesel. Diminution of underground-based carbon resources have been increasing due to continuous extraction and lavish consumption of fossil fuels. Disproportionate usage of fossil fuels has led to environmental degradation effects such as acid rain, greenhouse effect, ozone exhaustion, weather changes etc. These factors motivated the researchers to develop and commercialize alternatives for fossil fuels from bio-origin which are oxygenated, renewable and sustainable, efficient and cost-effective, convenient and safe. Commercial usage of biodiesel not only reduces emissions but it indirectly encourages farmers to plant and grow non edible oil plants so that the greenery of the world can be increased and hence environmental degradation can be minimized.

Recently, many studies have been done on the economic and ecological impacts of the bio fuels, especially bio methanol, biogas, biodiesel, and bio hydrogen and concluded that they release less emissions than fossil fuels. Presently, biodiesel is primarily prepared from conventionally grown edible oils like soybean, rapeseed, sunflower and palm which led to scarcity for food products as well as devastation of essential soil resources. All over the earth, huge amounts of non-edible oil plants are existing in nature. Biodiesel from non-edible oil crops like jatropha, mahua etc is broadly investigated over the last few years. However, very limited numbers of works are done on non edible oils like neem and linseed.

Diesel engines produce higher vibration due to higher compression ratio. The engine vibrations are generally classified as mechanical, aerodynamic, thermal and combustion induced vibration. The mechanical vibration is produced from rotating unbalance forces and the reciprocating inertia forces. Misalignment, bent shaft, looseness, corrosion and defected gear meshes are also possible sources for mechanical vibration. It may also be due to inlet valve open or close, exhaust valve open or close, combustion, fuel injection, and piston slap. The combustion process
causes aerodynamic vibration, thermal induced vibration and combustion induced vibration. The combustion induced vibration is due to the gas pressure inside the cylinder which acts on the piston resulting in piston thrust forces against the cylinder block, leading to engine shaking and vibrating.

Few researchers have used vibration analysis to find the condition of the engine i.e. to check whether it has any faults like imbalance, misalignments, bearing faults and looseness etc. A very few researchers have used vibration analysis for finding combustion characteristics of the engine using biofuels. Still there is a gap identified by review of different technical papers i.e. to explore the effect of compression ratio and load on combustion induced vibration using different biofuels and its blends along three mutually perpendicular directions.

In the present work, vibration, combustion, performance, and emission characteristics have been measured for engine fuelled with neem methyl ester (NME) and the results are compared with standard diesel fuel. The experimentation is carried out from no load to full load condition at various compression ratios like 14, 15, 16, and 17 when engine runs at the constant speed of 1500 RPM. The engine vibration is measured along X, Y and Z axes using triaxial accelerometer. Most significant reduction in engine vibration is noticed in vertical direction for NME over diesel at all loads and compression ratios. In vertical direction, at full load condition, when fuel is changed from diesel to NME, the reduction in combustion induced vibration is 32.92% at CR 14, 42.2% at CR 15, 39.4% at CR 16, and 29.23% at CR 17. As engine vibration is most significant in vertical direction compared to other directions, the vibration analysis is also carried out in vertical direction for engine fuelled with B10, B20, B30, B40, NME, diesel-biodiesel-methanol blended fuels B1 (diesel-50%, neem methyl ester-45%, methanol-5%) and B2 (diesel-50%, neem methyl ester-40%, methanol-10%) at maximum compression ratio 17.5. Combustion, performance, and emission characteristics are also measured at maximum compression ratio of 17.5 and the results obtained are compared with standard diesel. As stringent emission norms are being implemented all over the world, it is suggested that NME, blends B10 and B1 can be used as prominent fuels in diesel engines in view of lesser emissions and vibrations.