ABSTRACT

The demand for energy has increased manifold as a result of the rapid growth in industrialization, urbanization and standard of living. Much of the demand for energy in India is met by imported crude oil, which hinders the economic development. Energy crisis caused by the rapid depletion of fossil fuel and environmental degradation triggered by the combustion of fossil fuel pose alarming threat to the world community. Scientists and researchers have to focus their attention on finding an eco-friendly, energy efficient fuel to replace fossil fuel, particularly diesel in transport and other sectors. Pongamia pinnata, a tree- borne oil seed of Indian origin is a potential candidate to supplement diesel through its biodiesel and biogas applications in overcoming the alarming global concerns.

In the present work, through experimental investigations, performance and exhaust emission analysis of an unmodified diesel engine fueled with the blends of Pongamia pinnata methyl ester (PPME) and diesel in varying proportions are studied in detail. The biodiesel preparation from the seeds of Pongamia pinnata and its characterization are also studied. In addition, an analysis of energy and exergy of combustion of diesel and biodiesel (PPME) is made. Further to extract the energy in the form of hydrocarbon left in the cake after extracting the oil, biogas generation potential from the de-oiled cake and the parameters affecting the gas generation such as pH, COD, BOD, ammonia nitrogen and total nitrogen during the gas generation period are studied.

The results reveal that blends of PPME with diesel up to 40% by volume (B40) provide better engine performance and improved emission characteristics than that of diesel alone. The exergy loss index and the exergy
destruction per unit energy generation in a diesel engine are less for PPME in comparison with diesel, ascertaining the environment friendly nature of PPME. The de-oiled cake is capable of generating 185 liters of clean biogas (methane 66% and CO\textsubscript{2} 33%) per kg and also the sludge from the digester is a better manure than the raw cake due to its improved N, P and K values.

PPME has proved to be an energy-efficient and environment-friendly substitute for diesel in unmodified diesel engine applications. The exergy analysis emphasizes that the entropy based taxation could be an effective measure to curtail the use of fossil fuel and to promote renewable energy utilization. Production of biogas from the cake not only helps to gain clean source of energy but also contributes to environmental protection through avoidance of gradual accumulation of methane into the atmosphere, which is 21 times more vulnerable than CO\textsubscript{2} in causing global warming. Hence utilization of Pongamia pinnata through large scale green plantation would help to achieve India’s self reliance in energy, rural electrification, rural economic development, increased employment opportunities and improved standard of living.