

An experimental investigation in a diesel engine using alumina nanoparticles blended water-diesel emulsion fuel

J. Sathik Basha and R.B. Anand*

*Department of Mechanical Engineering, National Institute of Technology,
Tiruchirappalli – 620 015. INDIA*

(* corresponding author: 411108051@nitt.edu)

An experimental investigation is carried out to investigate the effect of alumina nanoparticles on the performance, emission and combustion characteristics of a diesel engine. The whole investigation is carried out in an experimental set-up consists of a single cylinder constant speed air cooled four stroke diesel engine, AVL 444 Di gas analyzer, AVL 437 smoke meter and a data acquisition system comprising of Kistler piezoelectric pressure transducer. Emulsification method is adopted to prepare the water-diesel emulsion fuel and nanoparticles blended water-diesel emulsion fuel by mixing the neat diesel, water, surfactants (Span80 and Tween80) and the alumina nanoparticles of size 51 nm. The experimental investigation is divided into 3 phases; using neat diesel in the first phase, the water-diesel emulsion fuel (15% water + 83% diesel + 2% surfactant by vol.) in the second phase and the alumina nanoparticles with varying mass fractions (50 ppm and 100 ppm) blended water-diesel emulsion fuels in the third phase. The alumina nanoparticles blended water-diesel emulsion fuels are prepared using mechanical agitator & ultrasonicator. The stability characteristics of the nanoparticles blended water-diesel fuels are analyzed under static conditions and found stable for more than a week. In water-diesel emulsion fuel, there is significant enhancement in ignition delay which causes high heat release rate and rough engine operation [1] in the diesel engines. Some recent studies on the diesel fuel modification have been conducted on adding nanoparticles to shorten the ignition delay and to improve the thermal properties of diesel [2]. From the present study, the peak pressure and heat release rate of the nanoparticles blended water-diesel emulsion fuel is lower compared to neat water-diesel emulsion fuel due to shorten ignition delay as shown in the Fig.1. In addition, there is a considerable enhancement in the brake thermal efficiency and improved brake specific fuel consumption for the nanoparticles blended water-diesel emulsion fuels due to better combustion characteristics of nanoparticles [3] compared to water-diesel emulsion fuel as shown in the Fig.2. Furthermore, there is a significant reduction in the harmful pollutants such as NO_x & smoke as an effect of improved fuel properties by incorporating the nanoparticles in the water-diesel emulsion fuels.

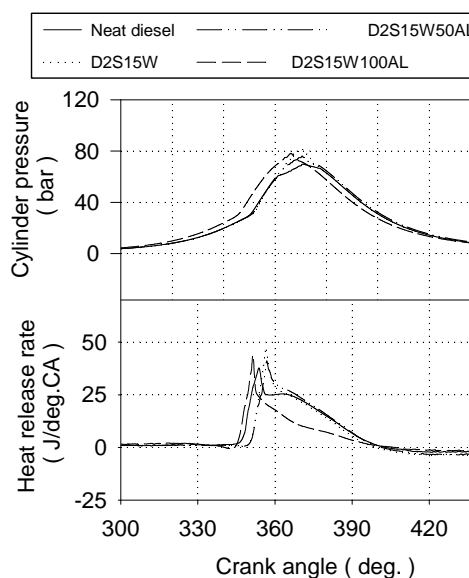


Fig. 1. Combustion characteristics of the diesel engine

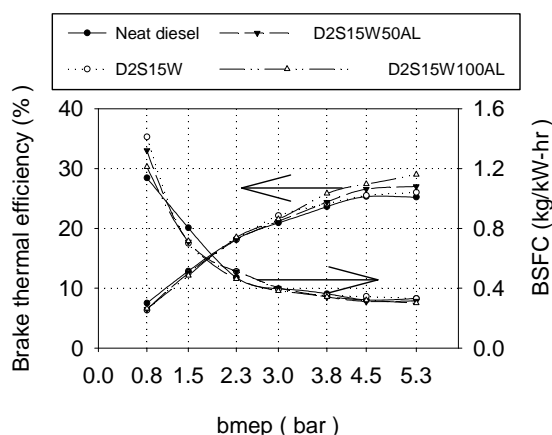


Fig. 2. Performance characteristics of the diesel engine

References

- [1] Subramanian, K.A., Ramesh, A. (2002) SAE technical paper no. 2002-01-2720.
- [2] Tyagi Himanshu et al. (2008) Nano Letters, Vol.8, pp.1410-1416.
- [3] Sathik Basha, J. Anand, R.B. (2010) International Journal of App. Engg. & Research, pp.697-708.