Diesel engines are the main prime movers for heavy duty vehicle applications worldwide. Due to their fuel efficiency, presently, they are also used in light duty applications. The pollutant emissions from diesel engines such as NO$_x$ and particulate matter are main contributors to environmental pollution. Engine designers are striving to improve the fuel economy and to reduce the NO$_x$ emission from diesel engines. Understanding the combustion in diesel engine will help the researchers to achieve these goals. Computer simulation is considered as an important tool to understand the combustion and NO$_x$ formation in diesel engine. Water injection into the combustion chamber of diesel engine was found to be one of the effective methods to simultaneously increase the fuel economy and to reduce the NO$_x$ and particulate matter emissions in diesel engine.

In this research, a single zone combustion model is developed using C programming to simulate the complete diesel cycle and NO$_x$ formation in diesel engine. The model effectively predicts the brake specific fuel consumption and NO$_x$ formation in diesel engine for combustion of diesel and diesel-water emulsion with 10% and 20% of water by volume. The model is also able to predict the NO$_x$ formation at various engine speeds and compression ratios.

Experiments were conducted on a 5.2 kW single cylinder Kirloskar engine using diesel-water emulsion with 10% and 20% water by volume. The effect of water percentage in the emulsion is compared with diesel fuel on
performance and emission. Experimentally, it was found that the diesel-water emulsion effectively increases brake thermal efficiency, decreases the brake specific fuel consumption and decreases NO\textsubscript{x}, HC and smoke emissions in diesel engine. Various types of fuel additives were used to reduce the NO\textsubscript{x} emission in diesel engine. In this research, a commercially available non-ionic fuel additive NanoXXL is used along the diesel water emulsion to reduce the NO\textsubscript{x}, HC and smoke emissions.

The simulated values of brake specific fuel consumption and NO\textsubscript{x} emission are in good agreement with the experimentally obtained results. The difference between simulated and experimental values of BSFC is 2.5% for DW10 and 5.8% for DW20 fuels and NO\textsubscript{x} emission is 1% for DSL, 2.2% for DW10 and 3.2% for DW20 fuels respectively. The model can be used to predict the NO\textsubscript{x} emission in a similar type of engine at various operating conditions and different fuels.

The effect of water in the emulsion on the kinematic viscosity of lubricating oil was also studied by conducting the test for 200 hours at full load condition. The long duration test was conducted using diesel and diesel with 10% water by volume for 200 hours at an average of 6 hours per day. The samples of oil were collected from the engine at an interval of 10 hours and the kinematic viscosity was determined using a Redwood viscometer at 100 °C. It was found that the kinematic viscosity of the oil was higher for combustion of diesel water emulsion than the pure diesel.