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A Swirl Gas Turbine Combustor for Turbulent Air and Oxy-Combustion Of Ammonia/Kerosene Fuels was Studied Numerically

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Short Communication

Biodiesel has received a lot of attention in recent years as a renewable and environmentally friendly fuel. Biodiesel manufacturing, on the other hand, is still more expensive than commercial diesel, and it takes a lot of time and work. The use of waste cooking oils (WCO) in diesel engines without converting to biodiesel was examined in this study. We used 25 percent waste oil +75 percent diesel fuel and 50 percent waste oil +50 percent diesel fuel ratios to combine WCO with diesel fuel. In addition, to improve the fuel qualities of the waste cooking oil-diesel fuel blends, 5%, 10%, and 15% toluene were added. For engine testing, a single-cylinder, direct injection, air-cooled diesel engine was used. The tests were carried out at a constant engine speed (1800 rpm) with various engine powers (2 kW and 4 kW). The results reveal that adding toluene has an effect on density, viscosity, calorific value, and in-cylinder pressure. The use of toluene raised the maximum in-cylinder pressures. The pressure peak was approaching the top dead centre (TDC). With the addition of toluene, the thermal efficiency and BSFC have improved. Other pollutants were lowered by the toluene addition, with the exception of NOx emissions [1].

One of the most sought-after vehicle fuels is dimethyl ether (DME). In the generation of direct dime from synthesis gas, catalyst is commonly preferred. 0 Computational Fluid Dynamics is employed in this study to model DME generation from syngas in a fluid bed reactor. Its goal is to figure out what conditions are required to enable maximum gas-solid contact in a fluidized reactor for the manufacture of zeolite-catalyzed DME, particularly for syngas produced by the gasification process from domestic wastes. The physical optimisation simulation is a unique aspect of this approach. Calculating the bed density at which the catalyst active surface is provided with maximal contact is crucial in defining reactor operating parameters. First, the simulation model is compared to a real experimental fluidized bed model in the study [2]. The conditions for achieving the highest solid-gas contact surface were sought in the ensuing optimization study. As a result, the results obtained in the instance of a 2200 kg/m^3 bed density revealed that the pressure drop increased positively across the bed. This results in a shorter reaction time. Therefore, the bed density value of 2200 kg/m3 (with a maximum volume fraction of 55%), is the ideal density value to ensure maximum gas-solid contact compared to 2300 (with a maximum volume fraction of 55,8%), 2400 (with a maximum volume fraction of 59,5%), 2500 (with a maximum volume fraction of 58,9%), and 2600 (with a maximum volume fraction of 57,2%) kg/m^3 [3].

Because ammonia is a carbon-free substance with hydrogen atoms per volume unit, many scientists believe it might be utilised as an alternative fuel in gas turbine combustors instead of natural gas or kerosene. The major purpose of this research is to evaluate turbulent swirl combustion of ammonia-assisted kerosene fuels in a model gas turbine combustor under air and pure oxygen combustion conditions. Numerical modelling was carried out for this aim utilising a commercial computational fluid dynamics (CFD) package. From several inlets, ammonia was fed into the combustor. The ammonia composition was established by heat fraction up to a 70% kerosene-30% ammonia combination in a 10% interval. The total heat load provided was kept constant during this increment [4]. The results revealed that kerosene combustion performance did not vary much. However, with the addition of ammonia, the maximum temperature levels and their placements in the combustor varied slightly. Post-processing of the CFD code utilised in this study addressed NOx emission levels in addition to temperature distributions of kerosene and ammonia-assisted kerosene fuels. The expected NOx emissions levels increased dramatically in the high temperature flame zone due to bound-nitrogen in ammonia, according to the predicted NOx values (fuel-NOx mechanism). However, the expected NOx emission levels at the combustion chamber exit were not excessive. As a result, it can be stated that ammonia-assisted kerosene fuels have significant promise as a novel and renewable fuel in terms of combustion performance [5].

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