A numerical study on the characteristics of ammonia-diesel dual-fuel engines under varying ammonia energy fractions

Choi Jeong Yeon [1)] · Ocktaeck Lim[*2)]

Graduate School of Mechanical Engineering, University of Ulsan, DaeHak-ro 93, Nam-gu, Ulsan 44610, South Korea [1)],
School of Mechanical Engineering, University of Ulsan, DaeHak-ro 93, Nam-gu, Ulsan 44610, South Korea [2)]

Key words: Ammonia, Dual-Fuel, Ammonia Energy Fraction, Lean conditions, Combustion characteristics

* Corresponding author, E-mail: otlim@ulsan.ac.kr

Ammonia is considered a promising alternative fuel for engines in the era of carbon neutrality. However, its application as a sole fuel is hindered by its low energy density and the high combustion temperatures required due to its chemical properties. This study presents a numerical investigation into the combustion characteristics of an ammonia-diesel dual-fuel engine, focusing on key parameters such as ammonia energy fraction, equivalence ratio, and diesel injection timing. In the simulation model, diesel fuel is directly injected into the combustion chamber, while ammonia is supplied through port fuel injection (PFI) via the intake manifold. The computational results indicate that advancing the diesel injection timing enhances the premixing of air and diesel, leading to more complete combustion and improved overall thermal efficiency. Furthermore, the increase in ammonia energy fraction did not result in a uniform trend in exhaust emissions. This nonlinearity suggests the existence of an optimal balance in the mixing ratio and energy distribution between ammonia and diesel fuels. These findings provide valuable insights for optimizing dual-fuel engine strategies utilizing ammonia as a low-carbon alternative.

Acknowledgment:

- This work was supported by Regional Innovation Cluster Development (R&D) by the Ministry of Trade, Industry and Energy(MOTIE, Korea)[Project Name: Open Innovation Project for Convergence Industry of Battery/Fuel Cell for Mobility Electrification and Energy Production/Storage (P0025406)].