Tri-fuel emulsion with secondary atomization attributes for greener diesel engine – a critical review

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ABSTRACT

Utilization of tri-fuel emulsion (a composition of diesel, biodiesel, and alcohol) has been introduced to alleviate existing drawbacks of diesel engines by means of reducing the level of emissions without compromising its power output. Tri-fuel is proposed to facilitate the efficient performance of compression ignition (CI) engines while promising the enhanced combustion characteristics, improved performance, and reduction of unwanted emissions without requiring major engine retrofitting. The current manuscript has critically reviewed the existing research on tri-fuel technology, linking preparation protocols and physicochemical properties with the enhancement of engine performance and emissions. Furthermore, several advantages of tri-fuel in CI engines as a blend and emulsion were reviewed including the capability of secondary atomization known as micro-explosion phenomenon. Despite these stated advantages, limited information is available regarding the puffing and micro-explosion of tri-fuel, as they are only considered under non-combustion conditions. It was found out that droplet size was too large in most of the experimental cases, while due to doubtful setup configurations, Leidenfrost or hotplate techniques were found to be not suitable for the investigation of micro-explosion involving tri-fuel, as they were not representative of conditions in CI engines. Furthermore, the filament or thermocouple in contact with the droplet may distort the droplet and lead to an unrealistic situation. Hence, tri-fuel entitlement to the claim of secondary atomization attributes has been recognized as needing further investigations. Along the way, the review exposes other possible research gaps such as tri-fuel's optimum ratio, post-injected droplet microstructure, mixing strategy and combined physicochemical properties, which could be key indicators for micro-explosion signature.

KEYWORDS

Tri-fuel; Emulsions; Secondary atomization; Micro-explosion; Combustion; Emission

ACKNOWLEDGEMENTS

The authors are grateful to Universiti Malaysia Pahang(www.ump.edu.my) for the support through grant number of RDU1803164 and Ministry of Higher Education, Malaysia for financial support through the grant RDU150124 (FRGS/1/2015/TK07/UMP/02/2). Special thanks to Professor Morgan Heikal from the University of Brighton for his valuable input in improving the quality of the manuscript. Fig. 2 is printed with permission from Elsevier (4582300822095).