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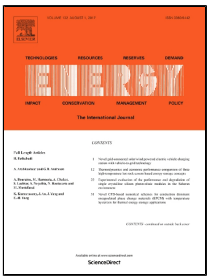

Compression ignition engine performance modelling using hybrid MCDM techniques for the selection of optimum fish oil biodiesel blend at different injection timings

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COMPRESSION IGNITION ENGINE PERFORMANCE MODELLING USING HYBRID MCDM TECHNIQUES FOR THE SELECTION OF OPTIMUM FISH OIL BIODIESEL BLEND AT DIFFERENT INJECTION TIMINGS

Abstract:

The increasing demand on energy due to population growth and rise of living standards has led to considerable use of fossil fuels which cause environmental pollution and depletion of fossil fuels. Biodiesel proves to be a good alternative for fossil fuels. But sustainability of biodiesel is the key factor for determining it as a fuel in diesel engines. It needs identification of proper blend of biodiesel and diesel to meet the efficiency, engine suitability and environmental acceptability. Alternative fuel blend evaluation in IC engine fuel technologies is a very important strategic decision tool involving balancing between a number of criteria such as performance, emission and combustion parameters and opinions from different decision maker of IC engine experts. Hence, it is a MCDM problem. This paper describes the application of hybrid Multi Criteria Decision Making (MCDM) techniques for the selection of optimum biodiesel blend in IC engine. FAHP-TOPSIS, FAHP-VIKOR and FAHP-ELECTRE, are the three methods that are used to evaluate the best blend. The performances of these MCDM methods are also compared with each other. Here, FAHP is used to determine the relative weights of the criteria, whereas TOPSIS, VIKOR and ELECTRE are used for obtaining the final ranking of alternatives. A single cylinder, constant speed and direct injection diesel engine with a rated output of 4.4 kW is used for exploratory analysis of evaluation criteria at different load conditions. Diesel, B20, B40, B60, B80 and B100 fuel blends are prepared by varying the proportion of biodiesel. Similarly, Brake thermal efficiency (BTE), Exhaust gas temperature (EGT), Oxides of Nitrogen (NO_x), Smoke, Hydrocarbon (HC), Carbon monoxide (CO), Carbon dioxide (CO_2), Ignition Delay, Combustion Duration and Maximum Rate of Pressure Rise are considered as the evaluation criteria. The ranking of alternatives obtained by FAHP-TOPSIS, FAHP-VIKOR and FAHP-ELECTRE are B20 > Diesel > B40 > B60 > B80 > B100 for 21^{o}bTDC and 24^{o}bTDC and Diesel > B20 > B40 > B60 > B80 > B100 for 27^{o}bTDC. It shows that B20 is ranked first for 21^{o}bTDC and 24^{o}bTDC and second for 27^{o}bTDC injection timing. Hence, it is concluded that mixing 20 % biodiesel with diesel is suggested as a good replacement for diesel. This paper provides a new insight of applying MCDM techniques to evaluate the best fuel blend by decision makers such as engine manufactures and R&D engineers to meet the fuel economy and emission norms to empower green revolution.

Keywords: Fish oil biodiesel, Engine, Performance, Emission, Combustion MCDM, Blend Selection