

Particulate emissions from diesel operated vehicles cause hazardous health effects. Increasing automobile engine out pollution has become a matter of grave concern and there is need to improve emission control strategies. Diesel oxidation catalyst (DOC) is one of the major after-treatment devices, used to reduce gaseous as well as particulate emission in engine exhaust. DOC technology presently uses expensive noble metals such as Pt, Pd, etc., which give excellent performance in reducing particulate matter mass emissions by 30-60% (w/w). In this study, inexpensive non-noble metal based mixed oxide catalysts have been developed and used for DOC coating. Four non-noble metal based DOCs (named as DOC2, DOC3, DOC4 and DOC5) were prepared for evaluating their emission reduction performance. Their effectiveness was compared with a commercial DOC (named as DOC1) and raw exhaust. The prepared DOCs were tested for emission reduction with mineral diesel and 20% (v/v) Karanja biodiesel blended with mineral diesel (B20). An extensive experimental study was performed in a medium duty transportation diesel engine (1.4 L, four cylinder engine) for observing the effect of prepared DOCs on various emission parameters.

Emissions including regulated gaseous emissions, unregulated gaseous emissions, particle size-number distribution, elemental carbon (EC), organic carbon (OC), particle bound polyaromatic hydrocarbons (PAHs), particulate mass emissions and trace metal emissions were determined under different engine operating conditions, in order to evaluate the effectiveness of prepared DOCs with use of B20. Screening of DOCs was performed in order to find DOCs with satisfactory performance in the first instance. In-depth analysis was performed for two short-listed DOCs (DOC2 and DOC3) based on results obtained in the initial screening. It was observed that DOC2 (three layer coated DOC based on Cobalt-Cerium mixed oxide catalyst) and DOC3 (three layer coated DOC based on lanthanum based perovskite catalyst) performed satisfactorily in emission reduction and were comparable to commercial DOC (DOC1). Performance of DOC2 was good in particle number and particle mass reduction compared to DOC3. On the other hand, performance of DOC3 was good in regulated gaseous emission reduction compared to DOC2. Prepared DOCs were quite effective in PM reduction. DOC2 and DOC3 showed significant reduction in organic carbon (OC) content of particulates at 50% and higher engine loads. DOC2 was found to be superior in reduction of particle number emissions for tested engine speeds and loads for both diesel and B20. Significant reduction in carbon monoxide (CO) and total hydrocarbon (HC) emissions were seen could be achieved at higher engine loads by DOC2 and DOC3 (upto ~90% and ~70% reduction respectively). For a few unregulated species, B20 showed lower emissions compared to mineral diesel. Unregulated emissions also indicated presence of relatively larger molecular weight compounds in the engine exhaust. The present study brings out some important aspects for possible use of some of the prepared DOCs in effectively reducing overall particulate and gaseous emissions from commercial diesel engines as well as with use of Karanja biodiesel blended with mineral diesel (B20).