Impact of Alternative Fuels in Off-road Maintenance Equipment

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Advocates for biodiesel claim that it is a clean, renewable, and cost effective fuel that provides economic and environmental benefits while easing the energy impacts of petroleum diesel. However, many of the claims presented in the popular press are often anecdotal in nature and frequently are not based on empirical data. They are mostly not based on real-word data and more investigation is required to make conclusion. The primary objective of this case study is to compare the economic, energy, and environmental impacts of B20 biodiesel versus petroleum diesel fuel use in off-road maintenance equipment.

An extensive dataset of real world, quality assured construction equipment emissions data is existed from previous work has don by Dr. Lewis et al. This dataset includes tailpipe emissions rates on a mass per time (grams per second) and a mass per fuel used (grams per gallon) basis for NOx, HC, CO, CO2, and PM. It represents nearly 140 hours of quality assured, second-by-second data from 34 items of construction equipment including: (8) backhoes; (6) bulldozers; (3) excavators; (6) motor graders, (3) off-road trucks; (3) track loaders; and (5) wheel loaders. 4 wheel loaders, 6 motor graders, and 3 backhoes were chosen for additional study. Hypothesis testing was the principal component of the analysis by determining whether or not there was a statistically significant difference in fuel prices, fuel use rates, and emissions rates between B20 and petroleum diesel. Mean values of price per gallon, fuel use rate, and emissions rates for B20 vs. PD were compared and a 2-sample t-test was conducted to test hypothesis.

Based on evidence in the case study, it was concluded that B20 has slightly higher economic and energy impacts than petroleum diesel, but B20 showed potential for lower emissions rates for certain air pollutants and greenhouse gases. We will run out of fossil fuels in less than a century, so it is inevitable to find alternative sources of energy in construction. Hypothesis testing was used to determine whether or not there was a statistically significant difference between B20 and petroleum diesel in fuel prices, fuel use rates, and emissions rates in order to find out if B20 biodiesel is an appropriate alternative source of energy for off-road maintenance equipment. Also, this research addresses another important problem which is Indoor Air Quality for Heavy Duty Diesel (HDD) equipment operators. The current number of HDD equipment operators is expected to grow by 19% (faster than the national average for other occupations) to approximately 500,000 operators in 2022.Therefore, appropriate alternative source of energy for off-road maintenance equipment can lead to less pollutants and health issues for this half million HDD equipment operators.

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