Comparison of Data from the Field Study to Published Engine Dynamometer Data

For petroleum diesel, the comparison of PEMS and dynamometer data suggests general agreement for CO and HC, higher NO emissions, and lower PM emissions. The higher NO emissions might be attributable to differences in duty cycles. The lower PM emissions might be attributable to the effectiveness of Tier 2 engines in reducing emission rates relative to older engines.

For B20 biodiesel, the comparison of PEMS and dynamometer data suggest that the Tier 2 engines have lower PM emission rates than the older engines in the dynamometer data base, as expected, that NO emissions tend to be higher for the real world duty cycles than for the FTP test, and that the CO and HC emissions have approximately agreement regarding the ranges of values between the two data sets.

Thus, the comparison of PEMS data to dynamometer data provides some confidence that the PEMS data are reasonable with respect to absolute emission values. For example, despite the fact that the HC measurement is based on NDIR, and thus might be biased low, the HC emission rates obtained from the PEMS data are typically as large or larger than those from the dynamometer data. The PEMS measurements for NO are based upon NO only, whereas the dynamometer measurements are based upon both NO and NO_2. However, the fact that the PEMS estimates of NO emissions (reported on an equivalent mass basis in terms of NO_2) are at least as large, and typically larger, than for the dynamometer data, suggests that the vast majority of NO_x emissions are in the form of NO. However, this assumption could be verified based on additional measurements.

Diesel engines are typically considered a significant emission source of PM and NO_x, and emissions of CO and HC are generally lower than for other mobile sources, such as those fueled with gasoline. There was approximately qualitative agreement in the emission rates for CO and HC when comparing the PEMS and dynamometer data. Overall, the PEMS data compare reasonably well and appropriately to the engine dynamometer data.

Overall Conclusions and Recommendations

The main results of the field study measurements are the following:

- There is substantial variability in fuel use and emission rates by operating mode regardless of whether these are analyzed in terms of mass per time, mass per mile driven, or mass per gallon of fuel consumed. The mass per time approach was the most useful for this work because it enabled evaluation of the contribution of each second of operation in a given mode to the total fuel use and total emissions. However, for purposes of developing emission inventories in the future, NCDOT may find that the mass per gallon of fuel consumed emission factors are more useful in that the total amount of fuel consumed is easier to measure and document than the amount of time spent or the distance driven.
- There are extensive data from this study regarding the distribution of operating modes for a typical duty cycle with respect to time, distance, fuel consumption, and emissions. These data can be used to improve emissions inventories in combination with the modal emission factors by more appropriately weighting the modal emission rates.
- The baseline real-world in-use emissions of a selected set of diesel trucks were