Measured and Modeled Biodiesel Exhaust from Diesel Vehicles: A MOVES2010b Evaluation

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The EPA's MOtor Vehicle Emissions Simulator (MOVES) utilizes second-by-second modal (i.e., acceleration, deceleration, idle, and cruise) vehicle activity patterns to estimate mobile source emissions rates. MOVES estimates emissions rateson the basis of vehicle operating modes (OpModes), which are defined by vehicle specific power (VSP) and vehicle speed. OpMode specific emissions rates in the MOVES relational database are based on statistical and physical relationships between available data from existing emissions research on a wide range of vehicle types and ages operating on different fuels. Certain real-world conditions are not currently well-represented in the MOVES database. This is a growing issue as new vehicle technologies and emissions regulations continue to develop. In particular, MOVES estimated emissions from modern light-duty vehicles fueled by biodiesel blends are presently based on very limited data sources and assume overly simplistic relationships between operational variables and emissions rates.

This work compares the accuracy of MOVES2010b emissions rates by OpModefor a passenger car run on various blends of biodiesel to real-time emissions data (gas and particle phase) collected from a 1.9L Volkswagen diesel engine coupled to an eddy current dynamometer. The engine was run on a transient drive-cycle, developed from on-road data, and fueled by waste cooking oil based biodiesel blends (B0, B10, B20, B50, and B100). Lab collected data of tailpipe emissions rates were binned based on scaled tractive power (STP) to allow for comparison to MOVES VSP-based OpMode emissions rates. Results from this work demonstrate the need to implement new modal emissions data and adjustment factors into the MOVES framework in order to more accurately quantify light-duty biodiesel blend PM emissions. Future work will examine developing an algorithm to convert MOVES $PM_{2.5}$ emissions estimates to PN emissions rates based on the relationship between $PM_{2.5}$ (filter) and PN (TSI EEPS) experimental data.