



Environmental

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Project Title:

Air Quality: Brake Wear in Particulate Matter Emissions Modeling

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Brake Wear in Particulate Matter Emissions Modeling

Improve Emission Factors (EMFAC) model that California Air Resources Board (CARB) uses to regulate air quality by measuring and analyzing brake wear particulate matter (PM) emissions data.

WHAT WAS THE NEED?

With fleet turnover, exhaust particulate matter (PM) emissions are declining substantially; brake wear and tire wear PM emissions are becoming a larger fraction of total on-road PM emissions. There is a growing need to improve how brake and tire wear PM emissions are estimated in California.

In 2016 and 2017, a study was carried out under the direction of Caltrans' Division of Environmental Analysis, motivated by air quality emissions analysis requirements for transportation conformity, the National Environmental Policy Act (NEPA), and the California Environmental Quality Act (CEQA). PM emission analysis results, particularly for analysis years of 2020 and beyond, reflect the growing importance of brake and tire wear as a fraction of total on-road vehicle PM emissions.

However, there are important shortcomings in the way that brake wear emissions are currently estimated, due in part to the introduction of advanced technology vehicles utilizing regenerative braking systems and the use of outdated emissions data in mobile source emission inventory tools. In addition, brake wear and tire wear modeling techniques were originally developed to support regional emissions analysis work and have important limitations (e.g., they are not sufficiently sensitive to reflect emissions variations by vehicle type, vehicles speed, and payload) when applied to transportation project-level assessment.



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WHAT WAS OUR GOAL?

The goal of this study was to develop a revised and updated PM brake wear emission factors that will be implemented in Emission Factors (EMFAC).

WHAT DID WE DO?

Caltrans is required to use mobile source emission inventory tool known as EMFAC developed by California Air Resources Board (CARB) to estimate and analyze on-road emissions PM while other states use the Motor Vehicle Emission Simulator (MOVES) model developed by U. S. Environmental Protection Agency.

However, it should be noted that EMFAC brake wear PM emissions factors were developed based on limited data and are outdated. This research improved our understanding how brake wear PM emissions are estimated in EMFAC by measuring and analyzing brake wear data using a dynamometer testing tool to:

1. Understand the brake wear emissions from advanced regenerative braking technologies used by electric vehicles such as Tesla and conventional heavy-duty vehicles and
2. Develop speed-dependent emission factors that can be implemented in EMFAC.

WHAT WAS THE OUTCOME?

The Caltrans HDV project gathered brake PM emissions data on several HDV brake configurations to update EMFAC rates, and a Tesla Model 3 electric vehicle to expand California's dataset on regenerative braking emissions. The emissions factors developed in this project are fully incorporated on the latest beta version of EMFAC 2021. With the new emissions factors now fully implemented, Caltrans will have the opportunity to have a better and a more realistic estimates of PM emissions when conducting project level air quality conformity analyses.

WHAT IS THE BENEFIT?

The updated and/or newly developed emission factors will enable the generation of more realistic and proper brake wear PM emission estimates that will benefit Caltrans Districts and Caltrans Divisions that are involved in project delivery and transportation planning.