ABSTRACT

Soliman, Ahmed S. M., Ph.D., Purdue University, December 2005. Analysis Of Traffic-Air-Quality In Northwest Indiana Adjacent To The Borman Expressway. Major Professor: Robert B. Jacko.

The purpose of the study was to quantify the impact of traffic conditions such as free flow and congestions on local air quality. The Borman Expressway in Northwest Indiana is considered a test-bed for this research due to the high volume of class-9-truck traffic traveling on it, as well as the existing and continuing installation of the Intelligent Transportation System (ITS) to improve the traffic management along the highway stretch.

An empirical Traffic-Air-Quality model (TAQ model) was developed to estimate the $PM_{2.5}$ emission factors (g/mi) based solely on the measured traffic parameters such as average speed, average acceleration and truck density. The TAQ model has shown better predictions that matched the measured emission factor values more than the EPA-PART5 model. During congestions (speeds < 30 mi/h), the TAQ model, on average, over predicted the measured values by 1.2 folds, in comparison to the 4.0 folds under predictions of the EPA-PART5 model. On the other hand, during free flow (speeds > 50 mi/h), the TAQ model, on average, over predicted the measured values by 1.5 folds.

The measured values as well as the TAQ model have shown that the $PM_{2.5}$ emission factors change more aggressively with respect to the average truck speeds on the Borman Expressway more than the EPA-PART5 model predictions which assume constant emission values with respect to speed. On average a 74% improvement in air

quality is expected when the average Borman speed range is improved from < 30 mi/h to >50 mi/h (based on reduction of mass emitted per mile [g/mi]).

An autoregressive (AR) model was also developed to forecast hourly averaged emission factors using the TAQ model. The AR-TAQ model has shown the ability to predict $PM_{2.5}$ emission factors based on traffic parameters.