18th CRC ON-ROAD VEHICLE EMISSIONS WORKSHOP
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CUMULATIVE EMISSIONS REDUCTIONS FROM IMPLEMENTING BEST AVAILABLE TECHNOLOGY (BAT) FOR NONROAD DIESEL CONSTRUCTION EQUIPMENT, 2005-2007

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In late 2003, the City of New York promulgated Local Law 77 ("LL77") requiring the installation of Best Available Technology (BAT) for reducing primarily particulate matter (PM) and secondarily oxides of nitrogen (NO_x) emissions from diesel-powered nonroad construction equipment that is either owned by the City or by private firms operating on City construction projects. The first implementation of BAT following the precepts of LL77 was subsequently undertaken in July, 2005, at the New York City Department of Environmental Protection (NYCDEP) Croton Water Treatment Plant Project (CWTP) in the Bronx, New York. Over the two year project period from July, 2005 to July, 2007, a total of approximately forty nonroad construction machines, representing six machine types, were retrofitted with BAT emission control technologies (ECTs). Six of these representative machines from this group were selected to undergo in-use emission testing using the Environment Canada DOES2 integrated sampling system (ISS), to quantify the emission reduction performance of the selected BAT control technologies operating under real-world conditions.

This study provides a quantitative estimation of the cumulative emission reductions achieved during the project period from 2005 through 2007, and includes an estimation of equipment-specific emissions factors, development of an equipment-specific "hours of operation" database, and an estimate of "baseline" versus "controlled" cumulative mass emissions to calculate the effect of the ECTs on site-wide equipment emissions. Two different techniques using the EPA NONROAD Model as well as the in-use emissions testing were employed to calculate emission factors (EFs) for the nonroad contraction equipment.

Results from the analysis showed a significant departure in PM, HC and CO emissions from the baseline mass emissions case over time, attributable to: 1) an increase in total number of installed BAT ECTs as a percentage of total equipment emitting pollution on-site; and 2) high pollution removal efficiency of the ECTs. On a mass basis, PM emissions trended down considerably, from a high of 58 kg/month in March of 2006, to a low of 2 kg/month in June of 2007, for a total reduction of 96.5 % from the baseline.

Studies such as the Emisstar study can assist public health and environmental officials in calculating the benefits of implementing BAT programs to achieve occupational health and air quality improvements as well as assist private industry in better quantifying the end results of instituting these types of programs in urban construction environments.

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DETERMINATION OF EMISSION FACTORS FOR TRUCK-MOUNTED CONCRETE PUMPS USING ON-BOARD PEMS TESTING

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As part of efforts to characterize emission factors for construction equipment that will be used in the building of the new Columbia University Manhattanville Campus Expansion Project in New York City, the Environmental Consulting firm of AKRF is employing EPA's Mobile 6 and NONROAD emissions inventory models. These models are the government standard for emission factor characterization and are used for known applications involving on-highway engines powering on-highway vehicles, or nonroad engines powering nonroad pieces of equipment. As part of this construction project however, there exists a third equipment application for which neither EPA model is able to calculate these emission factors: an on-highway engine powering a nonroad application. Specifically, concrete pumper trucks will be employed to propel concrete via a long boom into hard-to-reach areas of a structure or foundation. These trucks use the on-highway engine that propels the vehicle to power the concrete pump itself. In order to determine the emissions factors for this unique, non-standard application, Emisstar was employed to perform in-use emissions testing using a portable emissions measurement system (PEMS).

In-use emissions testing on three selected concrete pumper trucks was performed using the Ride Along Vehicle Emission Measurement (RAVEM™) PEMS system manufactured by California-based Engine, Fuel and Emissions Engineering (EF&EE). Subsequent to performing this in-use emissions testing, Emisstar developed an approach to calculate PM emission factors on a mass per unit time basis by developing equipment-specific modal "high" and "low" intensity duty cycle and regression analysis. There were a total 12 test runs for all three trucks consisting of four runs for each truck. By definition, a test run was comprised of three different modes of primary activity encompassing "Idle + Power Take Off (PTO)", "High Idle + PTO Without Load", and "High Idle + With Load".

This study indicates that the selection of which duty cycle and emission factor to use for emission modeling should be based on the nature of the construction activity. For example, the "low intensity" duty cycle and the corresponding PM emission factor would be best representative of construction activities in which pumper truck "down time" is more than "concrete pumping time". Construction activities where the intensity is unknown or where long continuous pours are expected to occur without interruption would be best represented by the "high intensity" duty cycle and resultant emission factor.