Evaluating Air Emissions and Fuel Efficiency of Solid Waste Collection Vehicles

It is the goal of the Environmental Research and Education Foundation (EREF) to fund far reaching, impactful and high quality research that can be used by the solid waste industry and the public it serves to achieve greater sustainability, sound environmental stewardship, improved process efficiency and increased knowledge.

More information on this project is available on the EREF Web site at www.erefdn.org.

Grantee: University of Nebraska-Lincoln (Shannon Bartelt-Hunt, Elizabeth G. Jones), North Carolina State University (H. Christopher Frey)
Award Amount: $262,602

Over 500 million tons of municipal solid waste and construction and demolition (C&D) debris is generated each year in the United States. Proper disposal of this material in municipal solid waste and C&D landfills requires that this material be collected and transported from the point of generation to transfer stations or final disposal or processing sites such as landfills, materials recovery facilities or composting facilities. Due to the nature of solid waste collection, vehicles continuously start and stop, which creates a unique duty-cycle from an emissions standpoint. Additionally, air emissions resulting from solid waste collection activities are not well quantified and current data that exists is anecdotal at best. Emissions reductions measures implemented over the past decade, along with a large trend to utilize either dedicated or duel fuel liquefied or compressed natural gas vehicles, have fostered substantial reductions in emissions and have the potential to continue to result in environmental and economic benefits. In addition to local air quality impacts from solid waste collection, a better understanding of the contribution of the solid waste industry to carbon emissions is also of crucial importance.
Due to these factors, EREF funded a project to the University of Nebraska, with the primary goal to evaluate air emissions produced by operating vehicles during collection of municipal solid waste from various types of collection trucks. Ambient conditions, truck age and type, route characteristics and emissions from conventional fuel and alternative fuel (compressed or liquefied natural gas) vehicles are being monitored. This will provide a more accurate evaluation of the air emissions from solid waste collection under real world conditions. In addition, the fuel economy of solid waste collection vehicles will be estimated. Once these data are available, they can be used to develop strategies to reduce CO₂ emissions from solid waste collection, improve best management practices for collection activities and provide more accurate metrics in life-cycle analyses of the environmental and economic impacts of solid waste management systems.

The specific project objectives of this project are to:

1. Quantify air emissions from collection vehicles used to collect and transport municipal solid waste.
2. Develop a model to evaluate the impact of variables such as ambient conditions, vehicle characteristics and route characteristics on emissions data.
3. Characterize fuel consumption as a function of vehicle and trip characteristics.

Air emissions will be directly measured from solid waste collection vehicles operating in the Raleigh, North Carolina area by industry partner Waste Industries. The Portable Emissions Measurement System (PEMS) unit will be used to measure particulate matter, nitrogen oxides, carbon monoxide, carbon dioxide, oxygen and total hydrocarbons during operation of collection vehicles. In addition, the system contains a Global Positioning System to allow for determination of route, ground speed and elevation, as well as an engine control module that interfaces with the vehicle and provides real-time information on vehicle speed, engine speed and fuel flow data.

Starting in October 2012, the PEMS modules were used to collect second-by-second emissions data on 24 waste collection vehicles: 18 conventionally fueled vehicles and 6 vehicles operating on compressed natural gas. For each fuel type, emissions are being monitored on vehicles with different model years (2002-2006, 2007-2009 and 2010 and newer) and truck configurations.
(automated side-load, front load and roll-off). Information on the engine type and model are also being collected to evaluate the effect of these variables on air emissions.

The collected vehicle and roadway characteristics will be used as input data to the U. S. Environmental Protection Agency MOVES (Motor Vehicle Emission Simulator) emission modeling system. MOVES models will be evaluated based on the comparison of MOVES predictions and measured emissions using the collected data. The combined results from the data collection and modeling are expected to better define the relationship between emissions and fuel consumption in terms of vehicle trip characteristics. These results may then be used by the solid waste industry to help formulate operating strategies to help reduce fuel consumption. Reducing fuel consumption benefits the solid waste collection operator through cost savings and benefits society through reduced air emissions.

It is expected that initial results from the project will be available in late 2013.

Click here for more information.

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*Lighting a path to sustainable waste management practices*

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