Prototype generators emit much less carbon monoxide

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Portable electric generators retrofitted with off-the-shelf hardware by the University of Alabama (UA) emitted significantly lower levels of carbon monoxide (CO) exhaust, according to the results* of tests conducted by the National Institute of Standards and Technology (NIST) for the U.S. Consumer Product Safety Commission (CPSC).

Compared with standard portable generators, CO emissions from the prototype machines were reduced by 90 percent or more, depending on the specific hardware used and operating conditions.

According to the Centers for Disease Control (CDC), unintentional CO poisoning claims more than 400 lives a year. More than 20,000 people visit the emergency room and more than 4,000 are hospitalized due to exposure to toxic levels of the colorless, odorless gas. Fatality is highest among people 65 and older.

Many of these deaths and illnesses stem from unsafe use of portable generators, often in the aftermath of devastating storms and other causes of electric power outages. For the years 2005 to 2008, the CPSC reports that an estimated 37 to 47 percent of non-fire-related consumer product-related CO poisoning deaths were associated with generators.

The tests performed by NIST compared two commercially available gasoline-powered generators against two similar machines that UA retrofitted with closed-loop electronic fuel injection and a small catalyst. Tests were conducted at NIST's manufactured test home, with the

generator operating in the attached garage so as to simulate some common scenarios that often result in deaths or injuries.

In one series of comparisons, generators operated three or more hours in the garage with the garage bay door open and the entry to the house closed. For the stock generator tested, CO levels in the garage peaked at 1,500 parts per million (ppm,which are equivalent to microliters per liter) and inside the house ranged between 150 and 200 ppm.

Clinical symptoms of CO poisoning, including headaches, nausea, and disordered thinking, begin appearing at exposure levels of 100 ppm after at least 90 minutes exposure. During the NIST tests, emissions from the prototype generators ranged from 20 to 30 ppm in the open garage and from 5 to 10 ppm in the house.

CPSC staff conducted health effects modeling using NIST's test results, as part of CPSC's technology demonstration program of the prototype generator, to show that its engine's reduced CO emission rate is expected to result in fewer deaths by significantly delaying the onset and rate of progression of CO poisoning symptoms compared to the stock generator.

On the basis of results of findings from NIST's two earlier studies,** the CDC advises to never run a generator less than 20 feet from an open window, door, or vent where exhaust can vent into an enclosed area. Steven Emmerich, the lead NIST researcher, reminds that generators should always be operated outdoors, far from open windows. "Tragically, fatalities and injuries occur every year," he says. "We hope our research in support of CPSC's efforts to develop and demonstrate a low CO emission generator using existing emission control technology will contribute to practical safety improvements that will help to reduce this toll."

Annual sales of portable generators have been increasing in the United

States and around the world, largely as insurance in the event of power failures. By 2014, U.S. sales of home generator units are predicted to reach $1.2 billion, according to a 2010 report by SBI Energy. The consultancy predicts that worldwide sales will grow to almost 13 million units in 2014.

In their study, NIST researchers also validated the use of their CONTAM*** computer model for studying the performance of prototype generators under a wider range of conditions than those tested. Results of simulations carried out with this publicly available software for studying building airflow and indoor air quality were checked against measurements of CO levels in actual tests. The predicted results were in good agreement with the CO measurements.

More information: * S.J. Emmerich, A.K. Persily, and L. Wang, Modeling and Measuring the Effects of Portable Gasoline Powered Generator Exhaust on Indoor Carbon Monoxide Level, NIST Technical Note 1781, Feb. 2013. www.nist.gov/manuscript-public … ch.cfm?pub_id=912197

** L. Wang and S.J. Emmerich, Modeling the Effects of Outdoor Gasoline Powered Generator Use on Indoor Carbon Monoxide Exposures, NIST Technical Note 1637, Aug. 2009. fire.nist.gov/bfrlpubs/build09/art009.html

L. Wang, S. J. Emmerich, and R. Powell, Modeling the Effects of Outdoor Gasoline Powered Generator Use on Indoor Carbon Monoxide Exposures – Phase II, NIST Technical Note 1666, July 2010. www.nist.gov/manuscript-public … ch.cfm?pub_id=905887

*** CONTAM multizone airflow and contaminant transport analysis software: www.bfrl.nist.gov/IAQanalysis/index.htm

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