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Brief Abstract

Biodiesel and Cold Temperature Effects on Speciated Mobile Source Air Toxics from Modern Diesel Trucks

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Speciated volatile organic compounds (VOCs) with a particular focus on mobile source air toxics (MSATs) were measured in diesel exhaust from three heavy-duty trucks equipped with modern after treatment technologies. Emissions testing was conducted on a temperature controlled chassis dynamometer at two ambient temperatures (-7 °C and 22 °C) operating on two fuels (ultra-low sulfur diesel and 20 % soy biodiesel blend) over three driving cycles: cold start, warm start and heavy-duty urban dynamometer driving cycle. VOCs were measured separately for each drive cycle. Carbonyls, particularly formaldehyde and acetaldehyde, were the most highly emitted VOCs observed during emissions testing representing >70% of all emissions. Biodiesel use led to minor but highly variable changes in MSATs. Cold temperature and cold start conditions caused dramatic enhancements in VOC emissions, particularly carbonyls, compared to the warmer temperature and other drive cycles, respectively. Different 2007+ aftertreatment technologies had a strong influence on MSAT emissions through catalyst regeneration events. The NO_x Adsorber Catalyst and Diesel Particle Filter catalyst regenerations increased MSAT emissions that were compound-specific and highly dependent on test conditions. MSAT emissions observed in this work were compared with SPECIATE profiles and literature values for diesel engines. These comparisons indicated that these newer aftertreatment technologies resulted in lower emission rates of aromatic compounds. Yet, carbonyl emissions have not improved in modern diesel vehicles compared to diesel vehicles without 2007+ aftertreatment technologies.