On-road Ammonia Emissions from Gasoline Vehicles Representative of Northern Utah's Fleet

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The importance of ambient ammonia (NH_3) to the formation of wintertime particulate in northern Utah has been well documented in the last few years (UWFPS, 2017). Recent emissions inventories have estimated 3,884 tons/year of ammonia emissions are emitted into the relevant airsheds, and approximately 22% is estimated to be derived from mobile sources. However, attempts by the Utah Division of Air Quality (UDAQ) to model atmospheric NH_3 concentrations and subsequent photochemical reactions, as well as limited actual ambient NH_3 observations, have suggested that current NH_3 emissions inventory may be too low by a factor of 4-6x. Inadequate mobile source emission factors have been speculated as a likely source of at least some of these deficiencies. As such, a collaborative research project between Utah State University (USU), Weber State University (WSU), and UDAQ was initiated to examine on-road tailpipe emissions of NH_3 and the more typical emission gases (oxides of nitrogen, carbon monoxide, carbon dioxide, hydrocarbons) from a representative sampling of gasoline vehicles typical to the northern Utah fleet. The on-road tests were performed along a previously developed roadway transect in Logan, UT which included various speed limits (25-50 mph) and grades (-1.1% to +5.2%).

Initial results from approximately one dozen vehicle tests were reported at the 2020 Science for Solutions Conference. Since that time a total of 47 light-duty gasoline vehicles have been tested across the on-road transect for tailpipe NH_3 and typical pollutants. The number of tested vehicles were broken down across recognized federally-regulated "tiers": <Tier 0 (2%), Tier 0 (2%), Tier 1 (13%), NLEV (9%), Tier 2 (64%), and Tier 3 (13%). Most of the tests more done in triplicate. The fleet-wide NH_3 tailpipe emissions averaged 40 mg/km. Not surprisingly, older vehicles (Tier 0, Tier 1 and NLEV) with high odometer readings typically recorded showed elevated NH_3 emission rates, as high as 218 mg/km. Contrarily, newer motor vehicles (Tier II and Tier 3) with low odometer readings showed significantly lower NH_3 emission rates. Furthermore, NH_3 emission rates showed a strong positive correlation with post-catalyst CO, NOx and CO_2 exhaust concentrations with a correlation coefficients of 0.86, 0.869 and 0.7053, respectively.