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Measurements of Combustion Emissions of Lab-Scale Flares with Injected Aqueous Sodium Chloride Aerosols

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During completion of hydraulically fracture oil and gas wells, fluids returned to the surface prior to production (produced water) are typically sent to separator units where the gas-phase is directed to an on-site flare. Current separator efficiency regulations are designed to remove only larger droplets (>300-600 μm) of liquid hydrocarbons (API 521), to preclude the possibility of burning droplets persisting through the flare. However, there is strong potential for small produced water aerosols (<20 μm) to be carried through to flare systems, especially during flowback operations. Produced water compositions during flowback can initially be low in total dissolved solids (TDS). However, TDS levels typically rise by orders of magnitude over a short time-span ($\sim$2-5 days) as formation water becomes the dominate returned fluid; in some cases reaching salinity levels of super saturated brines. Data on large numbers of produced water samples from hydraulically fractured wells suggest the most prominent species are sodium and chlorine (e.g., Rosenblum et al. 2017; USGS 2016; Barbot et al. 2013).

This work explores potential impacts of entrained salt-water aerosol on flare emissions. Flares of typical upstream production composition in North America are tested Carleton University Flare Facility in Ottawa, Canada. Initial experiments suggest that aqueous Na-Cl aerosols have the potential to dramatically affect flare emissions. Results of both in that gas and particulate phase measurements are discussed. Using a combination of advanced sampling techniques, insights into the magnitude, composition, and optical properties of emitted particulate under different conditions are presented. Finally, the potential for trace emission of gas- and liquid-phase chlorinated-hydrocarbon species are investigated.