Remote Detection of Sodium Signatures as an Indicator of Liquid Carry-Over into Flare Flames in the Bakken Oil Production Region

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Abstract

During the completion, cleanup, and production phases of a typical oil or gas well, produced fluids – including crude oil, natural gas, formation water, and injected fracturing fluids – are separated in vessels at the surface. Oil and condensate are typically sent to production tanks or into a pipeline, water or brine are held in tanks for further treatment and disposal, and gasses are either captured and directed to a processing facility or burned via a flare system. Anecdotally, the liquid/gas separation process can become strained when an abundance of non-hydrocarbon liquid is produced by the well. Limited field (Strosher, 2000) and lab experiments (Jefferson et al, 2015) suggest entrainment of liquid aerosols in the flare stream can affect flare performance. In particular, experiments have shown that salt-water aerosols can affect combustion completion and augment carbon monoxide and particulate emissions.

There are little to no data in the literature on typical separation efficiencies in the field. Current regulatory guidelines are limited to specifying that "droplets larger than 300-600 microns" should be removed (API 521/AER D60) from flare gas streams. Surfactants present in the separator via crude oil or chemical additives may contribute to oil-water emulsification and foam production, which lower separation efficiency by increasing the quantity and diameter of liquid droplets exiting the separator. This may occur during well cleaning when injected liquids are being purged, or during early stages of well production when formation water is produced at its highest rate.

The objective of this work is to use remote field measurements to investigate the frequency with which non-hydrocarbon liquids may be carried through to flare systems at upstream oil and gas sites post–completion. A portable atomic emission spectroscopy system capable of remotely monitoring radiative emission from flare flames has been developed and deployed in field trials in Canada, the United States, and Ecuador. The most recent measurement campaign in November 2019 in North Dakota and southern Saskatchewan is expected to produce statistics on the frequency of sodium presence in flare flames in the Bakken oil production region. This poster will briefly review the developed measurement system and present preliminary results from the recent field measurements in North Dakota/southern Saskatchewan.