Characterization of VOCs, PAHs and CDD/CDFs from Gas Flaring at Different Liquid Injection Conditions

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Abstract

Organic compounds (OC) emitted from gas flaring could potentially be a concern for human health and climate. Little research to date has described and quantified the OC emissions from gas flaring in detail. Therefore, this study provides comprehensive characterization of the OC, including volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs) and chlorinated dibenzodioxins/ dibenzofurans (PCDD/Fs) from gas flaring utilizing different analytical techniques.

A pilot-scale co-flow diffusion flame burner was employed to mimic flaring by burning three methane-based fuel surrogates, which approximates the range of concentrations of hydrocarbon and inert gases typically found in Alberta. To investigate the effects of potential aerosol carry-over of non-hydrocarbon liquids found in the produced water on well-completion flares; distilled water, Cardium flowback water surrogate, flowback water collected from the Duvernay, and a 15% NaCl solution were aerosolized and introduced into the flare at varying liquid flowrates. The resulting OC emission profiles were analyzed and compared with those without liquid injection. Canisters, quartz, and PUF filters were used to collect the VOCs, PAHs, and PCDD/Fs, which were subsequently analyzed via gas chromatography/mass spectrometry techniques. Additionally, a photoacoustic technique was exploited to measure the soot emissions.

The analytical results illustrated that fuel types investigated had relatively small effect on the target OC emissions. However, heavier fuels did produce larger quantities of soot. Alternately, liquid injection was the dominant factor influencing VOCs, PAHs and PCDD/Fs emitted from the flare, with the NaCl solution causing the highest concentrations. Moreover, Cl^- variation at different flowrates of liquid injection were further investigated and high Cl^- content generally caused greater VOCs and PAHs, with the exception of the Duvernay flowback liquid which had relatively low OC emissions.