Benzene Destruction Removal Efficiency & Black Carbon Yield in a Lab-Scale Flare

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Abstract

Benzene is a known human carcinogen that is commonly encountered during upstream oil and gas production. When raw natural gas is produced, it is saturated with water vapour that must be removed. This is generally done using a glycol dehydrator, which uses liquid glycol to absorb water vapour. However, the liquid glycol also absorbs trace amounts of hydrocarbons including benzene, which are eventually removed in a still prior to the glycol being cycled back through the dehydrator. This benzene-laden still gas is commonly vented directly to atmosphere.

The objective of this research is to investigate the benzene destruction removal efficiency (DRE) and black carbon (BC) emissions when using flaring as an emissions control mechanism for glycol dehydrators. Experiments were performed at the Carleton University Flare Facility (CUFF) in which fuel mixtures representative of glycol dehydrator still vent gas were combusted in a 50.8 mm diameter flare. Additional fuel mixtures were also tested to investigate the effects of heating value, methane and carbon dioxide dilution, and benzene addition on benzene DRE and BC yield.

In all cases the DRE of benzene in a laboratory flare in quiescent conditions was nearly 100%, but the presence of benzene in the fuel increased the BC yield above similar results for alkane-only fuels. Considering reported data for Alberta, Canada in 2017, the results of this work suggest that flaring glycol dehydrator still gases could potentially reduce benzene emissions to less than 1 tonne annually, while increasing province-wide black carbon emissions by less than 5%. The increase in BC could be partially mitigated by adding methane to the still gas mixture prior to flaring. Further work is recommended to investigate the effects of crosswinds on the benzene DRE in a flare.