Flaring during Refining and Upgrading: Effects of Air-Assist on Emissions Control

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Abstract

Part of routine practice in oil and gas production is the burning of flammable waste gases in an open-atmosphere flame, commonly known as flaring. In 2014, the total flared gas in Alberta's upstream oil and gas industry alone exceeded 1 billion cubic meters. Satellite data reveals that global flared volumes exceed 140 billion cubic meters annually. This amounts to 360 million tons of carbon dioxide, unburned hydrocarbons, and other harmful emissions.

A practical measure taken by flare operators to minimize incomplete products of flaring is the injection of high pressure air into the flame. The rapid inflow of air enhances fuel-air mixing and promotes a higher degree of combustion. However, recent studies have suggested that air-assisted flares often fail to perform as required by flaring regulations. This is the result of a lack of quantitative data regarding air-assisted flare emissions to properly guide the design, operation, and regulation of air-assisted flares.

The objectives of my research are to design, construct, and test bench-scale air-assisted flares and perform exploratory experiments to characterize emissions. To simulate full-scale air-assisted flares, I developed a model that captures the key performance parameters. The desired outcome of my research is gas and particulate emission characterization. Ultimately, I hope to provide fundamental insights into air-assisted flare emissions that will pave the way to full-scale experiments.