Particle, Volatile Organic Compounds and Polycyclic Aromatic Hydrocarbon Emission from Flaring

O.W. Bello[1], T.A. Sipkens[2], M. Kazemimanesh[1], U. Trivanovic[2], A. Naseri[1], S. Schmidt[3], A. Baldelli[2], R. Callahan[1], D. Bui[3], A. Bertram[4], S.N. Rogak[2], J.J. Harynuk[3], L. Kostiuk[1], J.S. Olfert[1]

[1]Dept. of Mechanical Engineering, University of Alberta; [2]Dept. of Mechanical Engineering, University of British Columbia, [3]Dept. of Chemistry, University of Alberta; [4]Dept. of Chemistry, University of British Columbia

Abstract

The world is concern about the potential impacts of hydraulic fracturing which releases a large volume of wastewater or flow-back water and produced water, a contaminant that finds its way into the environment by mixing with flared gases and water bodies. The main concern of this study is the mixture of the flow-back and produced water with flares in an aerosolized form. When they mix with flares, they produce toxic materials, substances that deplete our ozone layer and greenhouse gases. Volatile organic compound (VOCs) and polycyclic aromatic hydrocarbon (PAHs) are the main substances of those aforementioned produces.

A primary emission measurement has been carried out on a lab-scale flare, where Methane (CH_4) and Propane ($C3H_8$) are the two hydrocarbons used in this study. A photoacoustic extinctiometer (PAX) was used to measure the amount of black carbon (BC) emitted by the flare, and a NO_x analyzer was used to measure the concentrations of NO, NO_2 and NO_x present in the flare. Also, exhaust gases were collected in a Tedlar bag for gas chromatographic analysis to know the amount of CO, CO_2 and hydrocarbon present in the flared gases.

Also, preliminary qualitative and quantitative analyses of VOCs and PAHs in the gas and particulate phases were carried out using thermal desorption coupled to comprehensive two-dimensional gas chromatography with flame ionization detection and time-of-flight mass spectrometry (TD-GC×GC-FID/TOFMS). Thermal desorption provides a less tedious way of sample collection and introduction to the GC, as well as reduces the time and cost of analyses compared to traditional liquid extraction methods. The comprehensive two-dimensional GC is superior to conventional one-dimensional GC by better peak capacity and sensitivity. Furthermore, a mass spectrometer enables a direct identification of the analytes.