A Methodological Approach on the Utilization of Infrared Imaging for Estimation of Methane Gas Emission from Natural Gas System

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Abstract

Natural gas is one of major energy resources in the United States. According to the Annual Energy Report 2008 by Energy Information Administration (EIA), natural gas accounts for 24% of U.S. primary energy consumption by source. The use of natural gas as a source of energy is very crucial for all U.S. sectors of economy including residential, commercial, industrial, utility and transportation. According to EPA report on U.S. Inventory of Greenhouse Gas Emissions and Sinks 1990 – 2007, natural gas system emitted 104.7 Tg CO₂ Eq. (4,985 Gg) of CH₄ in 2007. The major contributors to methane emissions from natural gas systems are coming from normal operations, routine maintenance and system upsets.

Methane gas emissions from natural gas systems had been estimated using a methodology developed by Gas Research Institute (GRI) and EPA (EPA/GRI 1996). According to Environmental Protection Agency (EPA), a typical U.S. refinery spends approximately one million dollars annually on leak surveys. Previous technology consists of hand held total vapor analyzers (TVA) or also called “sniffers” which are labor intensive and must be conducted point by point surveys in close proximity with pipes, valves and other VOC carrying components. It is also easy to miss a leak as the device only gives an indication of a leak, but no visual image. This method is inefficient because annually companies spend millions of dollars to inspect an estimated 99% of equipment that doesn’t leak. API study showed that over 90% of emissions come from less than 1% of the components in the refinery industry.

In this research, utilization of infrared imaging technique using system for methane leak detection is being proposed. This method is leading compared to other detection method for its advantages including ability to visualize leaks in real time, easier location and repair of leaks, ability to pinpoint leak location, and capacity to scan large area rapidly. Despite its advantages, there are still some shortcomings in this passive detection using thermal camera. Thermal camera is unable to provide the concentration of the dispersed gas as well as to quantify the amount of methane emission directly. Several type of thermal imager can provide the apparent temperature distribution of the object scene, however for gas measurement; the apparent temperature is not depicting the true or actual temperature of the gas. This research is aimed to troubleshoot the shortcomings of this method and finally provide a methodological approach to estimate methane gas emission from natural gas industry by applying the infrared imaging technique.