Quarterly Report

Date of Report: Oct 1st, 2020
Contract Number: PHMSA-RA-DTPH56-17-RA-00002
Prepared for: Pipeline and Hazardous Materials Safety Administration (PHMSA)
Project Title: Tools for Predicting Gas Migration and Mitigating its Occurrence/Consequence
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For quarterly period ending: Sept 30th, 2020

Results and Conclusions:

In this quarter, we have continued to make progress. A peer reviewed paper (Estimating natural gas emissions from underground pipelines using surface concentration measurements) was published in *Environmental Pollution*. We had a meeting with industry partners to provide an update on the leak response survey results. We also met with regulatory partners to discuss project results and provide a status update. We have continued to coordinate the upcoming field work. Current plans are to perform the field experiments in late October or early November.

We have worked on the following tasks to achieve the proposed work in this project (The task number follows the numbering in the project timeline):

Task 4: Validation of analytic tool

We published a paper entitled "Estimating natural gas emissions from underground pipelines using surface concentration measurements" which presents the analytic tool developed in this project. We believe that the findings/results are important, and the analytic tool measures emission rates from underground pipeline leaks.

As a follow on to this work, we performed a series of experiments at METEC in May 2020 that we are currently analyzing, and we are working on the draft for publication. The manuscript focuses on estimating leakage rates from underground pipeline leaks using atmospheric methane concentrations measured various environmental conditions. In addition, the findings/ manuscript focus on describing the environmental conditions that effect the gas readings. These experiments captured diurnal variations during the methane release experiments from underground pipeline. The results of this studies have important implications for understanding atmospheric conditions on fugitive methane emissions from underground pipeline leaks. In addition to emission estimates from atmospheric methane concentrations, we used a network of low-cost sensors to measure near surface methane concentrations. Data analysis is currently in progress.

Tasks 3&4: Develop & deploy leak detection survey tool

We analyzed survey data and performed statistical analysis to understand the parameters affecting gas migration in soil. We met with industry partners to discuss the findings and their implications. We are working on the draft for publication.

Publications:

Cho, Y., B. Ulrich, D. Zimmerle, K.M.Smits, Novel dimensionless surface concentration number approach for estimation of leak rates from underground natural gas pipelines, Env. Pollution, https://doi.org/10.1016/j.envpol.2020.115514.

Presentations:

– August 4, 2020 Virtual meeting with project industry partners to present results of survey analysis and coordinate follow on field experiments

– August 7, 20202 Virtual meeting with regulatory partners to present results of survey analysis

Smits, K.M., *What's going on underground? How can we detect and respond better to leaks from natural gas operations?*, UTA College of Engineering Research Sessions, Sept 18, 2020, (Invited Presentation)

Plans for Future Activity:

Future experiments will focus on developing a quantitative method to predict leakage rates based on above-ground gas concentrations and atmospheric conditions. These experiments will evaluate (1) the extent of subsurface gas migration over a range of realistic natural gas leakage rates, and (2) the effect of wind conditions on above-ground gas concentrations that arise from underground leaks. Results from these studies will be used to calibrate numerical models to predict gas above-ground and below-ground migration behavior for a wider range of potential field conditions. Future modeling work will be extended to different obstruction conditions, vegetation, soil layering, and other environmental parameters. Future experiments will focus on developing a quantitative method to predict leakage rates based on surface and above-ground gas concentrations.

Upcoming Conference Session Chair and Organizer:

"New Approaches to Methane Measurements from Oil and Gas Operations – Methods, Data, and Insights." Session chairs: Kathleen Smits, Arvind P. Ravikumar and David Allen. American Geophysical Union Fall Meeting. December, 2020, San Francisco, CA.

"Experimental and theoretical strategies for quantifying the impact of small-scale heterogeneity on effective fluxes within the unsaturated zone and across interfaces with the atmosphere and saturated zone." Session chairs: Kathleen Smits, Veronica Moreles and Joaquin Jimenez-Martinez. American Geophysical Union Fall Meeting. December, 2020, San Francisco, CA.

New technologies and platforms to measure methane emissions from oil and gas operations – methods, data, and insights." Session chairs: Kathleen Smits, Stuart Riddick, Daniel Zimmerle and Arvind Ravikumar. American Geophysical Union Fall Meeting. December, 2020, San Francisco, CA.

Upcoming Presentations:

Riddick, S.N., C. Bell, A. Duggan, T. Vaughn, K.M. Smits, Y. Cho, K. Bennett, D. Zimmerle, Modelling temporal variability in the surface expression above a methane leakage: The ESCAPE model, American Geophysical Union Fall Meeting, Virtual, Dec 2020 (upcoming poster)

Cho, Y., K.M. Smits, S. N. Riddick, Estimating NG emissions from underground pipelines using surface concentration measurements, American Geophysical Union Fall Meeting, Virtual, Dec 2020 (upcoming poster)

Bahlman, L., K.M. Smits, R. Helmig, I. Neuweiler, Wind effects on soil-atmosphere gas exchange for gases of different density: A study with laboratory experiments and coupled subsurface – free flow modelling, American Geophysical Union Fall Meeting, Virtual, Dec 2020 (upcoming poster)

Bell, C., A. Duggan, T. Vaughn, S.N. Riddick, K. Bennett, D. Zimmerle, K.M.Smits, D. Allen, A. Ravikumar, Defining a controlled testing protocol for continuous emission monitoring systems performing leak detection at natural gas facilities, American Geophysical Union Fall Meeting, Virtual, Dec 2020 (upcoming poster)