Quarterly Report

Date of Report: January 1, 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: December 31, 2019

Results and Conclusions:

During this quarter, we (1) worked with industry partners to collect data at existing leakage sites using the developed survey tool (2) analyzed leak response surveys collected at leakage sites to include soil property characterizations, performing statistical analyses and correlations (3) built and tested a numerical model to measure soil and fluid properties of the testbeds at the METEC site. (This model will later be tested with field data later in the project and used for understanding the degree to which parameters affect the subsurface natural gas migration.) (4) tested a low-cost sensor system for follow-on experiments (5) developed an experimental protocol for the additional leak sites that will be further investigated in the coming months.

We have worked on the following tasks to achieve the proposed work in this project.

Task 3: METEC pipeline test bed experiments and Numerical modeling

We have designed and validated a model that reflects the METEC site using a commercially available multiphase modeling platform, TOUGH3. The model is currently being tested using the METEC experimental data. We will then use the model to understand the degree to which parameters affect the subsurface natural gas migration.

Task 4: Develop & deploy leak detection survey tool

In collaboration with industry partners, we have collected data at existing leakage sites using the developed survey tool. We are in the process of analyzing results to include soil property characterizations, summarizing all of the data, performing statistical analyses and correlations. Work is on-going.

Task 4: Field data collection, analysis and modeling

We developed an experimental protocol for the additional leak sites that will be further investigated in the coming months. The protocol includes data selection, analysis techniques, site selection etc. In addition, we coordinated the experimental protocol with the industry partners who are willing to collaborate/ support our efforts. Work is on-going.

Publications/presentations:

Smits, K.M., What's going on underground? CH4 Connections Methane Emissions Conference, Colorado State University, Fort Collins, Colorado, Sept 18, 2019. (Invited Presentation)

Ulrich, B., Y. Cho, D. Zimmerle, **K.M. Smits**, Gone with the Wind: Natural Gas Emissions from Leaking Underground Pipelines and Implications for Detection Systems, American Geophysical Union Fall Meeting, San Francisco, CA, Dec 2019 (poster)

Previously reported publications/ presentations:

Ulrich, B.A., M. Mitton, E. Lachenmeyer, A. Hecobian, D. Zimmerle, K.M. Smits. 2019. Natural gas emission from underground pipelines and implications for leak detection. Env. Sci. Tech. Lett., doi: 201967401-406

Plans for Future Activity:

Future experiments will focus on developing a quantitative method to predict leakage rates based on above-ground gas concentrations and wind 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.

We are currently analyzing data collected from the leak response survey and designing field-scale experiments. Future experiments will focus on developing a quantitative method to predict leakage rates based on above-ground gas concentrations and wind conditions.