

CAAP Quarterly Report

December 26, 2023

Project Name: Rhamnolipid: a Bio-based, Ecologically Friendly, Corrosion Inhibitor and SRB Biocide for Crude Pipelines

Contract Number: 693JK32350001CAAP

Prime University: University of Akron

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Reporting Period: Oct. 1, 2023 thru Dec. 31, 2023

Project Activities for Reporting Period:

Kick-off Meeting December 13, 2023. University of Akron PI Scott Lillard, co-PIs Luke Ju and Bi-min Zhang-Newby (UA), industrial partner / Co PI Tim Bieri of bp America held a virtual meeting with the DOT-PHMSA Project Manager Dr. Nusnin Akter, PHMSA Technical Task Initiator Mr. Ben Kendrick and PHMSA and PHMSA Technical Advisory Panels Representative Zhongquan (ZZ) Zhou. At this meeting UA PIs gave brief presentations on past RhL work at UA. The PI's discussed with Project Manager Atker the proposed deliverables on the project and the path forward for meeting them. Ben Kendrick also provided assistance on PHMSA reporting requirements and the MIS system. PHMSA also shared some feedback with the PIs that was a result of the proposal review process: "The limitation of the proposal is it does not include a plan to assess the inhibitors related to pipeline operating environments and code requirements. If this proposal is awarded, suggest the research team to conduct a literature review on pipeline code requirements regarding inhibitor application and crude oil pipeline operating conditions in order to assess the feasibility of applying the inhibitors for crude oil pipeline system and properly design the experiments to evaluate the inhibitors' performance." In FY '24 Q2 the UA PIs in collaboration with bp America will work on a plan of action to address this feedback.

Student Hiring. A major activity this period was graduate student hiring. The PIs have extended offers to two graduate students: 1. Zia Iqbal, B.E. Chemical Engineering, Harbin University of Technology (China) and 2. Uddipta Mondal, B.Sc. Chemical Engineering, Bangladesh University of Engineering & Technology. Both students accepted the offers and have an anticipated start date of Jan. 12, 2024. The PIs are also working on undergraduate hiring in parallel. They hope to hire two, juniors from the Chemical or Corrosion Engineering programs to work in the labs for the Spring '24 semester and possibly into the summer. Contact with several students has been made and we hope to have commitments at the beginning of the semester (2nd week of Jan. '24).

Literature Work: Simulating Crude Flow. Wall shear stress is an important parameters for characterizing flow in crude pipelines as it directly influences chloride and CO₂ corrosion rates.

For the most part, all of the experiments conducted in this project will be carried out using a rotating cylinder electrode (RCE) which allow us to “dial-in” a specific wall shear stress for a fixed geometry specimen by controlling rotation rate. From the literature, measured shear stresses that simulate crude flow (e.g. multiphase flow) have an upper bound of about 100 MPa (Li, Corr. Sci. 2016). This limit is easily obtained in the RCE and the initial boundary conditions to obtain representative wall shear stresses in our laboratory experiments have been calculated.

Project Financial Activities Incurred during the Reporting Period:

No costs to the program were incurred during FY '24 Q1.

Project Activities with Cost Share Partners:

None.

Project Activities with External Partners:

None. However, in Q2 the UA PIs anticipate discussing the wall shear stress calculations with the bp America partner for insight on their operating experience with this topic.

Potential Project Risks:

One potential risk to the project in the near term is a delay in the US embassy granting the students visas, thus, delaying student arrival until the Summer 2024. To help lessen the impact of this if it does occur we are hiring undergraduate students in parallel as discussed above.

Future Project Work:

During the second quarter of FY '24 the PIs anticipate performing the initial rotating cylinder experiments that will act as the baseline for comparison with the RhL additions. These experiments will proceed with undergraduate students if there is a delay in graduate student visas. Early on in the quarter, the PIs will procure “consumables” necessary for this work (all major equipment is on hand): specimens, cell parts, chemicals and gases (CO₂). These initial experiments will be for the uninhibited case and conducted in a produced water surrogate. As mentioned above, the UA PIs also anticipate discussing the code of requirements for inhibitor additions with their bp America partner.

Potential Impacts to Pipeline Safety:

FY '24, Q1 – none.