FIU | Applied Research Center
FLORIDA INTERNATIONAL UNIVERSITY

U.S. DEPARTMENT OF ENERGY

ENVIRONMENT & ENERGY / MECHANICS & MATERIALS

PROJECT: Pipeline Unplugging and Plug Prevention: *Computational Simulation and Evolution of HLW Pipeline Plugs*

CLIENT: U.S. Department of Energy
PRINCIPAL INVESTIGATOR: Dr. Leonel Lagos
LOCATION: Hanford Site, WA

Description:

FIU's Applied Research Center is assisting the Department of Energy's objectives by developing a computational tool to predict formation of plugs in HLW pipelines with an emphasis on the effects of pipeline geometry.

A vast amount of radioactive waste has been stored at Hanford spanning several decades. The majority of this waste is stored in tanks and is transferred in the slurry form via pipelines between tanks and from tanks to processing facilities. During transfer operations, however, the potential for solids to settle along the pipeline frequently exists resulting in partial or sometime full plugging of the pipelines. The plug formation is caused by changes in the chemistry and flow patterns within the pipe. Agglomeration and particle breakup due to changes in the chemical environment, particle-particle interactions, and precipitation, can result in waste behaviors that cannot be predicted by considering equilibrium chemistry or fluid flow alone. Hence, a computational tool that can predict plug formation by considering the chemistry dynamics coupled with fluid particle interactions is needed to reduce the risk of pipe plugging.

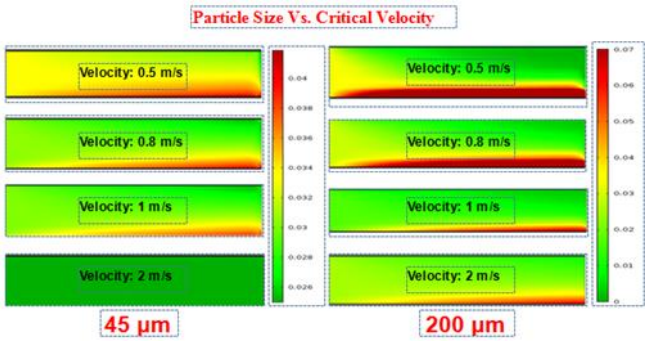
The overall objective of this project is to develop computational simulations that can predict plug formation in HLW pipelines and investigate the influence of chemical-flow interactions that lead to plug formation. Moreover, the effects of pipeline geometry will be explored to understand the impact of piping components on plug formation.

Benefits:

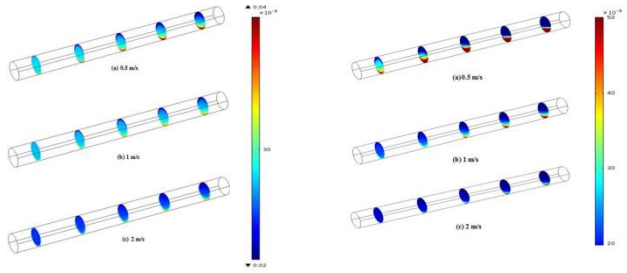
- Mitigation of the risk of plugging by identifying the factors that causes the lines to plug.
- Reduction of the cost and time of conducting extensive experiments on formation of plugs.
- Development of control strategies that aid in minimizing the onset of plugging events.

Accomplishments:

- 2D and 3D models were developed in COMSOL to study the various effects of solid volume fraction and particle size and density on the formation of solid layers.
- Results from the simulations agree with experimental data and empirical correlations.
- Began modeling loop transfer systems to evaluate the effects of pipeline geometry on plug formation.



Particle Size Vs. Critical Velocity



45 µm 200 µm

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