Biobased Corrosion Inhibitors to Mitigate Internal Corrosion in Crude Oil Pipelines

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1. Research Problem

a) According to the US DOT factsheet, approximately 12% of the total pipeline failures in the past 2 decades occurred due to internal corrosion.

b) Among all the corrosion-related incidents in the crude oil industry about 60% are attributed to the internal corrosion of the pipelines.

2. Research Objective

The objective of this study is to mitigate internal corrosion in steel crude oil pipelines employing non-toxic and sustainable bio-based materials

3. Methodology

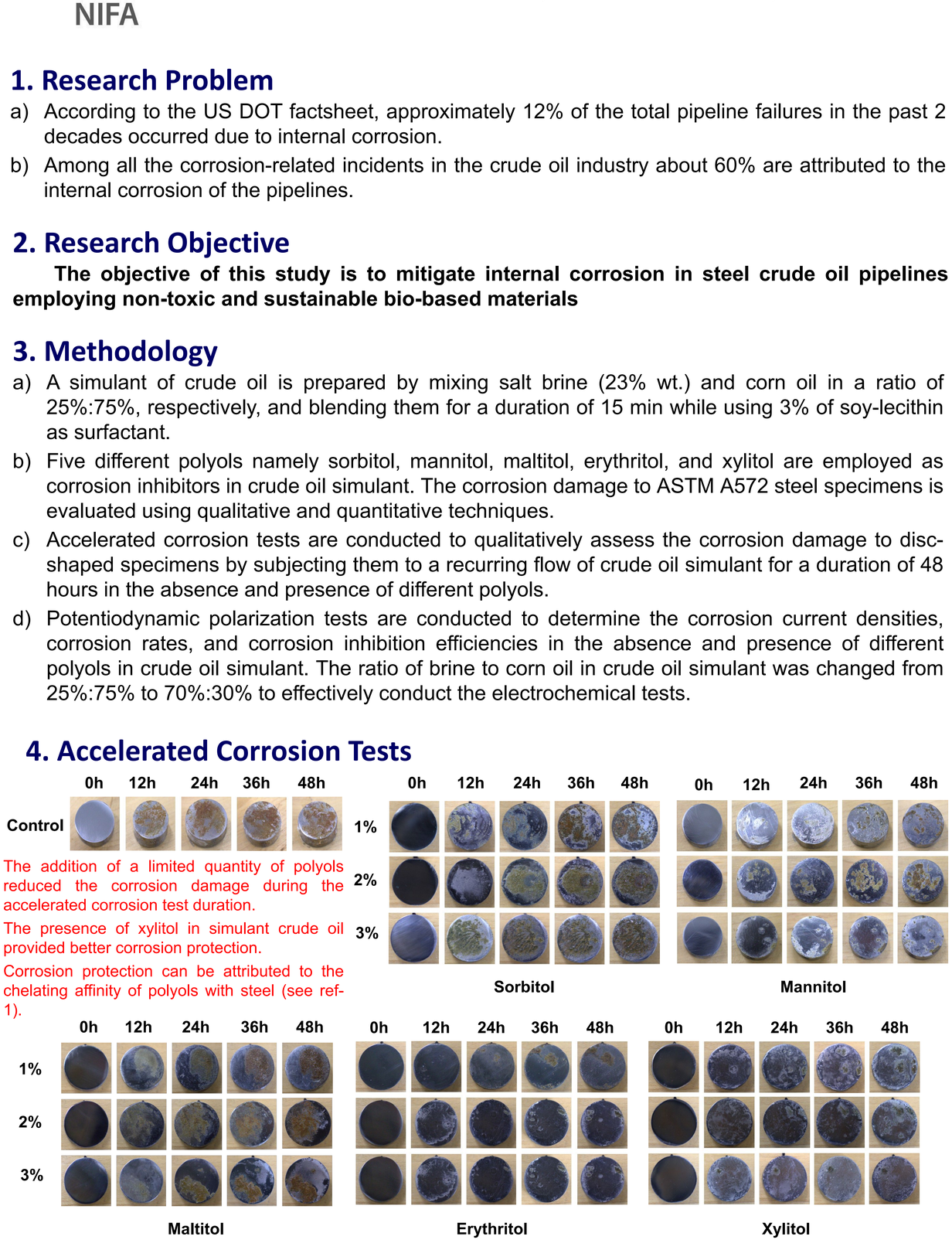
a) A simulant of crude oil is prepared by mixing salt brine (23% wt.) and corn oil in a ratio of 25%:75%, respectively, and blending them for a duration of 15 min while using 3% of soy-lecithin as surfactant.

b) Five different polyols namely sorbitol, mannitol, maltitol, erythritol, and xylitol are employed as corrosion inhibitors in crude oil simulant. The corrosion damage to ASTM A572 steel specimens is evaluated using qualitative and quantitative techniques.

c) Accelerated corrosion tests are conducted to qualitatively assess the corrosion damage to disc-shaped specimens by subjecting them to a recurring flow of crude oil simulant for a duration of 48 hours in the absence and presence of different polyols.

d) Potentiodynamic polarization tests are conducted to determine the corrosion current densities, corrosion rates, and corrosion inhibition efficiencies in the absence and presence of different polyols in crude oil simulant. The ratio of brine to corn oil in crude oil simulant was changed from 25%:75% to 70%:30% to effectively conduct the electrochemical tests.

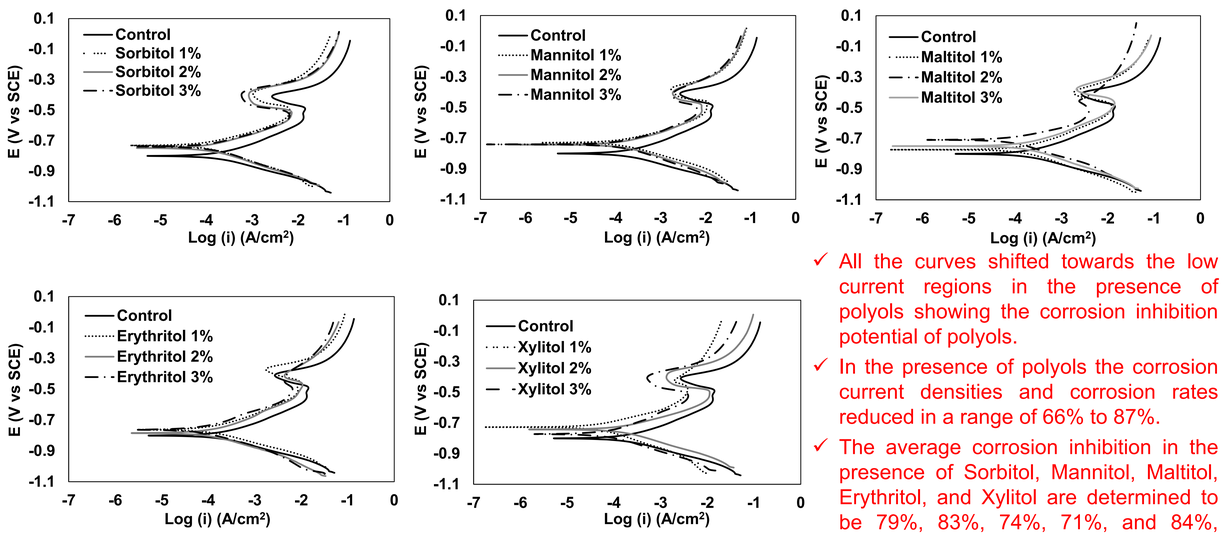
4. Accelerated Corrosion Tests



- ✓ The addition of a limited quantity of polyols reduced the corrosion damage during the accelerated corrosion test duration.
- ✓ The presence of xylitol in simulant crude oil provided better corrosion protection.
- ✓ Corrosion protection can be attributed to the chelating affinity of polyols with steel (see ref-1).

Figure 1. Visual inspection of corrosion damage to ASTM A 572 steel specimens subjected to simulant crude oil emulsion (25%:75) containing 0%, 1%, 2%, and 3% of Sorbitol, Mannitol, Maltitol, Erythritol, and Xylitol.

5. Potentiodynamic Polarization Tests



- ✓ All the curves shifted towards the low current regions in the presence of polyols showing the corrosion inhibition potential of polyols.
- ✓ In the presence of polyols the corrosion current densities and corrosion rates reduced in a range of 66% to 87%.
- ✓ The average corrosion inhibition in the presence of Sorbitol, Mannitol, Maltitol, Erythritol, and Xylitol are determined to be 79%, 83%, 74%, 71%, and 84%, respectively.

Figure 2. Potentiodynamic polarization curves of ASTM A 572 steel specimens in simulant crude oil emulsion in the absence and presence of 1%, 2%, and 3% of Sorbitol, Mannitol, Maltitol, Erythritol, and Xylitol.

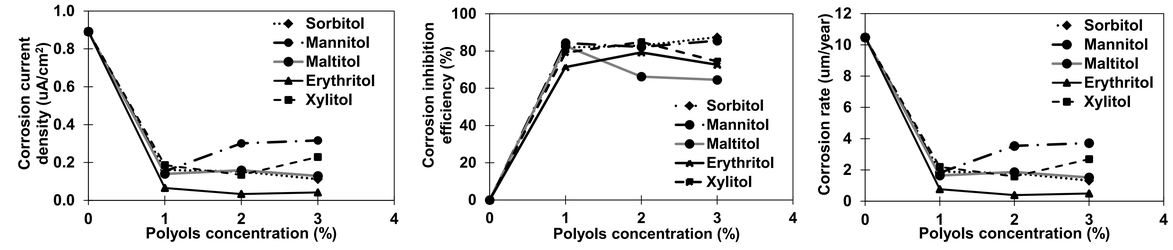


Figure 3. Electrochemical parameters obtained via Tafel analysis for ASTM A 572 steel specimens in simulant crude oil emulsion (70%:30%) in the absence and presence of 1%, 2%, and 3% of Sorbitol, Mannitol, Maltitol, Erythritol, and Xylitol.

6. Acknowledgments

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7. References

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8. Public Project Page

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