CORROSION FATIGUE IN SUCKER RODS AND CORROSION INHIBITOR APPLICATION

Mitchell Hudgens

Mechnical Engineering Department, Texas Tech University

SUCKER ROD PUMPING SYSTEMS IN APPLICATION

Sucker rod pumps are the most common artificial lift system for onshore operations. They remain the go-to solution for many stripper wells due to their relatively low operating cost, straightforward maintenance, and robust performance in low reservoir pressures. Despite this overall reliability, several operational challenges can accelerate rod pump failures, with corrosion fatigue ranking among the most significant. Corrosion effects have fueled a demand to develop new rod pumping equipment and leverage the effective use of corrosion inhibitors to prevent corrosion related failures.

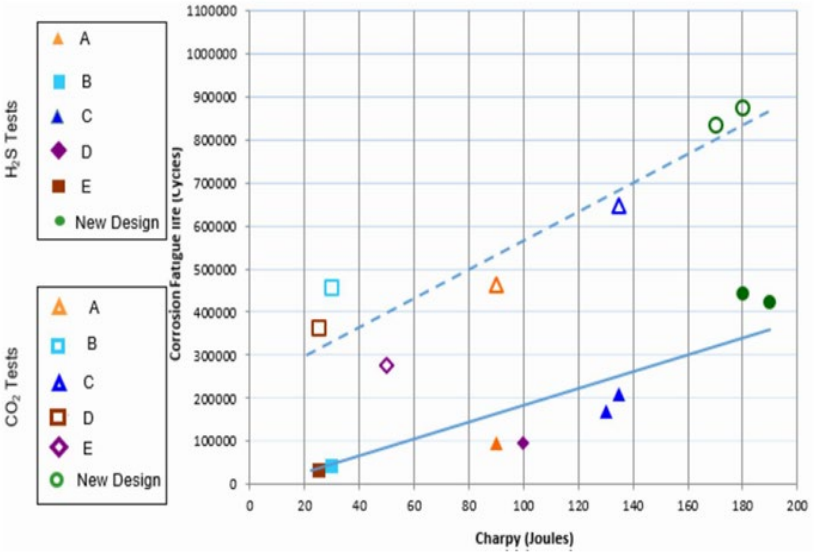

Figure 1 - Comparison of corrosion fatigue results under sweet and sour environments vs Charpy Energy

TOUGHNESS EFFECTS DOWNHOLE

Increased toughness in newly designed sucker rods shows a clear trend of increased corrosion fatigue life, in both H_2S and CO_2 environments. Microcracks that form due to cyclic stresses are less likely to initiate or rapidly propagate in tougher materials. Higher impact toughness also reduces surface degradation during rod-string movement resulting in less severe wear striations. Toughness plays a vital role in improving sucker rod life by reducing stress risers from wear that can initiate corrosion fatigue or stress corrosion cracking in H_2S environments.

ADVANCEMENTS IN SUCKER ROD PUMPING SYSTEM COMPONENTS FOR FAILURE MITIGATION

Harsh downhole environments such as pressure, temperature, H_2S/CO_2 concentration, pH and chlorides all significantly impact sucker rod lifespan. Studies show that CO_2 exposure reduces fatigue life by ~10x, and H_2S exposure reduces it by ~100x. Advanced sucker rods now feature ultraclean steel with fine-grained martensitic microstructures, and high tempering resistance. Alloying elements improve the hardness, toughness and corrosion resistance, increasing the corrosion fatigue resistance 2-3x over standard rods. With increased hardness of downhole components, wear striations can be mitigated if the components are harder than the suspended solids in the well. This helps combat stress risers from wear that can lead to new nucleation sites for corrosion reactions, as well as limiting anodic regions that can produce a galvanic corrosion cell.

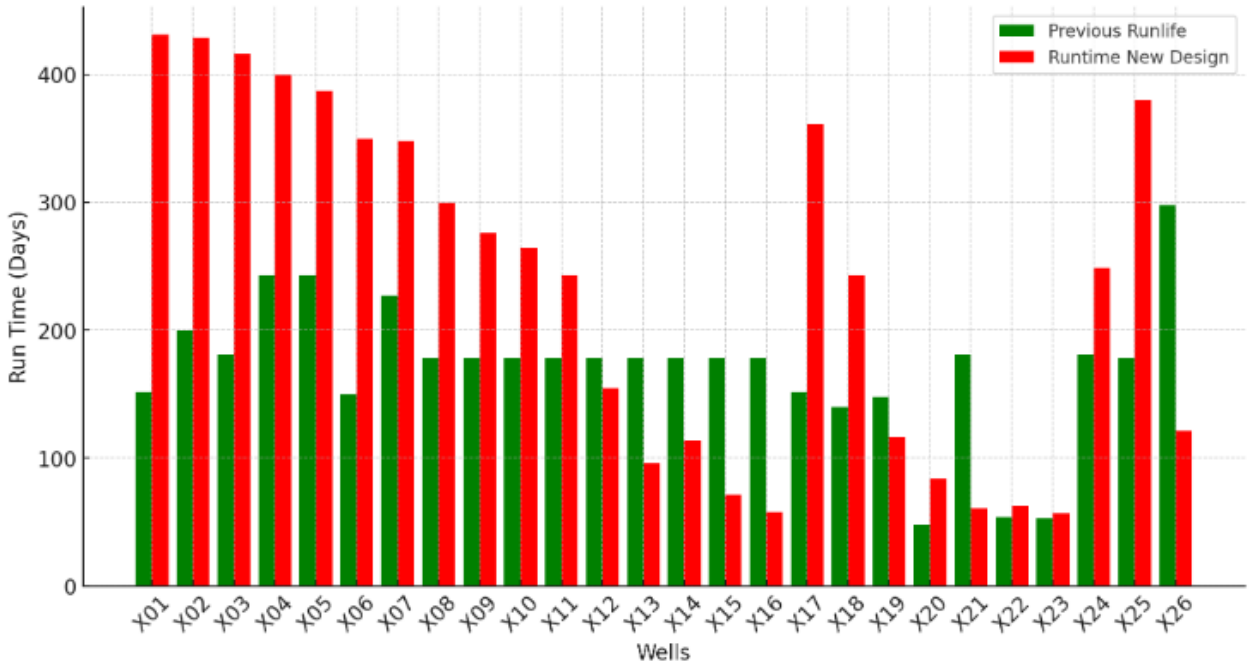

Figure 2 - Comparison of the new rod run time vs previous run life in the tested wells

CORROSION INHIBITOR APPLICATION

Corrosion inhibitors in rod pump systems are used to form a protective barrier on sucker rods, helping to reduce the impact of H_2S, CO_2 and chlorides. Inhibitors will also work to prevent hydrogen absorption. Effective application of corrosion inhibitors is essential in high-water-cut wells that continuously expose components to brine that accelerates

pitting and wear effects. Some corrosion inhibitors provide lubricating properties that help minimize wear related corrosion failures. Effective downhole programs must ensure even distribution of corrosion inhibitors along the rod string, as mechanical wear will strip protective films creating corrosion prone regions. Poor deployment of corrosion inhibitors is among the costliest processes in the oil field today, thus it is crucial that effective deployment of inhibitor treats all exposure windows per day in a producing well. Achieving effective application requires precise dosage control and optimized injection points to ensure full rod string coverage. Without proper distribution, untreated areas become exposure windows that accelerate localized corrosion and increase the risk of premature rod failures.

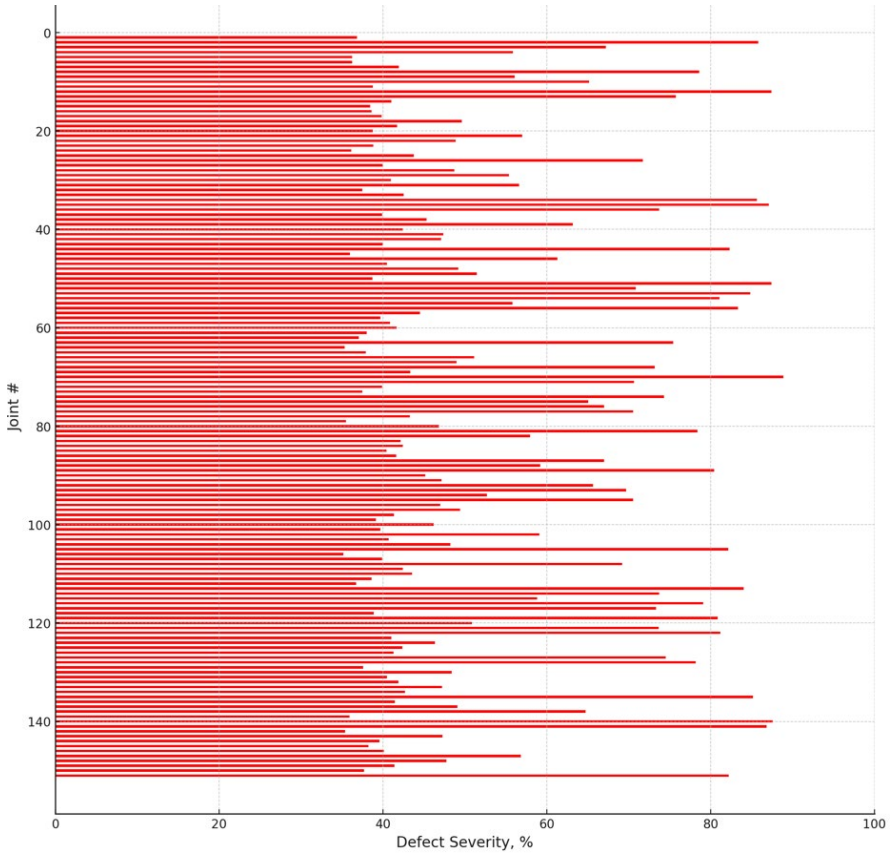

Figure 3 - The maximum defect severity determined by tubing scan of top 150 joints during a workover, 8 months of CI application.

CONCLUSIONS

Combining high-strength steels, corrosion inhibitors, and real-time monitoring is essential in mitigating the effects of corrosion fatigue, wear corrosion and stress cracking. Effective application of corrosion inhibitors ensures full rod string coverage, preventing exposure windows that promote localized corrosion regions leading to

failure. Integration of optimized sucker rod system components and proper corrosion inhibitor deployment can significantly improve well reliability and reduce long-term operational costs.

REFERENCES

Rodgers, P., Lundy, B., Ramachandran, S., Ott, J., Poelker, D., Lee, D., Stevens, C., Bounds, C., and Sullivan, M. 2019. Multifunctional Chemical for Simultaneous Dissolution of Iron Sulfide, Corrosion Inhibition, and Scale Inhibition. Paper SPE-193619-MS https://doi.org/10.2118/193619-MS

Bühler, M., Camara Guillet, F. R., Lopez, E., & Pereyra, M. 2017. Development of a Fatigue Corrosion Resistant Steel for Sucker Rods. Paper No. SPE-184899-MS, Society of Petroleum Engineers. spe-184899-ms.pdf

Al Adi, F., Zulhen, A., Adi, M., Al Saadi, H., Marcano, M., and Rangel, G. 2018. Enhance Mean Time to Failure (MTTF) by Automating and Optimizing Continuous Chemical Injection in Moderate-Severe Corrosive Oil Field Well Application. Paper SPE-192484-MS https://doi.org/10.2118/192484-MS

ACKNOWLEDGEMENTS

Carter Copeland, PE, Owl Energy Services

Jimmy Payton, Chem Tech Services, Inc.