Causes and prevention of corrosion in crude oil storage and distribution systems

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In this second part of this two-year project, we focused on testing proposed methods of corrosion mitigation in crude oil distribution and piping system. The mechanisms identified in the first part were uniform, microbially-assisted and under-deposit corrosion, which are all closely related to the presence of water or water-based mixtures segregated from the crude oil. For this reason, the focus was on quantification of the segregation mechanism. The mechanism was studied in 3 types of crude (high-quality, lower quality with high water content, lower quality with high content of water and viscous fractions). The corrosion aspects were studied using corrosion coupons (visual changes and mass losses) and electrical-resistance probes. The results showed that water segregation has far greater effect in high-quality crude oil, however the absolute corrosion rate was significantly higher in lower quality crude with high amount of viscous fractions. Two extreme conditions gave more than 2-order of magnitude difference in corrosion rate.

Based on these results, we proposed forming a closed loop in the distribution and employ periodic pumping. While it is known in the community that frequently-loaded pipes corrode at lower rates, the closed-loop periodic pumping was, to our best knowledge, never suggested as a corrosion mitigation method. Moreover, the frequency of pumping can be adjusted according to the monthly-average temperature. The economic feasibility suggests that the cost of pumping is very low and greatly is outweighed by the benefits.