

MEASUREMENT OF CRUDE OIL CORROSION USING RADIOACTIVE TRACER TECHNOLOGY

Corrosion in petroleum refineries has resulted in major economic losses due to catastrophic material failures and frequent maintenance downtime. Prior knowledge of the corrosivity of crude oils and their distillation derivatives is essential for the intelligent selection of feed slates, the implementation of optimum blending strategies, and the management of equipment turnarounds with minimal disruption to operations. Since pricing is directly related to the perceived corrosivity of the crude oil, knowledge of potential corrosivity is of particular interest to buyers and sellers of crude oils.

In the past, corrosivity testing has been expensive, lengthy, and often inaccurate due to the inherent deficiencies of available test methods. No robust models existed for predicting crude oil corrosivity, and traditional estimators based on sulfur and total acid number (TAN) measurements were inadequate for assessing the true corrosivity of specific crudes.

To overcome these limitations, Southwest Research Institute® (SwRI®) has developed two bench-top facilities that use radioactive tracer technology (RATT) to measure crude oil corrosivity with much greater accuracy than conventional methods. With RATT, test coupons are irradiated to develop suitable tracers for detection using on-line gamma ray spectroscopy. Corrosion is measured by monitoring the buildup of radioactivity in a closed-loop system as a function of test time.

IMPROVED METHODS FOR MEASURING CRUDE OIL CORROSION

Simulated Refinery Operation

SwRI's new Corrosion Test Facility provides valuable corrosivity data on crude oils, distillates, and residuals under high temperature, flow, and shear stress conditions in a circulating loop that simulates refinery operation. Using a test method based on SwRI's proven expertise with radiotracer technology and validated on a variety of synthetic and refinery samples, SwRI can provide corrosivity data that will allow increased use of discounted opportunity crudes. Typical test temperatures are 600–650°F. The time-resolved data show corrosion as a function of temperature and test time.

Advantages

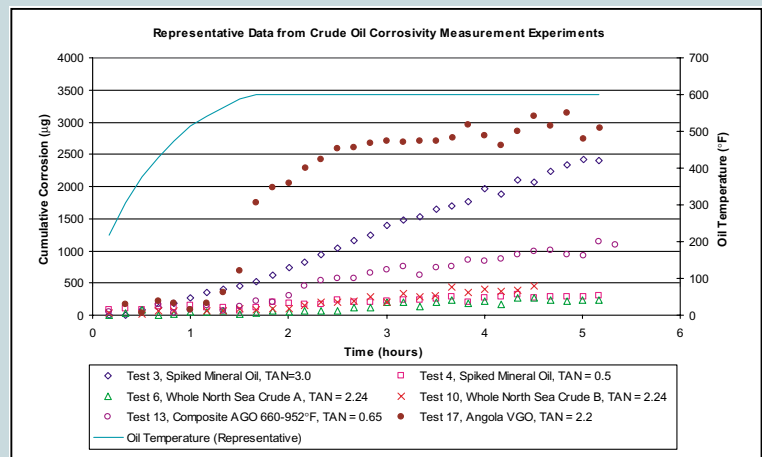
- Detection and measurement of corrosion in real time
- Shorter test times (typically 4 hours vs. 24–48 hours with conventional testing)
- No degradation of crude properties during testing
- Allows for safer and more reliable use of opportunity crudes

Stirred Autoclave

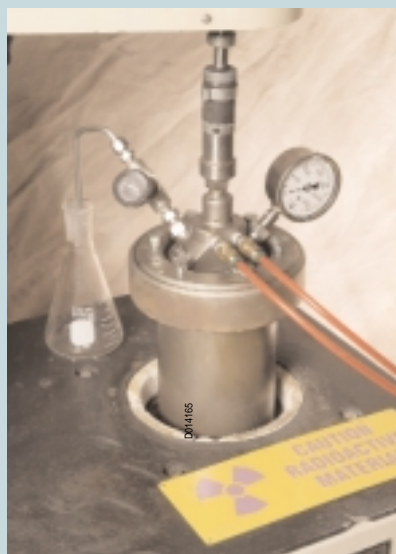
Naphthenic acid corrosion is of major concern to refiners, and naphthenic acid corrosion products are believed to be oil-soluble. SwRI has developed a process in which an irradiated metal coupon is introduced into a container of sample crude,



Real-time radioactive tracer flow loop simulating refinery conditions



Representative real-time corrosion data using radioactive tracer flow loop



Radioactive tracer corrosion test using stirred autoclave

which is then heated and agitated for a short period. Following cooling and removal of the coupon, the crude oil sample and the adhered corrosion product buildup are measured independently using gamma ray spectroscopy. The results are two single, average corrosion values.

The first value will report corrosion products, which were removed from the coupon into the oil during testing. The second value will report corrosion products such as scales (sometimes formed in the presence of sulfur compounds) that adhered to the coupon and were removed mechanically through a controlled abrasion process. Some measure of time dependency for soluble corrosion products can be made through periodic sampling of the agitated crude.

Advantages

- Simpler, lower-cost testing
- Entry-level and detailed measurements with high accuracy and sensitivity
- Results can be used independently or indexed relative to values for other crudes



Southwest Research Institute® is an independent, nonprofit, applied engineering and physical sciences research and development organization using multidisciplinary approaches to problem solving. The Institute occupies 1,200 acres in San Antonio, Texas, and provides nearly two million square feet of laboratories, test facilities, workshops, and offices for more than 2,800 employees who perform contract work for industry and government clients.

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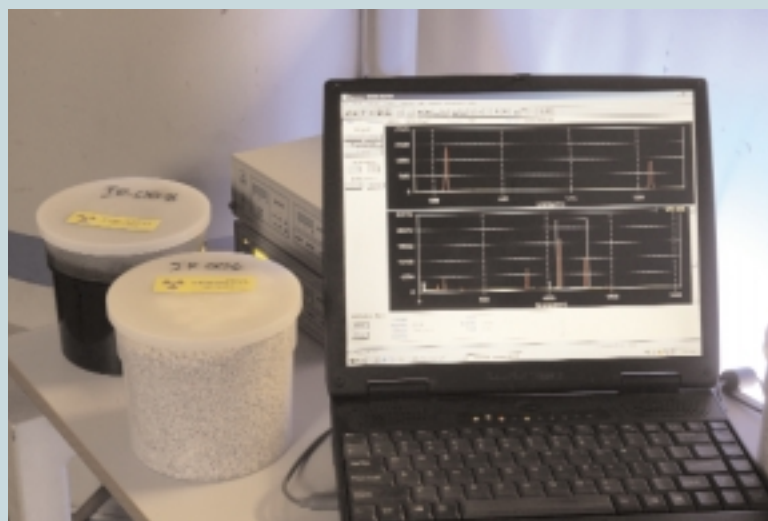
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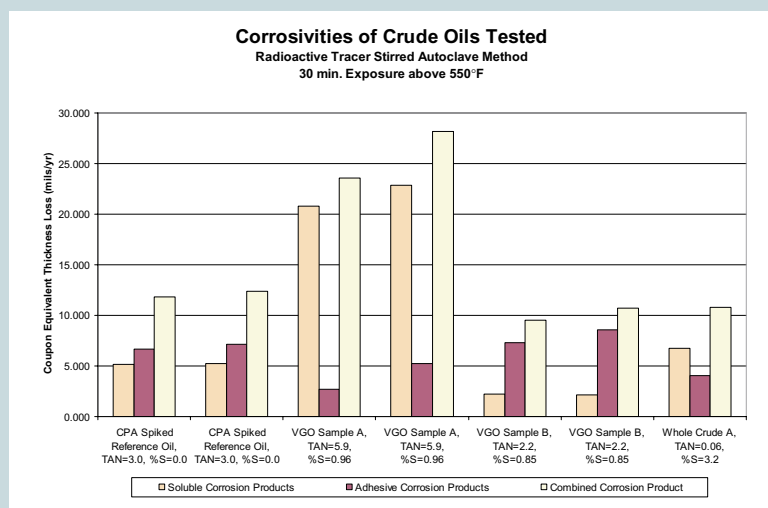
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BENEFITS TO BUYERS, SELLERS AND REFINERS OF CRUDE OILS

- Meaningful corrosion data will offer financial advantages and enable the suitable use of lower-grade, opportunity crudes.
- In addition to absolute corrosion data, relative corrosion can be indexed to the corrosion of known crudes through back-to-back testing or database reference.
- The effect of process variables on corrosion can be evaluated, permitting tracing of the corrosion process from its earliest stages through periods when oil composition and alloy surface conditions vary.
- The mitigating effects of corrosion inhibitors can be measured in the laboratory and monitored in the field to evaluate their efficacy and to implement control strategies for optimal usage.
- The flow loop can be used for erosion studies by monitoring wear particles abrading from irradiated components.



Gamma ray spectrum from corrosion products during post-test analysis



Representative corrosion data from stirred autoclave testing

