Tracerco
Insight through innovation

Using chemical tracers to detect leaks in heat exchangers

Tracerco has been at the forefront of the development of online leak detection for the last 65 years.

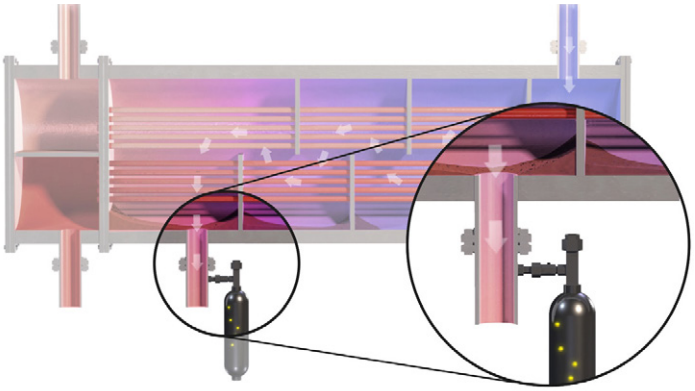
The method allows the detection of leaks as small as 0.5%. However, the demand to measure smaller leaks that affect product quality, has led to extensive research into alternative online methods. Through the development of Tracerco's specialist chemical tracers, they are detectable in samples at concentrations as low as 1 ppb, meaning that extremely small leaks can be detected.

The Field Test

Exchangers A and B were condensing naphtha from a crude distillation column on the shell side, using raw crude as the cooling media on the tube side. Customer laboratory results showed that the naptha was out of colour specification, indicating that there may have been damage to the internals of the crude column, or a leak in an exchanger. A Tru-Scan™ was performed on the crude column, and the results indicated there was no damage to the column internals, or operational issues such as flooding or severe entrainment.

A review of the process showed there was no sample point between exchangers on the naphtha side, so a common sample point downstream of the bank of exchangers was used. However, there was an injection point before each of the two exchangers on the crude side (Figure 1). The first chemical tracer (T105) was injected into the high-pressure crude inlet to the bottom exchanger (A) of the bank of exchangers. This tracer passed through the crude side of the bottom exchanger, and then to the top exchanger (B).

As the tracer was injected into the feed, the first sample cylinder was opened, allowed to fill, and then closed. Additional sample cylinders were opened, filled, and closed at intervals appropriate to the system. After the last sample was collected from the first test, a different chemical tracer (T205) was injected into the crude inlet line between the exchangers. The second chemical tracer passed through the crude side of the top exchanger (B) only. The sample point was the same as for the first test. Sample cylinders were then analysed for tracer presence.



To address the need to find very small leaks, Tracerco carried out an extensive research and development program, looking at the application of specialist chemical tracers. The chemical tracer approach can provide plant personnel new alternatives for investigating plant operating performance, with the goal of reduced diagnostic and shutdown time.

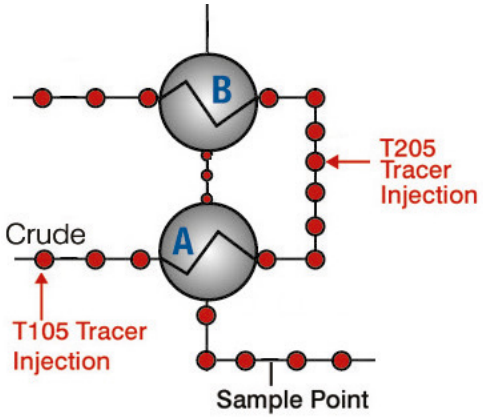


Figure 1 - Exchanger A and B schematic illustrating the two injection points and common sample point used.

The Analysis

Flowrates of the crude and naphtha through the exchangers indicated that the residence time should have been about 2 minutes each. Analysis of the first chemical tracer (T105) appeared in sample A5 with the maximum concentration of tracer seen in sample A6 (Figure 2). The residence times matching these samples was 2.5 and 3 minutes. Since the residence times were not known exactly, these results indicated a leak either near the crude outlet of the bottom exchanger (A), or near the crude inlet of the top exchanger (B).

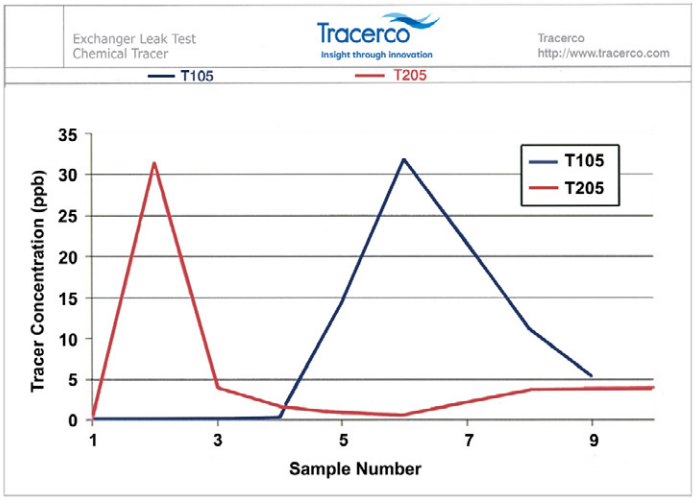


Figure 2 - Tracer analysis data revealed strong positive tracer responses indicating that exchanger B was leaking.

The second tracer (T205), injected into the crude feed to the top exchanger, was detected in samples B2 and B3, with the highest concentration of tracer found in sample B2. Since the analysis only found tracer in the first two samples, the leak appeared to happen near the crude inlet of the top exchanger (B). The test data showed a strong positive tracer response indicating that the top exchanger (B) was indeed leaking. But was the bottom exchanger (A) also leaking? The residence time of the chemical tracer found in the naphtha samples showed that the tracer had likely already passed through the bottom exchanger (A), and was near the entrance to the top exchanger (B). Therefore the conclusion was made that only the top exchanger (B) was leaking. Based on the process rates through these exchangers, the amount of tracer injected, and the amount of tracer in the samples, the leak size was calculated to be approximately 100 ppm (0.01%).

The Conclusion

These exchangers were floating head design, and experience of this exchanger type, when trying to detect small leaks, was found to be very difficult and time-consuming. With the knowledge that the Exchanger B was leaking, the plant was able to shut down, replace the leaking bundle and restart the unit with minimal downtime. After restart, the lab analysis showed the naphtha quality problem had been eliminated. This chemical tracer approach is only offered by Tracerco, and can provide new alternatives to investigate plant operating performance, with the goal of reducing diagnostic and shutdown time, as well as reducing maintenance costs.

Our innovative work gives customers the insights they need to help solve their problems. To learn more, read our case studies at **tracerco.com/downloads/case-studies**

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