

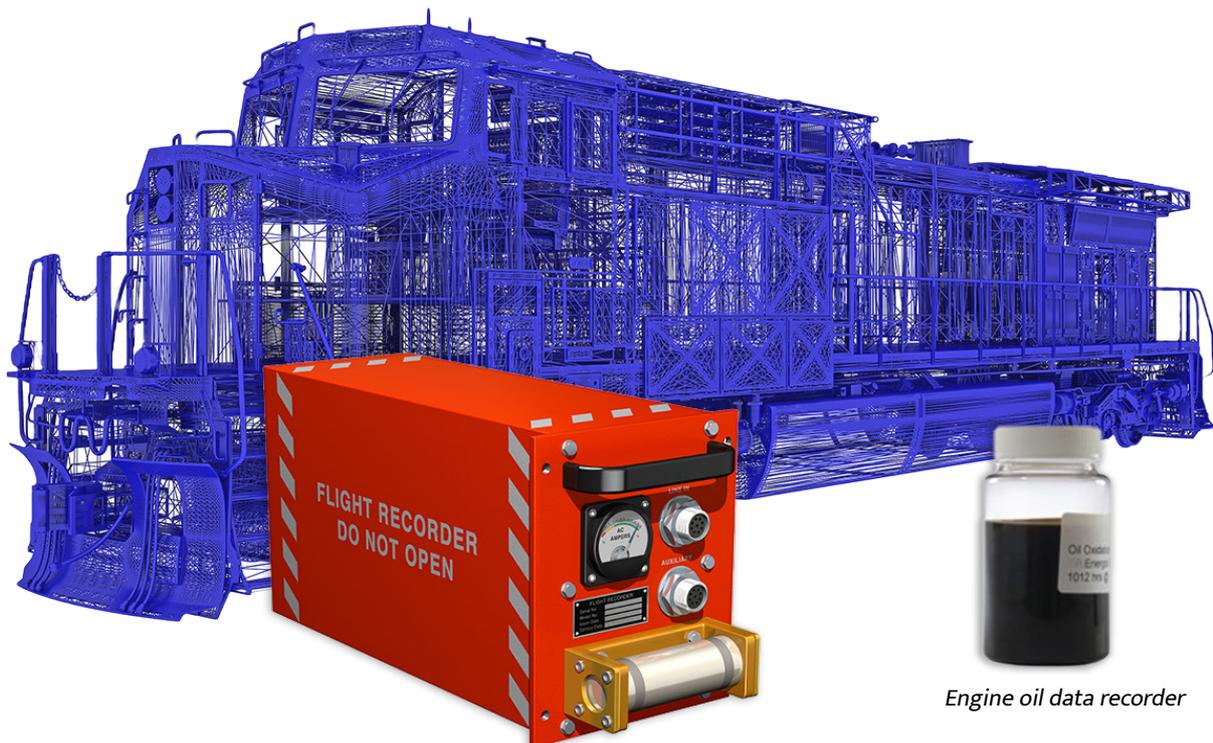
4Atmos Technologies, LLC

Predictive Oil Analytics – Beyond the Lab

Boom!...followed by violent shaking.

On a hot July afternoon, a passenger train was travelling at full throttle with its passenger carriages nearly full. The engineer on the lead locomotive heard the explosion and saw the warning lights and gauges on his console flashing at the same time. He could smell the smoke as the train quickly slowed and stopped on the tracks. The radio call went into dispatch: “We have an emergency.” The engine had experienced a catastrophic

failure on the line of road and all emergency protocols were put in place. A rescue locomotive was sent out, rail traffic on that line was suspended. In the aftermath, it would be discovered that the engine had suffered a complete failure with a large hole in the engine block. There had been no advance warning and the public agency operating the locomotive was forced to pay for a new engine. 4Atmos Technologies was contacted and sent only the previous 6 months’ oil sample sheets from the lab and was asked: “What do you see?”



Engine oil data recorder

Oil is a molecular flight data recorder. When sampled on a regular basis, it provides insight on the locomotive health as well as how the equipment was run operationally. Additionally, outside of the oil itself it can give indications of external factors (e.g. flat spots on wheels, lateral motion). How do we know? For more than 10 years, 4Atmos Technologies has been analysing millions of oil samples. This analysis is performed on data received from the oil labs who processed the samples sent in. So what is different? Rather than looking at individual thresholds, we cluster the elements into groupings that are based on known failure modes (e.g. bearing wear, turbo, crankcase overpressure, fuel leaks, contamination). These failure modes allow us to look at the health of the engine in terms of its overall risk. Our experience has also shown us that most catastrophic failures happen well below critical threshold limits provided by the manufacturers... sometimes 50% lower. Oil is also the 'blood' in the engine system.

When we received the oil histories from the railroad, we could see that there was a trend / pattern / rate of change that pointed us to an inspection back as early as April (three months before the failure). One observation was that the oil lab had reported all the samples as being good and provided no warning or advice of impending failure.

Beyond identifying risks / criticality, the 4Atmos team also provides prescriptive recommendations (with step-by-step instructions including photos where applicable) to help in locating and repairing the deficiency.

The oil labs play a critical role in processing the oil samples collected globally. 4Atmos takes that data and extends the value proposition by comparing those samples against similar fleets, looking for matches to known failure signatures, tracking rates of change and predicting the lead time ahead of a failure. Put in perspective, we're making recommendations based on data that is measured six digits below the decimal point.

Over more than ten years, we've helped our freight and passenger rail customers confirm thousands of 'good catches' and recognise rapid return-on-investment (ROI). One of our customers saw the ROI in only 31 days. IoT solutions don't require big data... they require big



Shattered main bearing

thinking. AI and predictive analytics based on probability and past failures have allowed 4Atmos to develop proprietary processes that create greater long-term value to our customer partners using fewer resources and offer insights to action a long time before alarms go off or vibration can be detected.

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