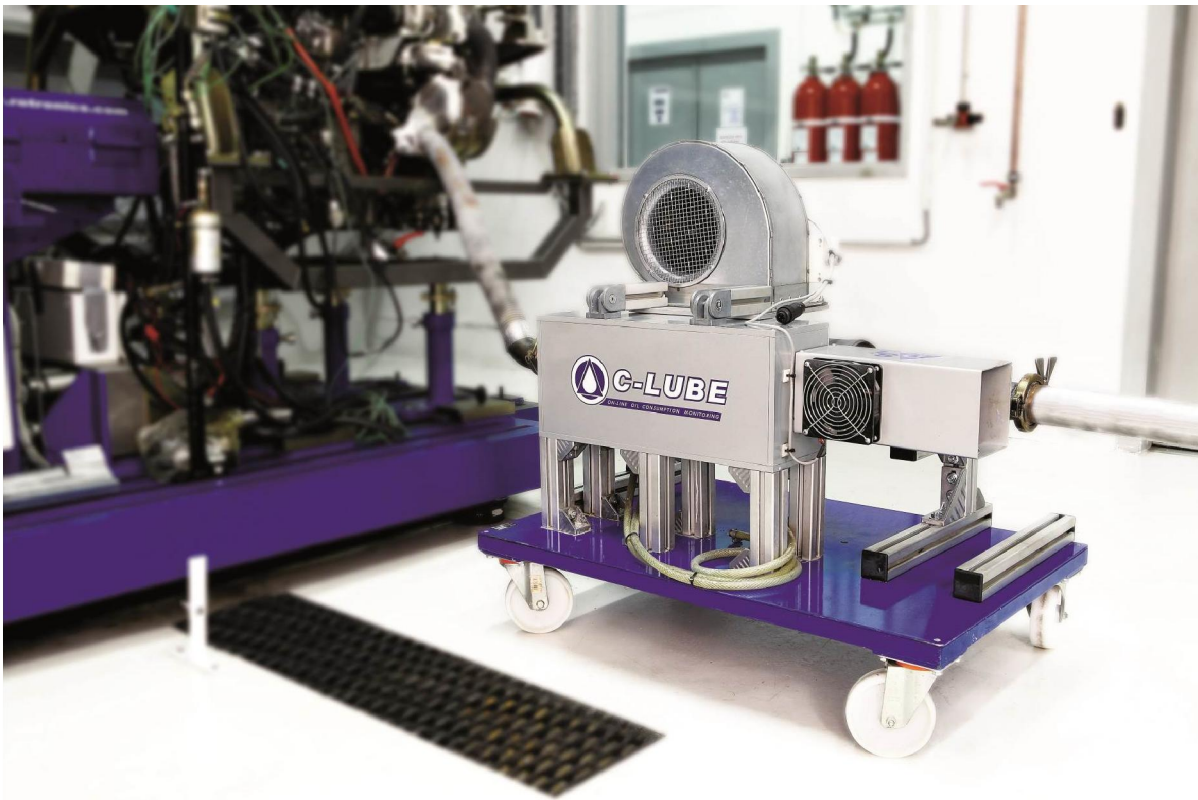




C-LUBE

REAL-TIME OIL CONSUMPTION MEASUREMENT FOR I.C. COMBUSTION ENGINES



TECHNICAL BROCHURE
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A PROVEN METHODOLOGY FOR REAL-TIME OIL CONSUMPTION MEASUREMENT



On-line measurement of oil consumption is of interest, in light of the new environmental regulations imposed on today's high-performance engines.

Lubricant consumption has a negative impact on the environment, but it also reduces the lifetime of post-treatment systems by poisoning catalysts and clogging particle filters.

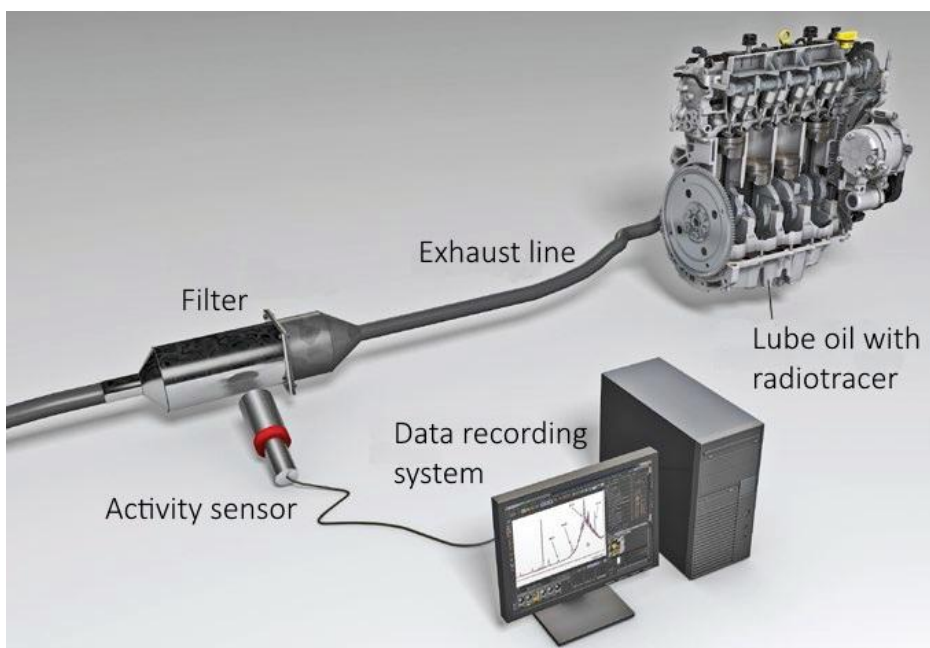
The presented methodology has been developed and patented by DSi Belgium and TOTAL France for monitoring oil consumption on running engines. It is based on lubricant labeling using innovative radiotracer compounds, which are made representative of the distillation interval of the base oil. It offers absolute oil consumption results in grams/hour.

The methodology is dedicated to R&D centers involved with the development of new engines and lubricants.

MEASUREMENT PRINCIPLE

Engine oil is labeled with a radiotracer and a monitoring system is installed in the exhaust line where the marker is efficiently trapped.

During engine operation the tracer is burned proportionally to the lubricant. The measurement consists of monitoring, in real-time, the amount of tracer trapped in the exhaust line. The amplitude of the detected signal is proportional to the oil consumption.



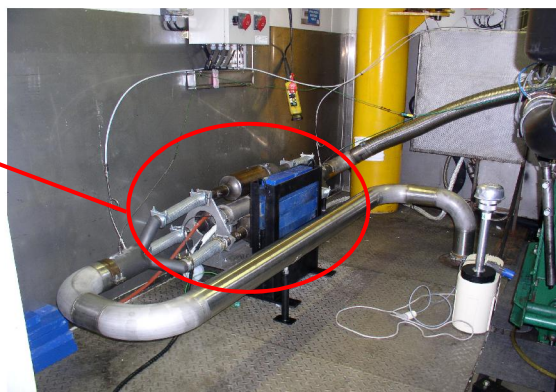
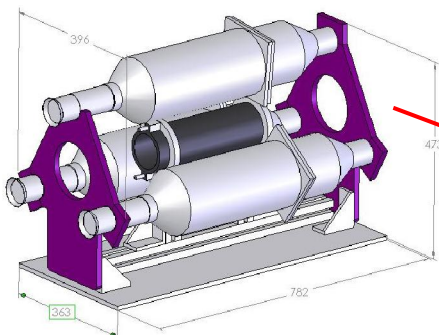
**On-line oil
consumption
measurement using
radiotracers**



The methodology is **reliable, repeatable** and very **sensitive** (mg). It is dedicated to research and development applications.

C-LUBE OFFERS SIGNIFICANT ADVANTAGES OVER OTHER METHODS:

- ▶ **On-line / Real-time results.** A precise measurement of oil consumption for one operating condition is typically acquired in 5 to 15 minutes. Analysis of short transient phases is also possible by increasing the amount of tracer mixed in the oil, or by using repeatable transient data.
- ▶ **Engine oil consumption mapping within 1 day.** A real-time, steady state map is generated within 4-6 hours of engine operation for typical oil consumption rates of 1 to 10 grams/hour.
- ▶ **The method allows the identification of the origin of the engine oil consumption.** A separated lubrication circuit can be used for the turbocharger to determine oil consumption issuing from the turbine and/or the compressor unit. Contribution and efficiency of the blow-by separator can also be measured.
- ▶ **No change in oil properties.** Less than 100 µl of tracer is added to the engine oil pan. The tracer shows no particular chemical reaction with the lubricant.
- ▶ **Representative of oil distillation interval.** Several tracer compounds are available, with various boiling points spread over the oil distillation interval. A single tracer can be used for measuring consumption of a particular oil fraction (light, medium or heavy), or a mixture of tracers can be also be used in order to be representative of the actual oil distillation interval.
- ▶ **No need for low-sulphur fuel.** The use of special fuels is not required.
- ▶ **Measuring equipment is compact and easy to install.** Only a filter (DPF) has to be installed in the exhaust line to trap the tracer. The measuring probe is integrated to the filter and its local data acquisition unit is linked to a remote PC via a USB cable.
- ▶ **The method can be applied on test beds and on vehicles.** Various equipment configurations are available to cover a wide range of engine sizes. A compact system is also available for on-board installation, with local data logger for acquisition during road tests.



Set-up for H.D. diesel engine: a triple filter is installed in the exhaust line. Measuring probe is located at the centre



CONTRIBUTION OF VENTILATION (BLOW-BY) SYSTEMS AND TURBOCHARGERS

The method allows measuring in real-time and independently oil consumption associated to the engine block, the ventilation system, and the turbocharger (compressor stage and/or turbine stage). Special probes are available for small, passenger car, and heavy duty engines.



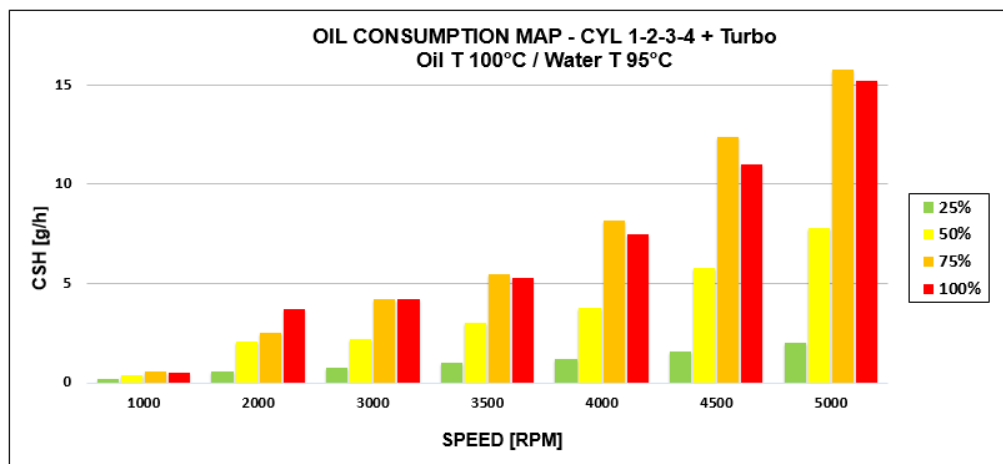
OIL CONSUMPTION FROM BOTH STAGES OF A TURBOCHARGER ARE MONITORED INDEPENDENTLY

Hereunder are typical oil consumption results obtained for a 4 cylinder turbo-diesel engine.

A 28-point oil consumption map was performed within one day, with an average measurement time of 10-15 min. per operating condition, in order to reach 3% accuracy on oil consumption results. Results are expressed in grams/hour with a high sensitivity up to 1 mg/hour.

The example hereunder shows clearly that for the selected engine oil consumption increases with speed and load, but the highest values are obtained at 75% load.

OIL CONSUMPTION MAP ON A 4-CYL TURBO-DIESEL ENGINE





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