

SCANFAP :
**NON DESTRUCTIVE,
3-D MEASUREMENT OF ASH DEPOSITS
IN AFTER TREATMENT SYSTEMS (ATS)**



TECHNICAL BROCHURE

ENVIRONMENTAL APPLICATION IN THE AUTOMOTIVE INDUSTRY : NEW METHODOLOGY FOR MEASUREMENT OF POISONING AND CLOGGING OF AFTER-TREATMENT DEVICES



Lifetime of after-treatment systems (ATS) is influenced by engine oil consumption and by the nature of the lubricant, in particular its additive content.

Long term performance tests on ATS include measurement of accumulated residues (ashes) in the ceramic structure.

DSi has developed a non-destructive radiotracer technique based on labeling of specific elements contained in engine oil (e.g. zinc and calcium). The new method offers on-line measurement of ash deposits in the ATS, and visualization of their distribution along the filter. The new method is extremely sensitive since it can detect extremely low quantities of ashes in the range of 1mg. Therefore, accurate measurements can be performed within very short running times.

MEASUREMENT PRINCIPLE

The new method(*) consists in labelling one or more elements contained in the lubricant, for example zinc, calcium, or phosphorus. During engine tests, a fraction of the lubricant is burned in the combustion chamber and ash residues are transferred through exhaust gases to the ATS where deposits are formed.

A radiation monitoring system is installed close to the ATS. It measures continuously, through the ATS, the radiation emitted by the ashes issuing from combustion of the labelled elements. As the detected signal is proportional to the amount of ashes trapped in the ATS, ash accumulation can be quantified on-line during engine operation.



Ash Deposit Monitoring Equipment

(*) International patent by DSi and Total France

SCANNING SYSTEM FOR 2D–3D MAP OF ASH DEPOSITS IN ATS

A scanning device is also available for 2D/3D measurement of ash distribution in the ATS. The system is used without dismantling the ATS since the radiotracer signal (gamma rays) passes through the casing.



Automatic scanner for measurement of ash
distribution profile in ATS

YOUR BENEFITS:

Compared to the weight measurement method, the new methodology offers significant advantages:

- **On-line results:** ash accumulation in the ATS is measured in real-time during engine operation. Engine parameters can be changed at any time during tests to study their impact on the ATS;
- **Real Operating Conditions:** measurements are performed under real operating conditions of the ATS and the lubricant (i.e. additive concentration in the sump, evaporation of volatile oil fractions, formation of oxides, sulfates, phosphates...);
- **Extremely high sensitivity:** the radiotracing method allows detecting less than 1 mg of ash deposit in the ATS. Such sensitivity allows shortening significantly test durations;
- **Excellent selectivity:** several organic compounds can be labelled simultaneously in the lubricant to evaluate their respective impact on ATS poisoning and clogging. Contribution of each element to ash deposit is evaluated during a unique test.
- **3-D map of ash deposition:** the scanning system measures automatically ash deposit profiles in the ATS;
- **No change in oil properties.** Radiotracers are of the same chemical nature as the lubricant. Therefore, lubricant properties remain unchanged.

- **No need for special fuel**
- **Non Destructive Measurement:** no need to open or to destroy the ATS since the radiotracer signal can be detected through the canning;
- **Measuring equipment is compact and easy to use:** It is easily installed in the test cell, or in a vehicle. The local data acquisition system communicates with a PC via a single USB cable.
- **Available as service measurement:** DSi is also able to offer this radiotracer technology as a service package that includes engine testing services and radiotracing tools.



SAE AWARD !

This new method is the fruit of a cooperative research program between DSi and Total France. The methodology is fully described in SAE paper 2005-01-2178, which received a "SAE Award for Research on Automotive Lubricants". This paper is entitled "An innovative On-Line measurement Method for studying the Impact of Lubricant Formulations on Poisoning and Clogging of After-Treatment Devices."



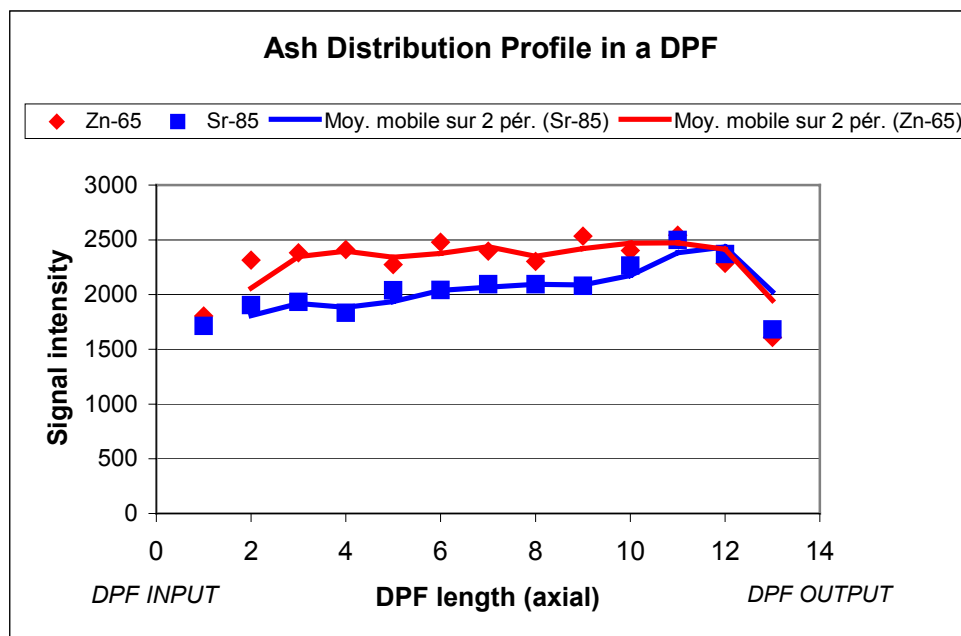
EXAMPLE : ASH DEPOSIT PROFILE IN A DPF

The graph hereunder shows how calcium (red curve) and zinc (blue) have accumulated in a DPF during a 10-hours engine test on a diesel engine operated at max. output power.

These results were obtained using Zn-65 as radiotracer for labelling ZDDP additive, and Sr-85 for labelling organic compounds containing calcium.

These profiles were obtained using the automatic scanner system displayed on page 3.

The same measurement can be repeated with various lubricant formulations. In particular, one can study the impact of mid-ash or low-ash additive packages on the deposit process.



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