CASE STUDY

Monitoring in-service lubricant wear

PHYSICO-CHEMICAL LABORATORY

Case study proposed by Eurailtest
in association with its partner,
the Railway Testing Agency (AEF) at SNCF Mobilités

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A WORLD LEADER IN RAIL TESTING & CONSULTING

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Contents

On rolling stock, a large number of lubricants are used to keep parts working smoothly. These may be greases (bearings, axles, flange lubricators, etc.) or oils (transmission, engine, insulating, etc.), all of which play a major role in extending equipment life cycles and can have vital safety functions (preventing axle breakages or fires in power transformers, for example).

Lubricants are instrumental in preventing wear and rust in contact surfaces, in maintaining air and water-tightness and in evacuating heat and impurities.

Over time, their physical and chemical characteristics will decline. The rate of this wear and tear will depend on operating conditions and stresses (temperature, loads, duration of use, etc.) and will culminate in changes to these characteristics. There are several types of wear:

- ✓ Chemical wear largely caused by oxidation of the hydrocarbons in the lubricant, contact with the air and temperature, resulting in the formation of new compounds such as acids,
- ✓ Physical wear, which may be the result of mechanical loads or occur in the fibre structures of the base oils.

When wear goes beyond a certain stage, lubricants can no longer function correctly, which may reduce their efficiency (increased consumption, etc.) or even create safety hazards, such as broken axles. In such cases, the part concerned must be drained or dismantled and the lubricant replaced.

It is therefore vital to monitor the physical and chemical characteristics of the different lubricants for wear and tear.

Four different types of monitoring have been developed by the Railway Test Agency (AEF), which partners Eurailtest in this field. These may be used to supplement each other and are selected in relation to the particular lubricant. The goal is to make the best possible use of the different oils and greases, containing maintenance intervals and keeping monitoring costs under control.

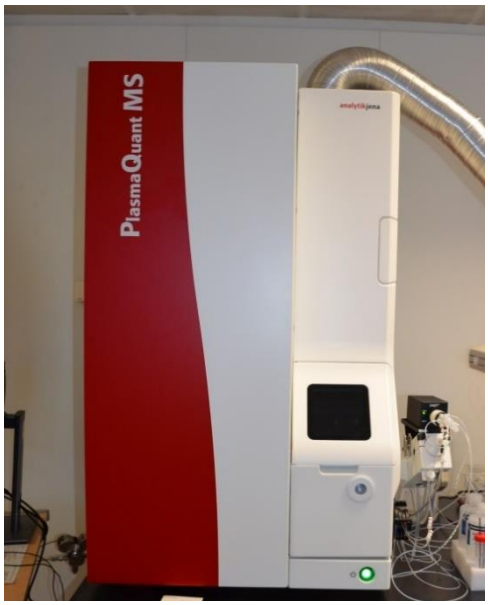
Laboratory monitoring

This takes the form of tests performed in the laboratory to check the physical and chemical characteristics of the lubricants and flag up possible wear. For this, it is necessary either to take samples (oils) or remove parts (greases) while the vehicles concerned are in the maintenance centres, and it may be several days before the findings are available. These operations are therefore costly in maintenance terms.

Sampling needs to be regular scheduled at pre-set maintenance intervals. In addition, oils and greases have a “potential” that is defined in advance and corresponds to a threshold beyond which they will need to be drained and replaced.

Nowadays, this type of monitoring is common practice for oils and greases. AEF has a range of cutting-edge equipment to perform analyses and experts capable of diagnosing the lubricating capacity of each product.

Rheometer



ICp -MS

For more information about the laboratory services offered by AEF, click here

Maintenance centre analyses

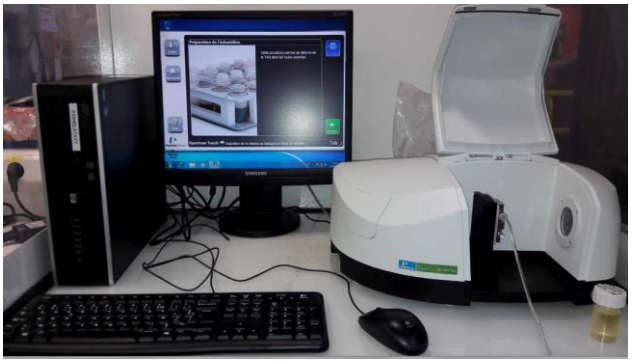
Some analyses can be directly performed in the maintenance centres (wear metals using X-ray fluorescence, acidity using infrared spectrometry, etc.). These methods are developed and deployed by AEF.
Maintenance centres are offered day-to-day support in areas such as:

- Research and application of new analysis techniques;
- Drafting the texts of procedures and setting up calibration operations;
- Producing oils for calibrating and checking purposes

A number of tools and measuring devices have been specifically developed for use in the immediate vicinity of the maintenance chain. This helps to optimise maintenance operations and translates into substantial time savings.

These systems are already widely used in several of the SNCF Mobilités TGV maintenance centres and in maintenance centres abroad.

X-ray fluorescence



Infrared spectrometry

On-line monitoring

This consists of **remote diagnostics** of lubricant characteristics via on-board sensors. With this technique, it is possible to monitor wear and tear “continuously” and thereby avoid sending vehicles unnecessarily to the maintenance sheds.

AEF is at present working on plans to develop a system of this type to monitor the condition of lubricating oils. The aim is to remote-measure a certain number of parameters in real time, these including factors such as volumes, quantities of water, viscosity, temperature, etc.

The main difficulty is that of finding sensors that can analyse the required characteristics on-line.
For the moment, there are no plans to use this technique for greases, given their specific characteristics and their lack of accessibility.

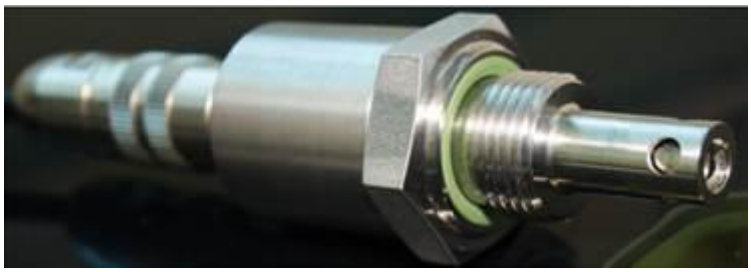


Photo: sensor

Monitoring using modelling techniques

This type of monitoring is based on the principle of modelling wear and tear in lubricants in relation to the loads to which they are exposed. Changes in specific physical and chemical characteristics are modelled applying knowledge available about the main contributing factors (temperature, loads, etc.). By predicting how these characteristics will evolve, it is possible to schedule maintenance operations well in advance and ascertain lubricant potential in relation to use.

AEF is currently working on a project for developing a model to simulate wear in axle greases. For this, it is necessary to have a broad array of data on how each particular part operates, and the various stages of the wear process in greases in order to create a reliable model. Data collection is always the main hurdle to be overcome when developing models of this type.

Monitoring method	Grease	Oil
Laboratory monitoring	Standard practice	Standard practice
Maintenance centre analyses	Not yet developed	Standard practice
On-line (telediagnostics)	Not applicable in the coming years	Under development. Target: rollout in 1 or 2 years
Modelling	Under development. Target: > 3 years	To be developed

Examples of lubricants found on trains:

- Greases: wheel flanges, bogies, axles, coupling screws, Scharfenberg couplers, buffers, transmission tripods, etc.
- Oils: TGV transmission, engine, insulating, brake rigging,

Wheel-rail contact: Wheel flange grease

Axle box grease

ABOUT EURAILTEST

Eurailtest is one of the world's leading railway test agencies. It is an independent group **based in Paris**, which works in close association with certification authorities recognised **worldwide**.

Eurailtest is in charge of coordinating the activities of a **dozen laboratories**, each of which can boast many years of experience in the heavy and light rail sectors in its particular specialist field.

For over **80 years**, our laboratories have been performing tests on different technical solutions geared towards ensuring the highest possible standards of safety and reliability. Together these laboratories offer you access to the skills and competencies of over **400 expert railway test** engineers and technicians.

Today, Eurailtest offers a **gateway to this know-how and experience**. From high speeds to urban light rail, we are able to offer more than one hundred tests and other expert services covering all rail industry sectors.

RAILWAY TEST AGENCY (AEF)

The Railway Test Agency (SNCF – AEF) is located close to Paris and extends over 3.75 hectares at Vitry sur Seine. It is here that the scientific and technical skills required to perform tests or expert appraisals on rolling stock can be found.

The laboratory represents the culmination of an odyssey, which started in 1933 with the inauguration of the "locomotive test rig" and then became the Vitry test centre and, subsequently, AEF in 1999.

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