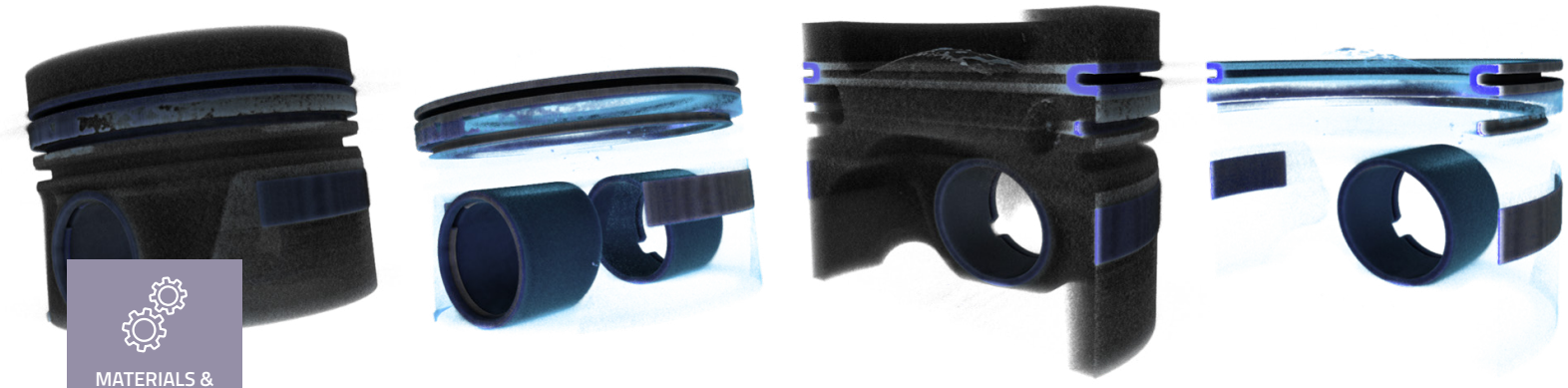

MATERIALS & COMPONENTS

EXPLORING ENGINE COMPONENTS TO DEVELOP MORE DURABLE, FUEL-EFFICIENT LUBRICANTS

Infineum UK Ltd and Finden Ltd, in collaboration, have taken advantage of ISIS Neutron and Muon Source to better understand organic deposits from lubricants in engine components.

THE CHALLENGE

Engine components can over time develop 'coke formations' which can lead to increases in temperature causing cracking of components, blockages and engine failure. Coked components have poorer thermal conductivity, can reduce efficiency and the lifespan of engine components through increased wear, so lubricants not only act to reduce friction of such components but also play a key role in engine thermal management and cleanliness.

Both visual and X-ray imaging are often used to assess the performance of lubricating oils during engine testing and studying 'carbon deposits' which are the natural by-product of burning gasoline in gasoline engines. Although there are challenges regarding both of these methods, visual assessment can often mean vital information can be missed. In small objects, X-ray imaging is available to achieve the correct contrast between the low-density material and high-density substrate, but the large scale of engine components means that X-rays are strongly absorbed and inner surface deposits are often obscured. Assessing internal deposits are currently left to destructive methods, as often the component must be cut open and damaged therefore preventing continued use.

THE EXPERIMENT

A team of scientists from Infineum and Finden conducted this project at the ISIS Neutron and Muon Source, which operates a neutron imaging instrument for a broad range of material sciences. The high penetration of neutrons allowed for the lighter carbonaceous deposits found in large engine components to be clearly imaged on both external and internal surfaces. The deposits could also be quantified, in terms of: thickness, volume and areas covered. The facilities at STFC solved the challenges their industry faced with other methods of assessments, including visual and X-ray imaging.

THE RESULTS

By accessing STFC facilities, Infineum and Finden can now quantify where and when coking occurs within engines. The same component can be reviewed before, during and after an engine test therefore identifying how this is affected by different conditions and lubricants. STFC's unique facilities and expertise supported this project and the better understanding of this challenge will help develop more durable, fuel efficient lubricants.

> "Accessing STFC's Neutron and Muon Source, allowed us to overcome a significant challenge within our industry. We were unaware of the benefits of neutrons before STFC engaged with us. Without the unique facilities and expertise provided by STFC the completion of this project would not have been possible. After this project we are now working closer with STFC and look forward to any further possibilities of collaborating again."
>
> **Steve Price**
> Finden Ltd.

INDUSTRIAL APPLICATIONS OF NEUTRON SCIENCE

LENS LEAGUE OF ADVANCED EUROPEAN NEUTRON SOURCES

For decades, European neutron facilities have established productive collaborations with a diverse range of industrial users. Such partnerships have delivered important results for industry, providing insights into materials and methods that have driven process optimisations and technological innovations.

WHY USE NEUTRONS?

STUDY STRUCTURE

Neutron wavelengths are are comparable to the spacings of atoms and molecules.

STUDY DYNAMICS

Neutron energies are comparable to the time scales of molecular diffusion, vibrations and rotations.

STUDY MAGNETISM

The neutron's magnetic moment can be used to study the microscopic magnetic properties of materials.

PENETRATION POWER

Neutrons can penetrate deep into matter (including many different metals) enabling the study of large samples - even within complex sample environments.

NON-DESTRUCTIVE

As a non-destructive, non-invasive probe, neutrons are suitable for the characterisation of delicate and precious samples.

VERSATILE SAMPLE ENVIRONMENTS

Sophisticated sample environments enable measurements under operating conditions - including extreme temperatures, pressures, etc.

SENSITIVITY TO LIGHT ELEMENTS

The neutron scattering power of nuclei varies in a quasi-random manner such that lighter atoms (e.g. H, Li) can be studied in the presence of heavier ones.

ISOTOPIC CONTRAST

Neutrons are sensitive to different isotopes of the same element, so isotopic substitution (e.g. H/D) can be used to highlight specific structural features.

COMPLEMENTARITY

Neutron scattering is highly complementary to other techniques, such as X-ray scattering, electron microscopy, magnetic resonance and computational methods.

HOW CAN INDUSTRY USERS GET ACCESS TO NEUTRON FACILITIES?

European neutron facilities provide industrial users with access to advanced instrumentation for R&D. No prior experience is needed – expert scientific and technical staff provide support for users to get the most from their experiments.

Neutron facilities offer a variety of mechanisms to access their infrastructure, including proprietary access, academic partnerships and public beamtime.

For more information, email contact@lens-initiative.org