MATERIALS & COMPONENTS

COMPOSITION OF STAINLESS STEEL BOLTS ASSESSED USING NEUTRONS

Bumax is a Swedish manufacturer of premium-brand high strength stainless steel fasteners, designed for extreme environments. A number of different materials are used to produce A4-grade stainless steel, including Bumax-88.

THE CHALLENGE

Bumax was looking to enhance its quality assurance programme with extremely precise measurement techniques that could be used to benchmark their methods for assessing the elemental composition of the raw materials required for the manufacture of Bumax-88.

THE EXPERIMENT

Bumax was advised on the advantages of Neutron Activation Analysis (NAA), which is a technique that uses nuclear processes to determine multi-element concentrations.

THE RESULTS

The concentrations of manganese, nickel, molybdenum, cobalt and copper could be quickly determined for each sample. Measurements revealed that the composition of Bumax-88 is significantly different from the standard material A4-grade material tested for comparison.

> The analysis performed by the people at Delft is really great and shows that Neutron Activation Analysis technology can help us with particularly precise characterisation of our products.

Camille Feuillet
Field Application Engineer, BUMAX France

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Fig 1. Encapsulation of the sample before packaging in an irradiation container. The container is positioned close to the nuclear reactor core via a pneumatic tube system.

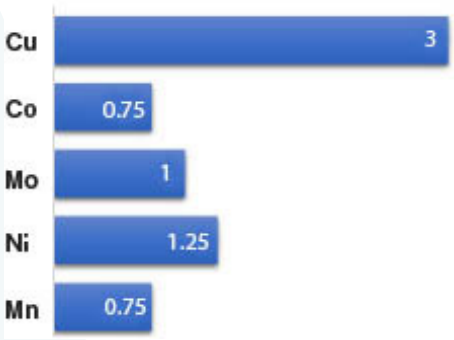

Fig 2. Total Uncertainty of Neutron Activation Analysis for concentration measurements in A4-grade stainless steel, [1 standard deviation in %].

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 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