ACCURATE AND PRECISE QUALITY CONTROL FOR LUBRICANTS AND FUELS BY EDXRF

GET ALL INFORMATION YOU NEED FOR FUELS AND OILS – ELEMENTAL ANALYSIS WITH EDXRF

To guarantee optimal engine and machine performance while maintaining the best-possible protection of our environment, today's fuels and lubricants are real high-tech blends. When producing, using, and recycling these substances it is important to have a clear and precise understanding of the content and composition of accompanying elements and additive metals. X-ray fluorescence (XRF) analysis is the ideal method to accomplish this: With this technique, an elemental analysis can be conducted quickly and precisely. This ensures that additives are used economically, the properties of lubricants and fuels are guaranteed, and that our environment is protected.

The range of uses for XRF in elemental analysis in the field of petrochemicals is very broad, ranging through the entire product life cycle of lubricants and fuels. For example, sulfur can be found in crude oil in amounts of up to five mass percent and above, but in lubricating oils only variable proportions ranging from the upper ppm range to percent are permitted, and in automobile fuels only a few ppm. In order to quickly and reliably determine the quality and quantity of the constituents in such blends, Bruker developed the S2 PUMA (see Figure 1): An energy-dispersive X-ray spectrometer (EDXRF) in the form of an easy-to-operate, bench-top device, which can be ideally configured for the kind of analyses that are typical in the petrochemical industry. Thanks to its user-friendly TouchControl™ with intuitive user interface, users without any special training can perform precise analysis.

Sulfur measurements with excellent precision and compliance to ASTM D4294

Instrument specifications and parameters for sulfur analysis in the petrochemical industry are specified in norms such as ASTM D4294, EN ISO 20847 (DIN), and EN ISO 8754 (DIN). The instrument easily satisfies the requirements of these sulfur norms with an excellent precision and accuracy.

Additives in lubricants –Norm compliance for Mg, P, S, Cl, Ca, Zn, and Mo

Sulfur isn't the only element that plays a central role in lubricants and fuels. That is why the S2 PUMA is also capable of determining the quality and quantity of additives used in the refinement of lubricants. These additives, such as abrasion minimizers or pitting protection additives, are added to lubricating oils in small quantities in order to achieve or improve certain properties. Due to their complex formulations, these special chemicals can sometimes be very expensive, so the quantities added are decisive for the quality, efficiency, but also the environmental friendliness of the product.

In addition to the norm ASTM D6481 now also ASTM D7751 is applied for these measurements. This norm takes into account the important additive elements magnesium, phosphorus, sulfur, chlorine, calcium, zinc, and molybdenum in concentration ranges typical for their use in lubricants. Table 1 gives typical repeatability and accuracy data of 10 measurements of QC sample for additives in lubricants.

The instrument meets all requirements of ASTM D7751 and D6481 on the analysis of additives. Calibration over a wide range of concentrations, the low detection limit, the small standard deviation, and very good accuracy make the S2 PUMA the ideal partner when it comes to the analysis of oil additives. The instrument can also be used to examine used oils. Here the amounts of heavy metals, halogens, etc. contained determine the type of recycling or disposal.

No matter which lubricating oil you need to specify: The S2 PUMA delivers spot-on ASTM compliance for D6481, D7751 and other.

	Mg [%]	P [%]	S [%]	Cl [%]	Ca [%]	Zn [%]	Mo [%]
Mean value of 10 replicates	0.102	0.113	0.515	0.024	0.203	0.124	0.010
Abs. standard deviation	0.0030	0.0004	0.0018	0.0005	0.0009	0.0005	0.0001
Rel. standard deviation	3.4 %	0.5 %	0.4 %	2.1 %	0.5 %	0.5 %	0.7 %
Certified value	0.100	0.110	0.500	0.025	0.200	0.120	0.010

Table 1: Repeatability and accuracy data of 10 measurements of a QC sample for additives in lubricants according to ASTM D7751

Figure 1: Energy-dispersive X-ray spectrometer (EDXRF) S2 PUMA

Figure 3: S2 PUMA XY Autochanger with 20 position sample tray

Technological innovations as key to best results and reliable evaluation

The S2 PUMA provides you with top-notch elemental analysis in a compact device: With its optimized optical construction with 50 Watt X-ray tube and silicon-drift detector (SDD), the HighSense™ technology developed by Bruker offers high count rates and excellent repeatability which guarantees the best in analysis results. The optional use of the XFlash LE detector ensures high transmission rates due to its ultra-thin entry window to quantify light elements and increases the instrument's capabilities even more. The S2 PUMA is eminently suitable for elemental analysis when examining engine and machinery lubricants as well as fuels. The analyzer works cost-effective and quick, but still offers a high degree of sensitivity and precision. It is just as possible to precisely analyze important additive elements such as calcium, zinc, phosphorus, and molybdenum as it is to analyze other additive and trace elements like magnesium, potassium, silicon, sulfur, or barium. Even the main indicator elements for abrasion conditions, such as iron, copper, and lead, can be determined with the same high level of precision.

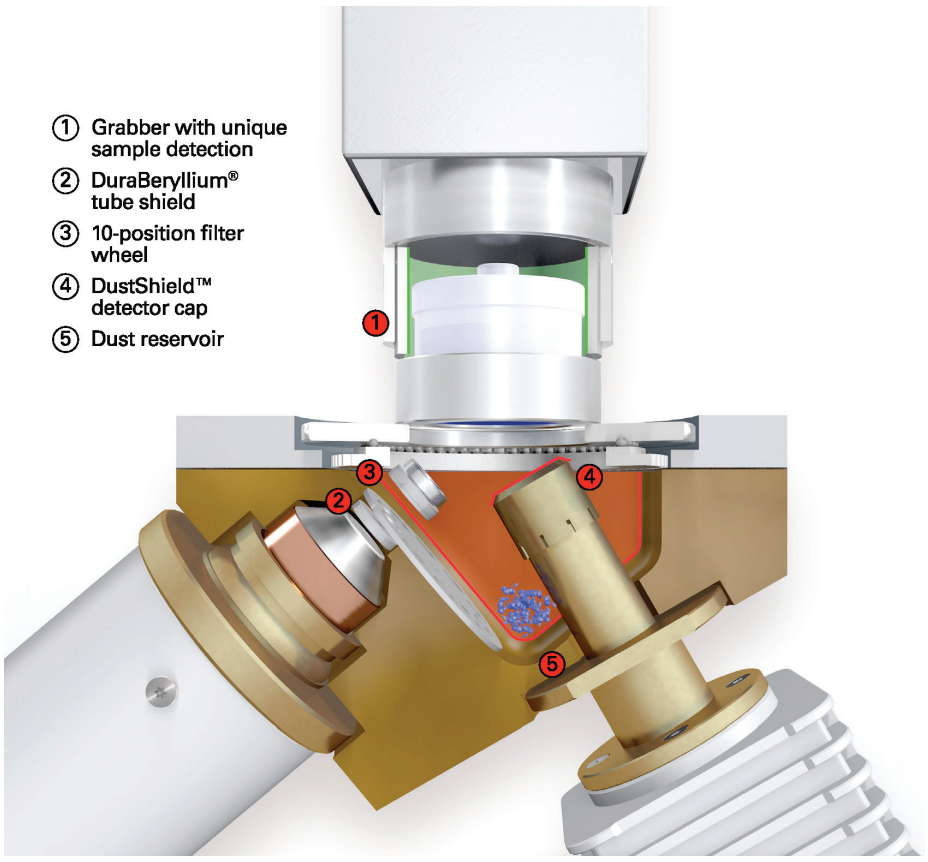

Figure 2: S2 PUMA measurement chamber with SampleCare™: Unique protection against contamination of important system components ensures the best in device availability. The detector cap provides the detector with additional protection against dust and liquids.

With the analysis of light elements in particular, their low-energy radiation is absorbed by the surrounding air. Consequently, such measurements are carried out in a helium atmosphere or under vacuum. Since such vacuum analyses may not be conducted with highly volatile samples, such as fuels, it pays off that the S2 PUMA XY Autochanger automatically detects these samples when loaded and prevents the formation of a vacuum (see Figure 2). A sample-chamber that is reduced to the smallest possible dimensions translates into minimal consumption of helium, which means very low operating costs but high analytical capability.

The instrument is frequently used in the petrochemical industry in the following areas:

- Sulfur analysis in fuels such as car or ship diesel (ASTM D4294, EN ISO 20847 (DIN), EN ISO 8754 (DIN))
- Verification of additives in lubricants, particularly Ca, Zn, P, and Mg (ASTM D6481, ASTM D7751)
- Metal abrasion analysis (e.g. Fe, Cu, Pb) in lubricating oils
- Monitoring of bio-fuel production, for example through P or Fe measurements

EDXRF together with the S2 PUMA provides you with everything you need for monitoring and optimizing lubricants and fuels:

- Unmatched detection limits, precision, and speed with HighSense™ technology
- With TouchControl™ any user can quickly and efficiently perform measurements – in 9 user languages
- Helium mode for best analytical performance of volatile samples
- S2 PUMA XY Autochanger allows to add new samples at any time to a measurement sequence
- The XY grabber ensures a failsafe recognition of liquid cups
- The SampleCare™ technology protects important system components against contamination and ensures a high system up-time with no maintenance effort

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