

Analysis of Marine Fuels & Oils, Sulfur, Cat Fines and Condition Monitoring

Meet regulations and save money.



SPECTRO Analytical Instruments offers unique analysis and monitoring solutions for onboard, on-line and laboratory elemental analysis of bunker fuels and lubrication oils, meeting the most demanding testing requirements.



Meeting government regulations, minimizing operational costs and maximizing profits are all key aspects of the fuel industries of today. As a result of MARPOL Annex VI, SECAs (SOx Emission Control Areas) have been put in place in Baltic and North Sea. In an effort to reduce pollution in ports and coastal waters, regions around the world are also beginning to limit the maximum allowable sulfur levels in marine bunker fuels.

Avoiding engine failure at sea is also of great importance. By monitoring cat fines in marine fuel and metals present in engine oil, engine failure can be avoided, lowering costs and ensuring a high degree of safety.

The residual fuel oil remaining after distillation of crude oil is mainly used as fuel for the larger two stroke engines. The main applications for these large two stroke engines are marine vessels, and to a lesser extent power plants, therefore the residual fuel oil is also known as marine or bunker fuel. The consumption of bunker fuel for a larger container ship can be up to 200 tons/day. The buying and selling of marine fuels has to be according to marine fuel specifications, which includes elemental composition, especially sulfur. Thus, cost justification for monitoring marine fuels and oils is gained in meeting regulatory requirements and maximizing engine performance.

The elements of interest to be monitored in marine fuels are:

- **Sulfur** originates from the crude oil and is the main trace element (1-5%). New legislation requires the use of low sulfur fuels in environmentally sensitive areas. Monitoring the sulfur content of bunker fuel provides an added assurance of compliance.
- **Silicon and aluminum** — called the cat fines — originate from the refinery catalysts, and these particles can cause severe cylinder wall damage when present at larger concentrations.
- **Vanadium, nickel and iron** are present at trace levels in crude oil. The distillation process enriches these elements.
- **Calcium, zinc and phosphorus** are normally not present in fuels, but are indicators for the fraudulent mixing of used lubrication oil in the bunker fuels.
- Unusually high levels of **Na, Cl, Mg, and K** can be indicators for sea water contamination, mainly resulting from overseas transport of the crude oil.

The elements of interest to be monitored in lube oils are:

- Monitoring the **calcium, zinc and phosphorus** content reveals information pertaining to additive depletion in service or a possible charging of the system with the wrong oil
- Monitoring the levels of **Fe, Cr, Ni, Cu, Zn, Pb** and other wear elements can be important factors in identifying sources of engine wear and preventing engine failure.



Legislation Description

2005/33/EC amending Directive 1999/32/EC as regards the sulfur content of marine fuels
MARPOL Annex VI Regulations for the prevention of air pollution from ships

Product Specifications

ISO 8217 Petroleum Products - Fuels (class F) - Specifications for marine fuels

Standard Test Methods

ISO 8754 Petroleum Products - Determination of Sulfur content -
Energy-dispersive X-ray fluorescence method

ISO 10478 Petroleum Products - Determination of Aluminum and Silicon content -
Inductively coupled plasma emission and atomic absorption
spectroscopy methods

IP 501 Determination of Aluminum, Silicon, Vanadium, Nickel, Iron, Sodium,
Calcium, Zinc and Phosphorus in residual fuel oil by ashing, fusion and
inductively coupled plasma emission spectrometry

ASTM D5184 Standard Test Methods for Determination of Aluminum and Silicon in
Fuel Oils by Ashing, Fusion, Inductively Coupled Plasma Atomic Emission
Spectrometry, and Atomic Absorption Spectrometry

XRF and ICP-OES spectrometers from SPECTRO can help ensure the fuel and lubrication quality according to specifications. Sulfur content can be monitored on-site, when bunkering the fuel or in the lab. XRF analysis can monitor most of the requested elements in marine fuel and lubes. Additionally the engine oil can be checked on site for its wear content to allow an immediate reaction in case of increased wear.

ICP-OES is used in the lab for many applications as a reference and quality assurance technique.

	S	V	Al & Si	P	Ca	Zn
SPECTRO iQII	●	●	●	●	●	●
SPECTRO GENESIS	●	●	●	●	●	●
SPECTRO ARCOS	●	●	●	●	●	●

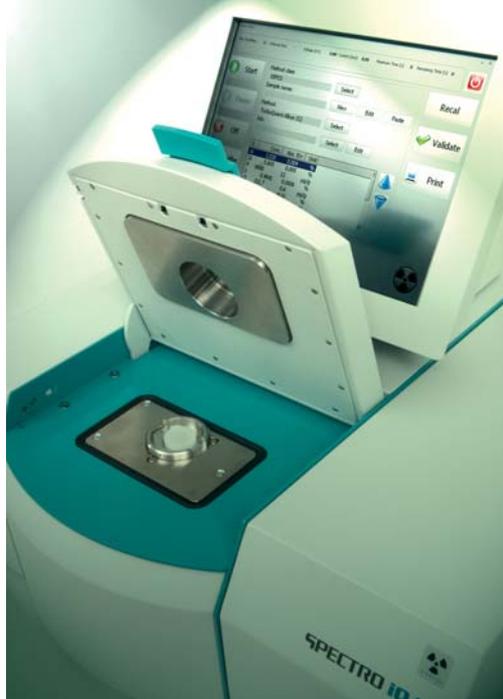
● possible at required levels

● possible, test method available



ED-XRF – Energy-dispersive X-ray Fluorescence

Energy-dispersive X-ray fluorescence technology (ED-XRF) provides one of the simplest, most accurate and most economic analytical methods for the determination of the elemental composition of many types of materials. It is non-destructive and reliable, requires no or very little sample preparation and is suitable for solid, liquid and powder samples. It can be used for a wide range of elements, provides detection limits in the sub-ppm level and can also measure concentrations of up to 100 % easily and simultaneously. ED-XRF onboard a ship can be employed to analyze fuels and used lubrication oil for condition monitoring of the engine. It also can ensure quality assurance when blending lubricants onboard.



SPECTRO iQ II

At-line or in the Laboratory, Advanced Performance ED-XRF Spectrometer

The SPECTRO iQ II employs proprietary optic and detector technology yielding excellent performance, especially for light elements like sulfur, aluminum and silicon that rivals the much more expensive wavelength-dispersive X-ray fluorescence spectrometers.

The SPECTRO iQ II features a combination of low power X-ray tube and advanced C-Force polarization optical system. It is ideal for analyzing and qualifying petrochemical products. Its detection limit for sulfur in fuels is less than 1 ppm, meeting the requirements for product control and product release analysis. For the analysis of cat fines and traces of used lubrication oil in marine fuels the analyzer is well suited. The same applies for condition monitoring and onboard blending. The instrument can be controlled with either a touch screen or standard monitor and keyboard. All important functions for routine analysis are displayed on one screen, making operation uncomplicated and intuitive.

For more information about SPECTRO iQ II, including a detailed brochure, please visit www.spectro.com.

SPECTRO iQ II

- Monitor S, V, Ni, Fe and cat fines in marine fuel
- Identify contamination of used lubrication oil in marine fuel
- Determine wear metals and additives in lube and engine oils for condition monitoring and onboard blending





SPECTRO GENESIS

- A powerful alternative to conventional sequential ICP spectrometers
- Factory calibrated, norm-conforming method for lubricating oils
- Excellent price-performance ratio

SPECTRO ARCOS

- New ICP Performance class for complex matrices and analytical tasks
- Extended spectral range from 130-770 nm for perfect line selection
- Low Maintenance UV system with minimal operating cost
- Analysis of Halogens



Versatile ICP spectrometers for routine petrochemical applications as well as demanding requirements.

The SPECTRO GENESIS offers a real economic alternative to sequential ICP. Leading CCD ICP technology, a powerful generator and its user friendliness make the low cost SPECTRO GENESIS the ideal analytical instrument for the elemental analysis of crude and heavy fuel oils, fresh and used lubricating oils, gas or fuel oils. Since the technique offers particular sensitivity for the light elements, ICP-OES closes the gap where in addition to the metals and non metals low level detection of alkali elements is required.

The SPECTRO ARCOS is different from conventional ICP spectrometers. With its proven optical system it offers unbeatable performance and stability. It delivers a matchless resolution of 8.5 picometer in the important wavelength range between 130 and 340 nm. An extremely robust, high power, free-running generator makes the SPECTRO ARCOS perfectly suited for any kind of organic liquid, including samples with higher volatility. The low maintenance and economical UV-Plus system delivers high VUV transparency down to 130 nm, enabling the analysis of halogens in petroleum products. An extensive package of accessories is available for the SPECTRO ICP spectrometers to further expand their application range. This includes a wide range of sample introduction systems as well as autosamplers, and dilutors for fully automated sample analyses.

For more information about SPECTRO GENESIS and SPECTRO ARCOS, including detailed brochures, please visit www.spectro.com.

ICP-OES

Over the last 30 years, Optical Emission Spectrometers with Inductively Coupled Plasma (ICP-OES) excitation sources have become an indispensable tool for elemental analysis. Their ease of use, high sensitivity and precision, plus relative freedom from interferences have made ICP-OES systems the analytical method of choice for the analysis of petroleum products.

SPECTRO GENESIS & SPECTRO ARCOS



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