

# Elemental Analysis of Biofuels with SPECTRO XRF and ICP Spectrometers



*With a complete range of Energy Dispersive X-ray Fluorescence (ED-XRF) and Inductively Coupled Plasma Optical Emission (ICP-OES) Spectrometers, SPECTRO's unique solutions for at-line and laboratory elemental analysis are capable of meeting the most demanding product specification testing requirements.*

# Biofuels today and tomorrow

To keep pace with the rapidly emerging developments of new biofuels, including second generation bio-materials, one of the key industry challenges is to ensure customer confidence in consistent quality of low sulfur biofuels using advanced, precise, easy to use analytical technology. This ensures extender product or finished blends meet the exacting new ASTM and EN biofuel specifications. This technology allows the industry to measure at sub 10-15 ppm levels of sulfur in biofuels to guarantee meeting federal government agency requirements, but also minimizing and measuring at trace ppm levels, metal elements such as Cu, Ca, Mg, Na, K, and P, to ensure that these biofuels of 'today and the future', maintain engine emission optimization, as well as providing trouble free motoring.

Demand for automotive fuels is increasing at a rapid pace, illustrated by the fact that in 1990 there were around one million cars in China, by 2004 that number had risen twelve times and in 2005 alone a further 2.4 million new cars and fuel consumers were added to China's roads. This is a trend which is repeated in many other developing countries, placing even greater strains on the goal for the downstream oil industry to reduce emissions of greenhouse gases. When considering the future of fuels one must not overlook the fact that Government and industry bodies worldwide are firmly predicting that oil and refined oil products will continue to form the major global source of fuels for the next 30 years or more. Renewable and other fuels are set to play a growing role during this period. By far the biggest area of biofuel developments have been for road transport for both gasoline and diesel power technology. The use of sugars and other plant materials to manufacture alcohols as 100 % fuels or as extenders to produce bio-gasoline has been around for years and actively applied in countries like Brazil and more recently Sweden.

Like ethanol production, the fast development of bio-materials suitable for diesel engine combustion has rapidly taken off, where the two main approaches have been the use of 100% vegetable oil material, in some cases, recycled cooking oils, to the more suitable derived ester oil materials that again can be used at 100%, but are generally blend back into conventional diesel fuels at 5-10 or 20% levels. The demand for continued use and increasing the levels of ethanol used in fuels is being pursued by many government agencies worldwide and it is expected that in the next 5-10 years the alcohol demand for road transport fuels will rise dramatically. Ethanol is now being made, in many cases, to regional federal specifications, which cover a broad range of physical and chemical properties to ensure consistent quality, with minimal risk of harmful trace contaminants. Therefore providing a finished quality fuel which can safely be run in advanced engine technologies without causing any detrimental effects on fuel injection (deposits) and engine/emissions management systems is of paramount importance.



	Na	Mg	P	S	Cl	K	Ca	Cu	Pb
SPECTRO iQ II			●	●	●	(●)	(●)		(●)
SPECTRO GENESIS	●	●	●	●		●	●	●	●
SPECTRO ARCOS	●	●	●	●	(●)	●	●	●	●

● analysis possible at required levels  
 ● analysis possible, test method available  
 (●) screening possible at required levels

For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org).  
 For referenced CEN standards, visit the CEN website, [www.cen.eu/cenorm](http://www.cen.eu/cenorm).  
 For referenced ISO standards, visit the ISO website, [www.iso.org](http://www.iso.org).  
 For referenced IP standards, visit the energy institute website, [www.energyinst.org.uk](http://www.energyinst.org.uk)

Legislation	Description
2003/30/EC	Directive of the European parliament and of the council of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport
2004/17/EC	Council Directive relating to the quality of petrol and diesel fuels
USA	US Energy Policy Act of 2005
<b>Product Specifications</b>	
ASTM D4806	Standard Specification for Denatured Fuel Ethanol for Blending with Gasolines for Use as Automotive Spark-Ignition Engine Fuel
ASTM D5797	Standard Specification for Fuel Methanol (M70-M85) for Automotive Spark-Ignition Engines
ASTM D5798	Standard Specification for Fuel Ethanol (Ed75-Ed85) for Automotive Spark-Ignition Engines
ASTM D6751	Standard Specification for Biodiesel Fuel Blend (B100) for Middle Distillate Fuels
EN 228	Automotive Fuel-Unleaded Petrol- Requirements and Test Methods
EN 15376	Automotive fuels - Ethanol as a blending component for petrol - Requirements and test methods
EN 14214	Automotive fuels - Fatty acid methyl esters (FAME) for diesel engines - Requirements and test methods
DIN 51605	Fuels for vegetable oil compatible combustion engines - Fuel from rapeseed oil - Requirements and test methods
EN 590	Automotive Fuel- Diesel- Requirements and Test Methods

Standard Test Methods	
EN 14538	Fat and oil derivatives - Fatty acid methyl ester (FAME) - Determination of Ca, K, Mg and Na content by optical emission spectral analysis with inductively coupled plasma (ICP OES)
EN 14107	Fat and oil derivatives - Fatty acid methylesters (FAME) - Determination of phosphorus content by inductively coupled plasma (ICP OES) emission spectrometry
ISO 10540-3:2002	Animal and vegetable fats and oils — Determination of phosphorus content — Part 3: Method using inductively coupled plasma (ICP OES) optical emission spectroscopy
AOC Ca 17-01	Determination of trace elements (Ca, Cu, Fe, Mg, Ni, Si, Na, Pb, Cd) in vegetable oil by ICP-OES
ASTM D7111	Standard Test Method for Determination of Trace Elements in Middle Distillate Fuels by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)
ASTM D4294	Standard Test Method for Sulfur in Petroleum and Petroleum Products by Energy Dispersive X-ray Fluorescence Spectrometry
ASTM D7220	Standard Test Method for Sulfur in Automotive Fuels by Polarization X-ray Fluorescence Spectrometry
IP 532	Determination of the Sulfur content of Automotive Fuels-Polarized X-ray Fluorescence Spectrometry Method
EN ISO 20847	Petroleum products- Determination of sulfur content of automotive fuels- Energy dispersive X-ray fluorescence spectrometry
ISO 13032	Petroleum Products: Determination of low concentration of sulfur in automotive fuels - Energy-dispersive X-ray Fluorescence spectrometric method

## **ED-XRF**

*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 chemical 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.*

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

The SPECTRO iQ II employs proprietary optic and detector technology yielding performance, especially for light elements like sulfur, 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 biofuel extenders, intermediate and final petrochemical products. Its detection limit for sulfur in fuels, including ethanol and methanol is less than 1 ppm, meeting the requirements for product control and product release analysis.

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 and practical biofuels analysis reports, please visit [www.spectro.com/iq](http://www.spectro.com/iq)*

# SPECTRO iQ II



## **SPECTRO iQ II**

- C-Force polarization optical system eliminates background for superior sensitivity
- Powerful Silicon Drift Detector with high resolution yielding ultra-low detection limits
- Precision sample cups and positioning system for better reproducibility
- Complete analysis in just a few minutes
- Touch screen interface for straightforward, intuitive, operation



# SPECTRO GENESIS

## ICP-OES

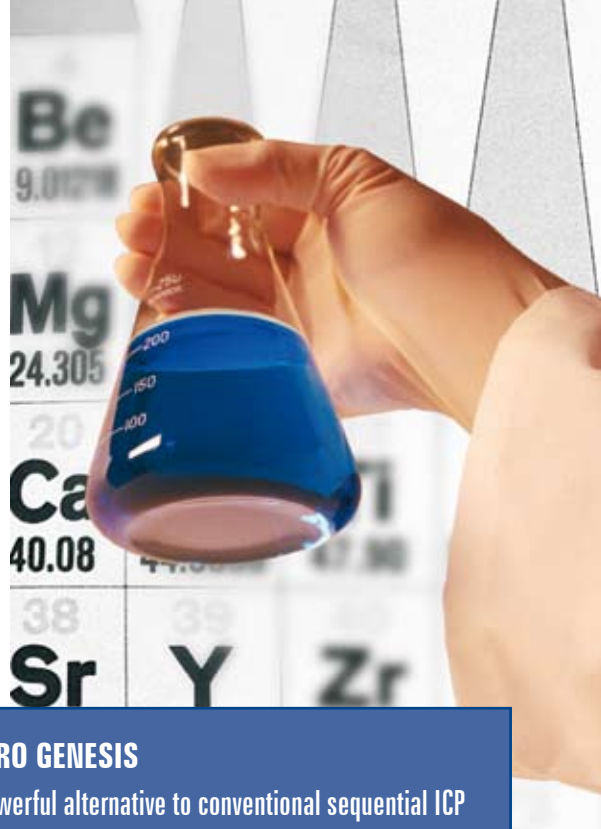
Over the last 30 years, Optical Emission Spectrometers with Inductively Coupled Plasma (ICP-OES) excitation sources have become an indispensable tool for chemical elemental analysis. Their ease of use, high sensitivity and precision, plus relative freedom from interferences have made ICP-OES systems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

The SPECTRO GENESIS offers a real economic alternative to sequential ICP-OES and Atomic Absorption spectrometers, enabling those who are unfamiliar with ICP-OES to profit from the advantages of leading CCD ICP-OES technology and to use a powerful, low cost and user friendly analytical system.

An extensive package of accessories is available for the SPECTRO GENESIS to further expand its application range. This includes, but is not limited to, a wide range of sample introduction systems, autosamplers, an autodilutor, an ultrasonic nebulizer and a hydride generator.

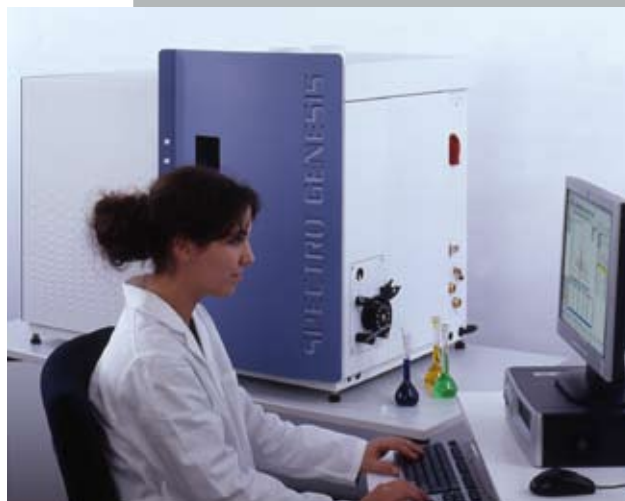
The SPECTRO GENESIS is equipped with powerful automation functions for the safe unattended analysis of a large number of samples. With an optional autosampler, several hundred samples can be processed without operator intervention. If the relevant methods are available, simply import or define a sample list.

*For more information about SPECTRO GENESIS, including a detailed brochure and practical biofuels analysis reports, please visit [www.spectro.com/genesis](http://www.spectro.com/genesis)*



## SPECTRO GENESIS

- A powerful alternative to conventional sequential ICP and Atomic Absorption spectrometers
- High speed analyses using simultaneous measurement of the complete spectrum
- Factory calibrated, norm-conforming methods for environmental and industrial applications
- Minimal installation and training requirements
- Compact design enables seamless integration into the laboratory
- Excellent price/performance ratio



# SPECTRO ARCOS



The SPECTRO ARCOS is different from conventional ICP spectrometers. Hidden inside the prominent left side of the instrument is the unique optical system – a major development with unbeatable resolution, accuracy and stability. Available with an interface for either axial or radial plasma observation, the new CCD optic system with Paschen-Runge mount assembly delivers a matchless resolution of 8.5 picometer in the important wavelength range from 130 to 340 nm.

Additional SPECTRO ARCOS strengths include the extremely robust, free-running generator and the low maintenance and economical UV-PLUS system for high VUV transparency down to 130 nm. The combination of these components deliver powerful analytical performance for difficult organic matrices like ethanol, methanol, biodiesel and biofuel blends. The generator has the power needed to analyze difficult organic samples “straight-up” without dilution, resulting in better sensitivity, precision and better recoveries.

Flexibility, transparent structure and simple operation characterize the SMART ANALYZER VISION software interface. Whether setting up norm-compliant methods or quantitatively reprocessing stored spectra, operators appreciate the straightforward and easily accessible functions. They enable the SPECTRO ARCOS to be perfectly tuned to the applicable analytical regulations and requirements.

*For more information about SPECTRO ARCOS, including a detailed brochure and practical biofuels analysis reports, please visit [www.spectro.com/arcos](http://www.spectro.com/arcos)*

## SPECTRO ARCOS

- High ICP-OES Performance class for complex matrices and analytical tasks
- Stable plasma conditions due to the robust free-running generator
- Extended spectral range from 130-770 nm for perfect line selection
- Low maintenance UV-PLUS system with minimal operating cost





[www.spectro.com](http://www.spectro.com)

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