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Furthermore, our OneSource comprehensive support gives you the efficiency of one contract and one contact for all your service needs. OneSource is the only single service point with the certified expertise to repair, maintain, qualify and validate equipment from PerkinElmer and virtually any manufacturer, including Agilent, Shimadzu and Waters.

From routine sample testing to moments of scientific breakthrough, count on PerkinElmer to supply you with the service, support, accessories and consumables you need to achieve success today and tomorrow.

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HUMAN HEALTH

ENVIRONMENTAL HEALTH



ecoanalytix™



BIOFUELS ANALYSIS  
KNOW MORE  
FUEL MORE

Comprehensive solutions for biofuels analysis and a brighter future.



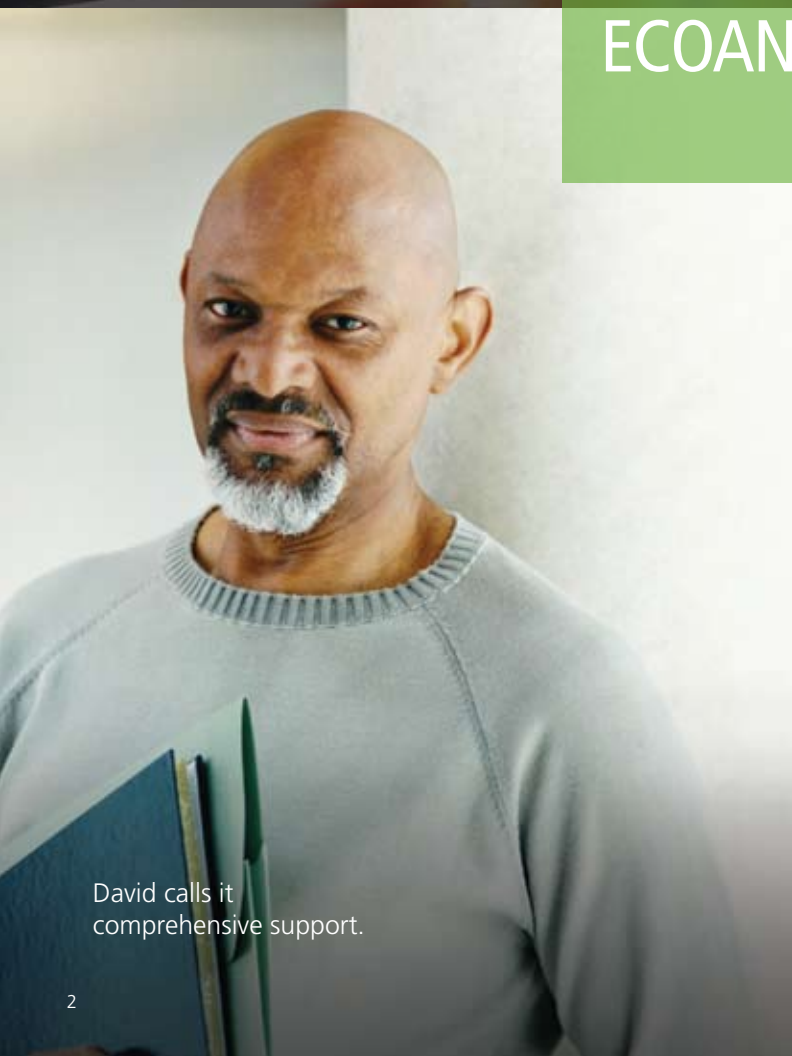
**PerkinElmer**<sup>®</sup>  
*For the Better*



Anne calls it simplified technologies.

Evan calls it expert application notes.

**WE CALL IT  
ECOANALYTIX**



David calls it comprehensive support.

Lillie calls it a brighter future.

# FEWER EMISSIONS FOR A BETTER TOMORROW

The world's energy needs are changing and growing rapidly. Traditional sources like oil and coal are being increasingly supplemented with innovative and renewable energy technologies.

Leading this revolution are two biofuels – biodiesel and bioethanol – which are made from natural, replenishable resources. However, optimizing the potential of biofuels continues to be a challenge.

Laboratories around the world responsible for biofuels development and testing face highly regulated environments and complex testing parameters. Markets require efficient output and quality control as demand increases and new biofuels discoveries continually alter the landscape.

**How can your business remain compliant yet productive?**

**Call on EcoAnalytix from PerkinElmer.**





# FUELING MORE OPPORTUNITY

EcoAnalytix™ from PerkinElmer provides you with a full suite of solutions that makes it easier to keep pace with an evolving industry. By combining tailored systems, standard operating procedures (SOPs) and application notes together with our OneSource® service and support, we ensure that from incoming raw material to the final product, your laboratory is ready to do more.

We enable your laboratory to maximize its prospects in biofuel development and testing, while meeting regulatory requirements worldwide. You can rely on EcoAnalytix to provide your laboratory with:

- Consultation and comprehensive solutions for building your lab from the ground up
- Analytical capabilities, SOPs and application notes to perform the required methods
- Complete system support including training, validation and maintenance

All of this means you'll know more, so your laboratory can do more. And for a world in need of renewable energy, nothing matters more.



# BIOFUELS DISCOVERY AND COMPLIANCE



EcoAnalytix from PerkinElmer offers proven leadership and a full range of solutions for your biofuel laboratory. Whether you are testing a new biofuel or verifying your current biofuel to meet industry standards, we have the proven technology you need.



**R&D  
Facilities**

**Feedstock  
& Chemicals**

**Process**

**Product**

**Blender**

**Regulator/  
Test Lab**

Looking for new feedstocks and processes

Testing incoming materials

Performing rapid screening

Qualifying biofuels

Confirming composition

Verifying products meet standards/ specifications



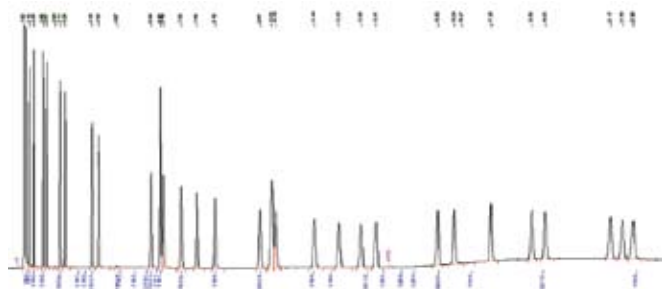
# BIODIESEL METHODS

The following methods show how EcoAnalytix provides solutions for a variety of biodiesel-production needs, including standard operating procedures (SOPs), comprehensive application notes and training.

## FAME Composition

### EN 14103 and NBR 15342

The determination of fatty acid methyl esters (FAME) is a critical component of biodiesel-quality testing. It determines the source of the feedstock, which indicates the quality of the biodiesel and how it will perform. Method EN 14103 requiring gas chromatography (GC) is used to determine FAME content between C<sub>14:0</sub> and C<sub>24:1</sub> and linolenic acid methyl ester content of oil feedstock used in biodiesel production. Featuring an intuitive touch screen that makes the system easy to learn and use, the PerkinElmer Clarus® GC family delivers robust methodology and accurate and reliable results to meet the specific requirements of national and international standard regulations.

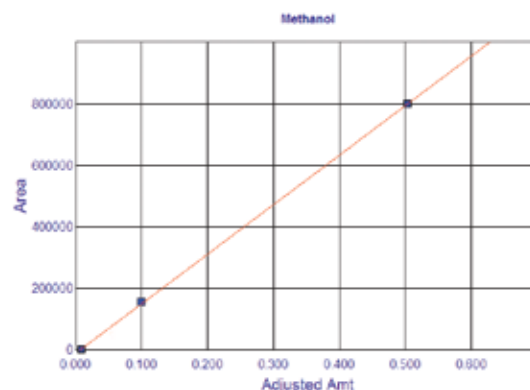


Analysis of a mixture of C<sub>14:0</sub> - C<sub>24:1</sub> FAMES.

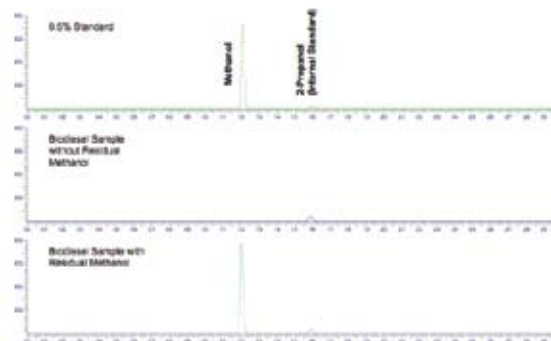
## Methanol

### EN 14110 and NBR 15343

As the content of methanol is a major value in the risk classification of the product in terms of transportation and security, it's absolutely necessary to get accurate results. With Headspace-GC methods, it is possible to determine the content of residual methanol in any FAME to be used either as pure biofuel (B100) or as a blending component for heating and diesel fuels. By slightly modifying the method, one can also determine other low boiling components in FAME. The PerkinElmer Clarus GC family, in combination with the TurboMatrix™ Headspace Samplers, provides the only fully-integrated solution for this type of application.



Calibration plot of a curve prepared with 5-g sample volume with linearity of 0.9999.

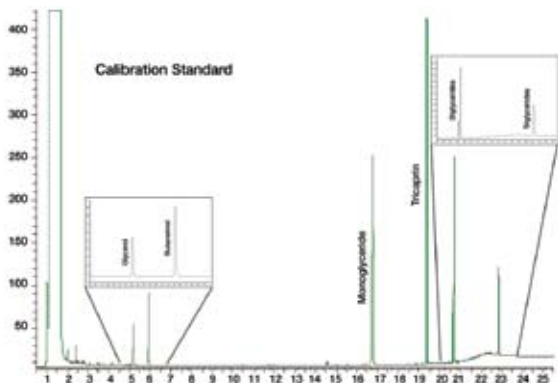


Chromatogram of the analysis of methanol in B100 biodiesel, following EN 14110 methodology.

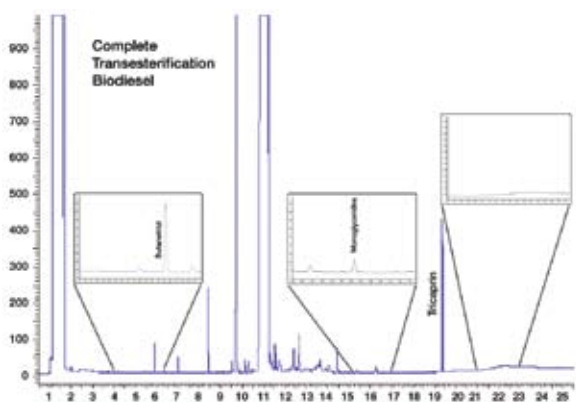
## Glycerin

EN 14105, ASTM D6584 and NBR 15341, 15342, 15344

The content of glycerin, determined by GC, generally indicates the quality of biodiesel. Glycerin takes the form of free glycerin or bound glycerin (mono-, di- and triglycerides). A high content of glycerin can lead to buildup in fuel tanks, clogged fuel systems, injector fouling and valve deposits and is limited strictly by regulations. PerkinElmer's Biodiesel Glycerin System, based on the Clarus GC family, features high-temperature capabilities and the fastest oven heat-up and cool-down times in the marketplace. This system provides a robust methodology and accurate and reliable results within the shortest time.



Free and total glycerin calibration standard.

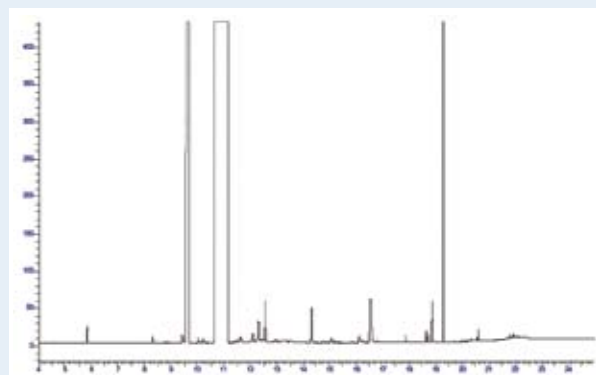


Sample biodiesel in which the transesterification reaction was completed.

## EcoAnalytix Biodiesel Glycerin and Methanol Analyzer

EN 14105, 14110 and ASTM D6584

Two solutions in one. The EcoAnalytix Biodiesel Glycerin and Methanol Analyzer provides a unique solution to test biodiesel using the GC test methods included in both the EN and ASTM standards. The analyzer incorporates a TurboMatrix Headspace Sampler coupled to a Clarus GC with an innovative dual-oven design. The ability to have two independently controlled ovens reduces the operating cost and optimizes laboratory bench space by combining methods which formerly required two GCs into a single instrument. There's never any need to modify your setup or swap columns, and with integrated SOPs, application training, consumables and accessories, the PerkinElmer EcoAnalytix Biodiesel Glycerin and Methanol Analyzer is the perfect solution to meet your needs in a cost-effective and time-efficient manner.



Chromatogram demonstrating the analysis of a biodiesel sample for glycerin and mono-, di-, triglyceride content.



## Trace Metals

### EN 14538 and ASTM D4951

The environmental and technical impacts of certain trace metals in biodiesel (emission of SO<sub>x</sub>, damage of catalytic converters by certain elements, etc.) make it necessary to control the levels of these metals. The United States and the European Union have posted specifications for these trace metals. Although there are many methods available to determine these elements, PerkinElmer's EcoAnalytix Biodiesel Trace Metal Analyzer can determine all of the specified elements with one single instrument in one run. The analyzer consists of an Optima™ 7000 DV inductively coupled plasma-optical emission spectroscopy (ICP-OES) system, calibration standards, SOPs and all the necessary support to get the analyzer up and running quickly.

Table 3. Analysis of Oil Feedstock for Metallic Elements (mg/kg).

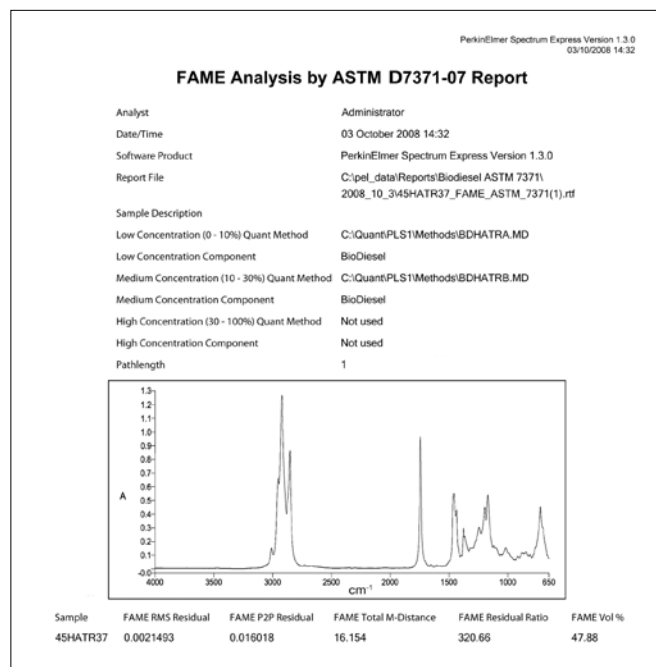
Feed Stock	Plant Feed			Degummed Oil			Crude Oil		
	P	Ca	Mg	P	Ca	Mg	P	Ca	Mg
Batch 1	7.07	0.83	0.79	30.00	3.63	3.30	448.5	57.9	54.7
Batch 2	11.63	1.48	1.45	7.89	0.72	0.72	550.7	68.3	66.1
Batch 3	8.64	1.10	1.10						
Batch 4	8.97	1.00	1.01	6.36	0.67	0.79	521.0	60.7	61.5
Batch 5	6.32	0.86	0.89	6.87	0.79	0.82	625.7	73.3	67.0
Batch 6	6.01	0.84	0.86	10.04	1.11	1.04	447.4	55.7	51.5
Batch 7	6.33	0.88	0.83	12.92	1.39	1.21	507.4	63.4	57.0
Batch 8	11.55	1.38	1.51	61.75	6.40	6.90	545.1	60.4	68.8
Batch 9	11.55	1.38	1.51	61.75	6.40	6.90	545.1	60.4	68.8
Batch 10	37.81	4.42	4.95						
Batch 11	16.27	1.84	2.11						
Batch 12	12.23	1.43	1.53	24.70	2.69	2.88	584.3	68.7	74.4
Batch 13	7.92	1.02	1.01	10.00	1.12	1.04	583.3	66.8	61.6
Batch 14	7.37	0.95	0.91	7.93	0.97	0.86	639.0	77.5	71.0
Batch 15	7.96	0.87	0.87	9.39	0.95	0.86	589.1	63.9	60.1
Batch 16	16.80	1.94	1.77	9.16	1.21	1.00	814.0	99.6	87.7
Batch 17	16.20	1.77	1.55						
Batch 18	19.70	1.94	1.69						
Batch 19	15.10	1.40	1.20						
Batch 20	14.70	1.14	1.33	8.91	0.87	0.89	582.0	67.9	61.3
Batch 21	4.78	0.32	0.42						
Batch 22	36.50	4.87	4.37	115.90	15.00	11.80	1286.0	167.7	151.7
Batch 23	37.10	4.90	4.60	23.97	2.53	2.28	1218.0	157.2	149.5

Analysis of oil feedstock for metallic elements (mg/kg).

## FAME Blend

### EN 14078 and ASTM D7371

The move to blend biodiesel into everyday fuel has created a number of unresolved issues. One such issue lies in determining the concentration of fatty acid methyl esters (FAME) in biodiesel-diesel blend fuels. PerkinElmer's EcoAnalytix IR FAME Analyzer uses a Fourier transform infrared (FT-IR) spectrometer from the Spectrum™ family and optimized sampling and software to solve this matter. The analyzer comes pre-calibrated and includes SOPs and an application CD for easy start-up. With slight changes to the setup, which can be easily done by the user, the spectrometer can also be utilized for the identification and qualification of incoming feedstocks, as well as the monitoring of the conversion process to determine progress of reactions and yield.



ASTM D7371-07 report.

# A COMPLETE RANGE OF BIODIESEL SOLUTIONS

PerkinElmer provides you with a f



FAME Composition and Glycerin by GC System



Methanol by HS-GC System

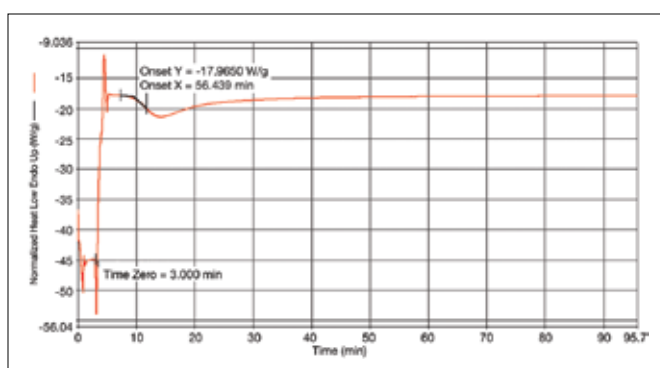


EcoAnalytix Biodiesel Glycerin and

## Oxidation Stability

### ASTM D6186 and EN 14112

Biodiesel is made from various oil-containing feedstocks, such as rapeseed, sunflower and soybean. These feedstocks also contain a certain amount of unsaturated acids, which when exposed to air, react with oxygen to form unwanted by-products. These by-products have an enormous impact on the overall quality of biodiesel, especially regarding transportation and long-term storage issues. The European Union has posted a very specific method to test oxidation stability. Using differential scanning calorimetry (DSC) with PerkinElmer's fast-scan DSC 8500, you get an accurate indication about the current oxidation status for your product within minutes, instead of hours.



OIT of rice biodiesel at 130 °C. Test completed in 6.4 minutes.

## <sup>14</sup>C Determination

In many countries, it is key to know the primary origin of the base material for the production of biofuels because of tax incentives and other financial reasons. Bioethanol or biodiesel, derived from living material, contains <sup>14</sup>C. Gasoline refined from crude oil, however, does not contain <sup>14</sup>C.

The Tri-Carb® 3180 from PerkinElmer's Liquid Scintillation Analyzer (LSA) family is used to analyze diesel fuel blended with biodiesel to verify bio-based content. This methodology can be used to cover biofuels made from a variety of feedstocks, and is not limited solely to bioethanol.

## LABWORKS greenLIMS System

A Laboratory Information Management System (LIMS) enables efficient monitoring and reporting of critical data. Comprehensive LIMS functionality is imperative for effective sample management, tracking and use of this data. Superior product quality and efficient manufacturing depends on your laboratory's ability to handle any number of samples, monitor plant functions and control the entire laboratory process from start to finish.

LABWORKS® greenLIMS™ draws on nearly 20 years of global experience and has become one of the leading user-rated LIMS. LABWORKS® greenLIMS comes pre-loaded with the ASTM and EN analysis codes biofuel laboratories must perform, and can be set up to meet the specific requirements of laboratories small and large.

Full suite of biodiesel methods and technologies for all your development and testing needs.



Methanol Analyzer



EcoAnalytix Biodiesel Trace Metals Analyzer by ICP-OES



Oxidation Stability by DSC System

EcoAnalytix Biodiesel IR FAME Analyzer



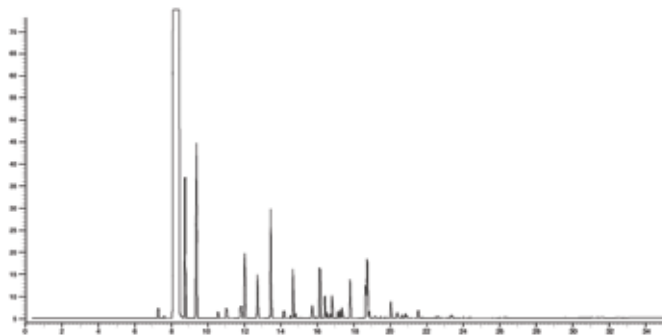
# BIOETHANOL METHODS

The following methods show how EcoAnalytix provides solutions for several common bioethanol production needs. As with biodiesel, our suite of bioethanol solutions includes standard operating procedures (SOPs), comprehensive application notes and training.

## Alcohol

### ASTM D5501

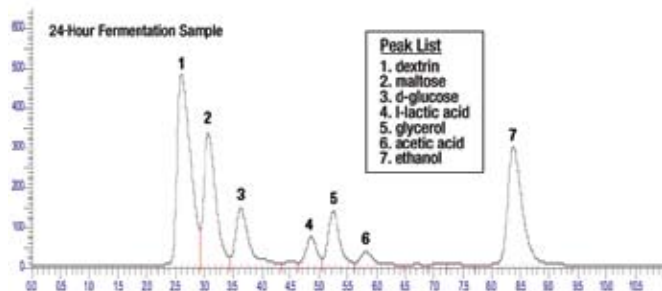
The content of ethanol and other alcohols, ranging from C<sub>1</sub> to C<sub>5</sub>, demonstrates the right blending amounts for gasoline. The blending range can be from 5% (E5) to almost 85% (E85), and it is critical to select the right composition; otherwise, engines can be damaged. Since the testing method uses long separation columns and low starting temperatures, the PerkinElmer Clarus 600 GC, with its fastest-in-class oven cool-down time, provides cycle times of less than 30 minutes – the fastest on the market.



Chromatogram demonstrating the analysis of fuel ethanol.

## Fermentation

Worldwide, the use of bioethanol as a complete substitute or as 5% to 85% blend in regular gasoline is a growing technology. Due to strict regulations for bioethanol production, the use of top-line analytical equipment is paramount. Carbohydrates, including dextrin, maltose and glucose, play an important role in the production of bioethanol, and are an indicator for the quality of the fermentation process. A PerkinElmer Flexar™ HPLC system, configured with an isocratic pump, autosampler, column oven and refractive index detector, provides the fastest method for determining



Actual 24-hour fermentation sample from ethanol production monitoring.

# A COMPLETE RANGE OF BIOETHANOL SOLUTIONS

PerkinElmer provides you with a f



Bioethanol Alcohol by GC System



Bioethanol Fermentation by HPLC System



Bioethanol Trace Metals by ICP-OES System

ethanol produced and monitoring of fermentation broth – now only 10 minutes. The inclusion of TotalChrom® Chromatography Data Systems and PerkinElmer expertise ensure the system is up and running as quickly as possible.

### Trace Metals

EN 15485, 15487, 15488, ASTM D1688, D2622, D5453, NBR 10893, 9867, 11331, 10422

It is important to test the concentration of trace metals in bioethanol, as too high a concentration will impact engine and catalytic converter performance. PerkinElmer has worked with the industry to develop the bioethanol trace metals recommended configuration, a proven system for this analysis. Based on established inductively coupled plasma optical emission (ICP-OES) technology, the system can rapidly determine copper, sodium, iron, phosphorus and sulfur amounts in one run, without any pre-treatment of samples.

### <sup>14</sup>C Determination

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Bioethanol <sup>14</sup>C Determination LSA System



greenLIMS Laboratory Information Management System