

BIOFUELS BACKGROUND

Analytical Solutions to Support the Rapidly Growing Biofuels Sector

The Biofuels Opportunity

In the last few years, there has been increasing interest in replacing petroleum, oil and natural-gas based products with biomass-based products. Biomass refers to material from which biofuels, such as ethanol and biodiesel, can be made. The biofuels industry has grown for several reasons, including the following:

- Less pollution: biofuels require less energy to produce and create fewer emissions during production
- More predictable feedstock (raw materials used to make fuel): free from the variable price and decreasing supply of petroleum-based feedstock
- Environmental benefits since the use of biofuels can greatly reduce the level of atmospheric greenhouse gases which contribute to global warming
- Increased global directives and government subsidies encourage the use of biofuels

Types of Biomass

Ethanol and biodiesel are the two most commonly produced biofuels, although their respective popularity varies in different countries. Both of these biofuels can be made from a variety of readily available materials including corn and sugar cane for ethanol and soybeans, palm oil, and even cooking oils for biodiesel. Research is underway to find new sources of biomass that can be used to make biofuels. The two primary areas receiving the attention of researchers today are the production of biodiesel and ethanol from algae and the production of ethanol from cellulose materials such as sugar cane stalks and tree clippings.

Regardless of crop type, analytical testing to ensure the quality of the fuel is necessary at many stages of production through delivery to end users to ensure quality and safety – all the way from the field to filling up the tank.

Biodiesel

Pure biodiesel (B100) can be used in a conventional diesel engine providing some modifications are made to the engine. More commonly, however, the biodiesel is blended with petroleum based diesel up to a level of 20 percent biodiesel to 80 percent petroleum diesel. Such a mixture is identified as B20 and can be used in a conventional diesel engine without modifications. The term “biodiesel” refers to the pure fuel before blending. It is a renewable fuel that is

produced from natural oils like soybean oil, rapeseed oil or animal fats. Biodiesel is cleaner burning than petroleum diesel, reducing overall engine emissions. Biodiesel's benefits are not just environmental, but can be performance-based as well. Using biodiesel will produce similar fuel consumption, power, torque and haulage rates as traditional fuel and can actually improve lubricity levels.

The Worldwatch Institute reports that in 2005, Europe accounted for nearly 89 percent of all biodiesel production worldwide with Germany alone producing more than half of the world's supply. New American production capacity, coming on board in 2007, will soon position the United States as a leading producer of biodiesel by year's end according to data from the National Biodiesel Board of the United States.

Ethanol

Ethanol is a clean-burning, high-octane fuel that is produced from renewable sources. At its most basic level, ethanol is grain alcohol, produced from crops such as corn. Unmixed ethanol is not generally used as a motor fuel; instead, a percentage of ethanol is combined with unleaded gasoline. Any amount of ethanol can be combined with gasoline, but the most common blends are E10 (10 percent ethanol, 90 percent fuel), which can be used in many current vehicle makes and models and E85 (85 percent ethanol, 15 percent fuel), which can be used in fuel flexible vehicles (FFVs), which are being produced in increasing numbers around the world.

In a report released by Earth Policy Institute, Brazil is the world's leading producer of ethanol, with 37 percent of the world market. The United States is second with 32.8 percent of the production. Ethanol use is growing rapidly around the world, including in the Pac-Rim, China, India, South Africa, Russia and France.

Navigating Regulatory Standards

As with any young and rapidly growing industry, government regulations and organizations setting testing standards often have to play "catch up" to the technology. Agencies and organizations across the globe are working to implement standards for production and quality control, as well as to address the increasing demand for biofuels brought on by recent directives around the world to increase the use of alternative fuels.

- As part of a Biofuels Initiative, the United States has proposed reducing gasoline use by 20 percent in 10 years and supplementing 35 billions of gallons of renewable fuels into the national energy pool in that same time period
- The European Union announced EU Directive 2003/30 to obtain 5.75 percent of transportation fuel needs from biofuels by 2010 in all member states
- Through the National Biodiesel Program, the Brazilian government is requiring that all diesel fuel contain 2 percent biodiesel by 2008 and 5 percent by 2013, and is considering moving the B5 requirement up to 2010
- Japan is beginning to use low-level ethanol blends as preparation for a possible blending mandate that would attempt to replace 20 percent of the nation's oil demand with biofuels of gas-to-liquid (GTL) fuels by 2030

As these standards and directives are quickly emerging, governments and other organizations are issuing regulatory practices and standards to ensure the quality of biofuels for use as fuel alternatives.

Biodiesel metrics have been set in the United States (ASTM D-6751-03) and in Europe (EN 14214) to measure the quality of biodiesel. PerkinElmer provides several appropriate analytical solutions to meet these standards, which incorporate test methods and applications including measuring sodium, potassium, calcium, magnesium and phosphorous levels and the amount of free and total glycerol using a gas chromatography (GC) test method.

Ethanol is regulated by ASTM standard D4806, which determines the amount of ethanol, methanol, water and other contents in the product.

PerkinElmer's Role – Leveraging Expertise and Insights to Support Analysis

A pioneer in the analytical measurements business for more than 60 years, PerkinElmer Life and Analytical Sciences is on the forefront of instrumentation, service and support for the rapidly growing, global biofuels industry.

PerkinElmer has a dedicated team of experts to support the biofuels industry – whether assisting a start-up, providing insights to regulators or investors, or helping an existing laboratory expanding into biofuels analysis. PerkinElmer expertise helps laboratories across the world navigate compliance standards for biofuels, design laboratories from the ground up and provide applications support, training and maintenance management. PerkinElmer is a proven strategic partner for trouble-free, accurate analysis of alternative fuels to help biofuels laboratories increase the pace and precision of their research and testing. In partnership with Arnel, Inc., a market leader in customized chromatography solutions, PerkinElmer offers turnkey solutions that enable rapid ramp-up in local markets across the world.

PerkinElmer was an early leader in analytical tools to support the biofuels industry. The company has a deep history of expertise in gas chromatography, a key analytical technique for biofuels analysis. PerkinElmer introduced the first commercial GC more than 50 years ago and offers a complete family of GC instrumentation.

PerkinElmer Biofuels Solutions

In February 2007, PerkinElmer introduced four Biodiesel Gas Chromatography (GC) Turnkey Systems that provide the biofuels industry with a choice of high-quality analyzers for the verification of free and total glycerin in pure biodiesel (B100) to meet ASTM standard D6584 as well as the European CEN Method EN14105 standard, as well as biodiesel content of B2 through B20 mixes.

In addition to GC instrumentation, PerkinElmer offers a wide range of other analytical instrumentation that meets ASTM and EN standards for use in the analysis of biofuels, including:

- Used for routine measurements in laboratories measuring a few samples for a few elements – ***Atomic Absorption (AA)***
- Used to measure the residual sugar in the fermentation process of ethanol to help determine when the reaction is approaching its end point – ***High Performance Liquid Chromatography (HPLC)***

- Used in laboratories requiring measurement of more than a few elements per sample or measuring large numbers of samples – ***Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES)***
- Monitors different stages of the biofuels production process, such as quality control, to identify incoming feedstocks and to monitor the conversion process and can be used to measure the levels of fatty acid methyl ester (FAME) in biodiesel blends – ***Infrared Spectroscopy (IR)***
- Determines the biological content of any organic material, meaning it can be used to distinguish between ethanol produced from biomass and ethanol produced from crude oil – ***Liquid Scintillation Counters (LSC)***

PerkinElmer offers complete, turnkey solutions including the LABWORKS® Green, a pre-configured lab management and reporting application for Biofuels that manages work, captures lab data, and generates Certificates of Analysis for the plant. It offers pre-loaded ASTM specifications, low entry price, zero maintenance and is expandable for growing labs.

Service and Support

PerkinElmer's 1,200 factory-trained and certified engineers have on average 15 years of experience maintaining leading-edge scientific equipment from predictive and preventative maintenance to validation support, instrument repair and training and technical support. It's the largest and most experienced service force in the industry.

Global service and support are available to assist in any aspect of a lab's analysis, data management or reporting challenges. The company's easy-to-use instruments with local-language capabilities allow ease in instrument set-up and training.

Through PerkinElmer's OneSource offering, labs can tailor a service solution to meet their needs, including multi-vendor service offerings, managed maintenance to let labs focus on their research and testing or an on-site engineer to trouble-shoot service issues and save the cost of travel and equipment downtime.

Web Site

For more information, visit PerkinElmer's Web site at www.perkinelmer.com/biofuel to find:

- Biofuels capabilities brochure
- Information on products, service and support
- Application notes
- Archived and upcoming online seminars and events