

BIOFUEL

Process Analysis

Tomorrow Begins Today



AMETEK[®]
PROCESS & ANALYTICAL INSTRUMENTS

AMETEK CORPORATION

We've taken technology that we developed for one industry and modified it for application in related industries.



PIBU Locations

Our business unit headquarters is in Pittsburgh, PA with manufacturing, sales and service operations in Pittsburgh, PA, Newark, DE and Calgary, Canada.



WE ARE A GLOBAL LEADER

AMETEK, Inc. is a leading diversified manufacturer of electronic instruments and electromechanical devices. We have over 11,000 colleagues at more than 80 plants across the United States and in 14 countries around the world. Supporting those operations are more than 80 domestic and international direct sales and service locations in over 30 countries worldwide.

AMETEK consists of two business groups: Electronic Instruments and Electromechanical. We are a leader in advanced instruments for process, aerospace, power and industrial markets; a differentiated supplier of technical motors and motion control solutions, electrical interconnects and specialty metals; and a global leader in floor care and specialty motors.

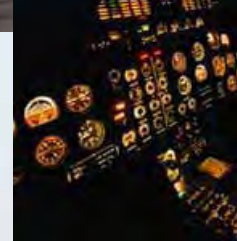
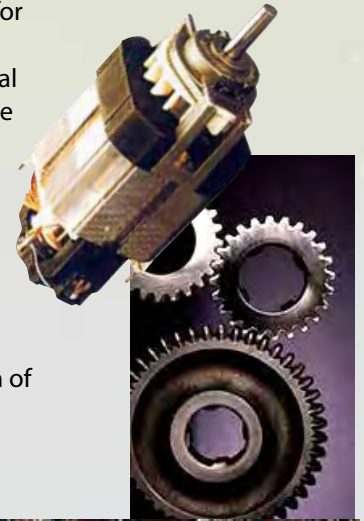
Among our greatest strengths is the ability to develop innovative new products and bring them to market successfully. We enjoy an excellent reputation for technical innovation and product development know-how. We have acquired businesses with excellent technical capabilities and made a significant investment in new product development. The result has been a steady stream of successful new products.

WE ARE A RESPONSIBLE CORPORATE CITIZEN

AMETEK is an ethically responsible company committed to the highest standards of business behavior. We encourage good corporate citizenship among our colleagues and are sensitive to the needs of the communities in which we operate. The AMETEK Foundation, which has served as the Company's charitable arms since 1960, lends support to educational, health, civic and social programs in communities in which we operate.

OUR BREADTH

Our sales are evenly divided between two business groups: Electromechanical Group (EMG) and Electronic Instruments Group (EIG). Our EMG group provides motors used in industries such as aerospace, military, mass transit, business equipment, medical applications. We are also a leader in specialty metal powder, strip, wire, and bonded products and produce specialty clad metal alloys and powders used in electronic applications. Our EIG group provides equipment for process industries, analytical laboratories, the aerospace industry; wherever power instruments are needed, for virtually every industrial market.



We rank among the world leaders in process analyzers control instruments.

BIOFUELS & AMETEK PROCESS INSTRUMENTS

WHAT IS BIOFUEL?

Biofuel can be broadly defined as solid, liquid, or gas fuel derived from recently living biological material. This distinguishes it from fossil fuels, which are derived from long dead biological material. Biofuel can be theoretically produced from any biological carbon source, though the most common by far is photosynthetic plants. Many different plants and plant-derived materials are used for biofuel manufacture. Biofuels are used globally, most commonly to power vehicles and for generating heat. Biofuel industries are rapidly expanding worldwide.



There are two common strategies for producing biofuels. The first is to grow crops high in either sugars (sugar cane, sugar beet, and sweet sorghum) or starch, (mainly in the form of corn) and then use yeast fermentation to produce ethyl alcohol (ethanol).

The second is to grow plants that contain high amounts of vegetable oil, such as oil palm, soybean, algae, or jatropha. These oils are then processed using heat to reduce the molecular weight (lower the viscosity or thickness). The free fatty acids in these oils can be converted to esters in a continuous process by combining the esterification and transesterification processes. The result is a fuel that can be burned directly in a diesel engine, or the oils can be chemically processed to produce fuels such as biodiesel blends which are a mixture of biofuel and petroleum distillates. Wood and its byproducts can also be converted into biofuels such as woodgas, methanol or ethanol fuel. It is also possible to make cellulosic ethanol from non-edible plant parts, but this can be difficult to accomplish economically. In addition to the approaches just described, biofuels can be produced by the breakdown of waste materials. The methane produced can be captured, purified and sold to natural gas producers.



Biofuel production requires analytical process measurements at various stages of the production process. The AMETEK Process Instruments Group produces instruments that can measure the chemical properties of liquid and gas streams using ultraviolet and near infrared absorption using broadband and laser sources, mass spectrometry, zirconium oxide for O_2 and gas chromatography for low levels of hydrogen. The following pages describe some of the biofuel application solutions provided by AMETEK.



BIOFUEL PRODUCTION PROCESS CONTROL

AUTOMATED PROCESS CONTROL



Western Research® Model IPS-4 Integrated Process Spectrophotometer



One of our most versatile analytical platforms is the Model IPS-4 UV-VIS and NIR process analyzer capable of detecting, quantifying, and compensating for multiple chemicals and interfering species. AMETEK can customize the sample handling and conditioning system to meet your sample fluid and application requirements. The IPS-4 can be used to analyze for ethanol content in gasohol, methyl esters in plant oil-derived fuels, ester content in biofuel/diesel mixtures, and many other liquid and gas biofuel production applications.

IPS-4
Integrated
Process Spectrophotometer

The IPS-4 can be used to measure the ethanol content in liquids, methyl esters in biofuel, transesterification endpoint, VOC's in wastewater and moisture in waste methane, to name just a few.

ProMaxion™ Process Mass Spectrometer

Process mass spectrometry provides real-time analysis of multi-component streams and is ideal for control of many complex industrial processes such as the manufacturing of biofuels. These include the compositional analysis of gases produced during the biodegradation of waste materials and the monitoring of volatile organic compounds (VOC) in waste water streams.



ProMaxion

BIOFUEL OFFGAS ANALYSIS

Depending on the feedstock used, gasification can produce significant amounts of the higher hydrocarbons. Knowing what they are and how much is there can lead to tighter process control and provide an early warning system for potentially damaging process upsets. When the extracted landfill gas is to be reintroduced into the pipeline, O₂ and CO₂ levels must be within strict transmission guidelines. With 10 ppm baseline sensitivity (1 ppm with optional electron multiplier detector), the ProLine can ensure continuing product quality.

Maximizing the output of a syngas-producing bioreactor requires a differential measurement across the reactor. A ProLine or ProMaxion analyzer, with a typical analysis time of less than 15 seconds/sample point, is able to provide a uniquely detailed picture of the entire process. The Process 2000 software package, with its real-time Calculation Editor, eliminates the need to port data into a separate package for post-acquisition manipulation. Component ratios, input/output subtractions, and merging of other process data are performed and displayed simultaneously with the raw data acquisition.



INDUSTRIAL GAS PRODUCTION

Model 3050 AM Moisture Analyzer

The Model 3050 AM moisture analyzer is ideal for critical moisture measurement applications including feed gas analysis in biofuel production and moisture levels in methane produced from biodegradation of organic waste. The Model 3050 AM moisture analyzer uses AMETEK's proprietary Quartz Crystal Microbalance (QCM) sensor technology to provide an accurate and responsive moisture measurement. The Model 3050 analyzer has a built-in NIST-traceable moisture source that periodically validates the sensor's response, ensuring operator confidence.

ETHANOL & BIOGAS PRODUCTION

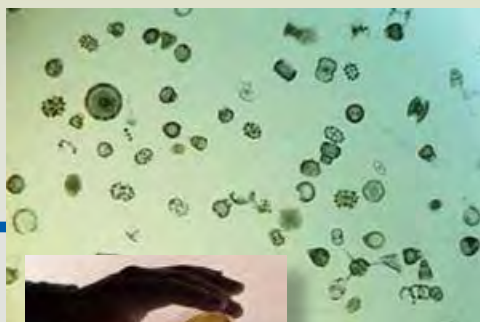
CONTROL OF FERMENTATION

ProLine™ RQ Process Mass Spectrometer

The ProLine RQ process mass spectrometer can monitor multiple fermentation reactors simultaneously and measure all of the gases entering and exiting each reactor. Most important are the O_2 consumed, the CO_2 produced, and the ethanol content in the vent gas. This provides a continuous, highly refined control signal to maximize culture health and productivity.



ProLine RQ



What is RQ?

Fermentation is the process by which living organisms are cultured to produce a specific product. Fermentation reactions must be closely monitored to gauge the health of the culture and to determine when it can be harvested. The levels of carbon dioxide and oxygen in the off-gases are used to follow the progress of fermentation. The ratio is called the respiratory quotient (RQ) and is the prime indicator of culture health.

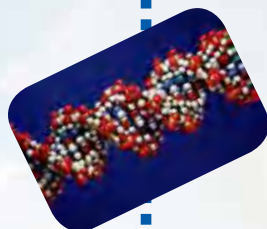
Ethanol Production

Ethanol offers a valuable energy alternative to fossil fuels, which are both nonrenewable and contribute significantly to atmospheric pollution. Ethanol is often referred to as a 'biofuel' since it can be manufactured by fermenting grains, plant biomass and other organic materials using microorganisms such as yeast cells. Ethanol can be used as a fuel directly, but most often it is blended with gasoline (at about 5-10%) to yield gasohol.

Biogas Analysis

Stan Siegel, owner of Green Gas Energy, LLC :

"The Ametek ProLine is a great example of a modern, on-line analytical tool. High performance and reliability coupled with easy operation allows us to turn landfill gas into a pipeline quality product. The high speed analysis and multi point sampling makes for fast process optimization. And the low maintenance overhead of the instrument guarantees we'll stay that way."



Trash to Clean Energy

As the population of our planet continues to grow, millions of tons of waste accumulate in landfills around the world. Landfills release gases, mostly methane gas, which has become an important contributor to global warming. But methane gas can be captured and used to power businesses and vehicles and heat homes and greenhouses.

According to the EPA, 350 landfills across the U.S. are converting landfill gas to clean energy. In addition to the United States, 15 other countries also plan to recover and process methane gas from landfills. Experts project that the environmental and economic benefits of using landfill gas as an alternate energy source will triple in the next few years.



TRACE GAS ANALYSIS

TRACE ANALYZERS

5910
Moisture Analyzer



CG1100-RTP
Oxygen Analyzer

Trace Moisture - Model 5910 and Model 5830

AMETEK's moisture analyzers are designed to help minimize process upsets caused by excessive moisture in bulk atmospheric gases. The Model 5910 has the sensitivity and stability required to ensure that bulk feed gases possess the required sub-1 PPBv moisture impurity level with its limit of detection of a mere 150 PPTv. On-line verification functions allow users to validate both the sensor's zero-baseline and its accuracy calibration using a NIST-traceable moisture source.

Trace Oxygen - Clean Gas CG1100 and CG1100-RTP

Oxygen level monitoring is another important analysis in biofuel production. Our Clean Gas Model CG1100 provides a PPMv measurement of the oxygen present in a feed or exhaust gas stream. Zirconia technology provides fast response from initial high percent levels of oxygen to low PPMv levels with no loss of accuracy or sensor life.

Impurities in Bulk Gas

Trace Analytical ta7000 Series

Biofuel energy, power made from organic materials such as plants and animal waste, represents the classic win-win for farmers, electricity producers and the public. Biomass is cheaper and cleaner than other energy sources such as fossil fuels and is, of course, renewable. At the same time, manure-based fuels offer farmers a simple, profitable way to manage farm waste and the accompanying odors and environmental issues.



Trace Analytical ta7000 Series



In the last two years, eighteen Wisconsin State dairy farms have invested in methane digesters that heat up cow manure to produce gases and fuels which in turn power an engine and turbine unit. The resulting electricity can be enough to supply anywhere from 500 to 1,200 homes on an annual basis.

The Trace Analytical Reduction Gas Analyzer is ideally suited for the determination of ppb-to-ppm levels of hydrogen and carbon monoxide in methane evolved from bacteria in anabolic digestors. In this analysis, the Reduction Gas Detector (RGD) is used to provide rapid and reproducible measurements.



COMBUSTION CONTROL

OPTIMIZATION OF PROCESS HEATERS

Thermox® WDG-V

Fuel fired heaters are used extensively in the production of biofuels. They offer special challenges for optimization due to high temperatures, multiple burners and zones, as well as widely varying fuel calorific values.

The fast-response WDG-V series is designed for direct measurement of oxygen and combustibles in the high temperature zones (up to 3000°F / 1649°C) and is used worldwide for optimization of fired heaters. Benefits of optimization include substantial energy savings, 15-20% NOx reduction, increased product quality and throughput, improved safety, and longer heater and tube life.

EFFICIENT CONTROL OF WASTE FUEL BURNERS

Thermox® S A/F IQ Air Demand & Wobbé Index Analyzer

The increased costs of traditional fuels and the uncertainty of their supply has led to greater use of waste gas, biomass and off-gas to supplement or replace them. Such fuels have widely varying energy content making it difficult to operate the combustion process efficiently and safely. The Stoichiometric Air/Fuel Ratio Analyzer (S A/F IQ) continuously measures a sample of the fuel gas and air supplied to the burner. This result produces a control signal to set the correct air-to-fuel ratio. Fast response enables the efficient combustion of waste and off-gases in a wide range of applications.



S/A/F IQ
Air Demand Analyzer

Combustion processes play a major role in the biofuels industries, and fuel costs associated with boilers, furnaces, kilns, and process heaters, often account for the majority of the cost of running a plant. Increasing fuel costs and more stringent emissions limits have focused attention on improving the combustion efficiency of industrial boilers and process heaters.

THERMAL OXIDATION OF BIOFUEL PRODUCTION WASTE

Thermox® WDG-HPII Flue Gas Oxygen Analyzer

Thermal oxidation is widely used to dispose of the plant material wastes that are a byproduct of biofuel production. The high temperatures and high dust loading in such processes demand a special analyzer. The WDG-HPII flue gas oxygen analyzer is designed for such applications and facilitates reliable operation of these critical facilities.

Thermox flue gas analyzers have been helping customers improve combustion efficiency for more than 40 years. Thermox offers a wide range of sensor styles so you can select the right analyzer for even the toughest applications.



Thermox
WDG-V Analyzer
with AMEvision Display
User Interface

CONTINUOUS EMISSIONS & COMBUSTION EFFICIENCY MONITORING

LAND COMBUSTION FGA Analyzers



Installed LAND FGA

A CEM or AMS system in terms of number of gases measured and data reporting, can often be met by a single product from our product range. The solution does not need to be a systems integration exercise. However, when you are looking for a flexible approach to system design which may include components from other suppliers, AMETEK can provide complete, integrated systems - not just a series of components.

VOCS IN AMBIENT AIR (MIMS)

ProMaxion™ Process Mass Spectrometer

The biofuel production process often produces toxic substances or use such substances in their manufacturing process. As a result there is a requirement to monitor the environment in and around the plant to ensure that the

concentrations of known pollutants remain below the exposure limits. Equipped for Membrane Interface Mass Spectroscopy (MIMS), the ProMaxion uses a dimethylsilicone membrane inlet coupled directly to its ion source along with a multiport arrangement for multiple sample stream selection and the introduction of calibration standards. Thanks to its extremely fast response and high sensitivity, a single analyzer can be used to monitor up to 80 ambient air sample locations around a plant.

COMPLIANCE MONITORING FOR OPACITY AND DUST

LAND Model 4500 MkII+

Installed Model 4500 MkII+



Dust is an element of air pollution regulated by regional and federal air pollution control agencies. Facilities must demonstrate compliance by implementing a dust control program. The 4500 MkII+ is designed for compliance applications. It uses patented "Flood LED" technology to achieve the highest levels of stability and accuracy and is approved to the latest government standards. Using RS232 or RS485 serial Modbus interface, it is easily integrated into your plant control system.

Typical Uncontrolled Emissions from Biomass Combustion in Boilers

Particulates:	12.5-15	(kg per ton biomass)
Organic compounds:	1	(kg per ton biomass)
Sulphur dioxide:	< 1.5	(kg per ton biomass)
Nitrogen oxides:	5	(kg per ton biomass)
Carbon monoxide:	1	(kg per ton biomass)



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