AMETEK®
PROCESS INSTRUMENTS

APPLICATION NOTE

TUNABLE DIODE LASER ABSORPTION SPECTROSCOPY ANALYSIS OF LANDFILL GAS MEASUREMENTS

Landfill gas is a natural by-product of the decomposition of organic material in anaerobic conditions. Landfill gas contains 45 to 60% methane and 40 to 60% carbon dioxide (CO_2). In addition, landfill gas contains small amounts of nitrogen, oxygen, ammonia, sulfides, hydrogen, carbon monoxide, and non-methane organic compounds such as trichloroethylene, benzene and vinyl chloride.

Methane is a potent greenhouse gas with a global warming potential that is 25 times greater than CO_2. Rather than releasing landfill methane into the atmosphere or flaring it, methane can be collected, converted and used as an energy source. The collected methane can be burned to generate thermal energy for heating applications, generate steam or sold off-site and sent into natural gas pipelines after further purification.

AMETEK 5100HD TUNABLE DIODE LASER ABSORPTION SPECTROMETER

MEASURING METHANE CONTENT TO DETERMINE GAS QUALITY

Operators of landfill gas plants need to continuously evaluate the percentage of methane in their product because this determines the end use of the gas and the pricing. This quality is either determined by measuring the actual methane content or by determining the BTU values. Direct measurements of methane are always preferable because they provide real-time information.

The environment (i.e. physical conditions like temperature and moisture content), as well as the makeup of the waste materials can determine the level of methane. Operation in a landfill plant requires analyzers that can give fast, accurate and real-time methane information.

EQUIPMENT

A tunable diode laser absorption spectroscopy (TDLAS) analyzer is a good choice for such a task. Traditionally, gas chromatography and mass spectrometry are used to provide methane monitoring in the process of landfill gas production. Gas chromatography offers high sensitivity, but it has the disadvantage of a slow response time. A TDLAS analyzer provides real-time monitoring with a data acquisition rate of two seconds. AMETEK 5100 series analyzers are significantly less expensive than either gas chromatographs or mass spectrometers.

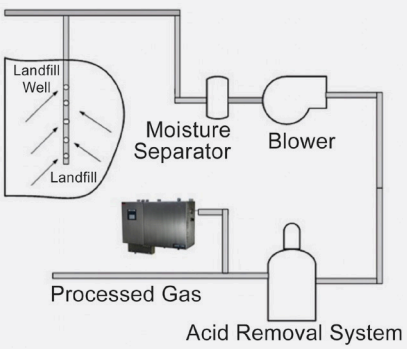

Figure 1. Landfill gas system

TDLAS ANALYSIS FOR METHANE LEVELS

TDLAS is a non-contact analysis technique with long-term stability, high specificity and selectivity. A laser-based methane sensor offers the advantage of faster response time, large dynamic range and low drift in comparison with conventional techniques such as gas chromatography. In applications such as monitoring the methane levels at the outlet of the landfill gas plant, the above-mentioned attributes help to meet the optimal requirements of the plant operation better.

The AMETEK 5100HD is an extractive-type analyzer designed for hot/wet sample analysis. There is no sample conditioning for the analyzer system, just a fully integrated sample handling to transport the sample. The 5100HD uses a sealed reference cell for continuous online analyzer verification and offers high specificity and sensitivity. The analyzer uses a digital implementation of the wavelength modulation spectroscopy (WMS), so changing the experimental protocol is simply a matter of uploading a file. The 5100HD is the choice of many customers to replace gas chromatographs for monitoring methane.

FAST, ACCURATE MEASUREMENT WITH TDLAS TECHNOLOGY

The information shown in Figure 2 represents the response of the instrument to a series of methane challenges in the concentration range of 40 to 60%. Zero base line, which was represented by air saturated with water was also evaluated in this test. The data acquisition rate was 2 seconds/measurement.

Validation testing for the analyzer resulted in a maximal error value of 0.3 volume percent, evaluated for methane measurements in the concentration range 40 to 60%. This error was calculated as a difference between set value and averaged over the measurement time reading for each selected concentration level. Repeatability as a degree of agreement between replicate measurements of the same quality was expressed in terms of standard deviation of the measurement results. Standard deviation of the methane readings on each of the selected concentration challenges was less than 0.2% and repeatability at the methane level of 55% was 0.3%.

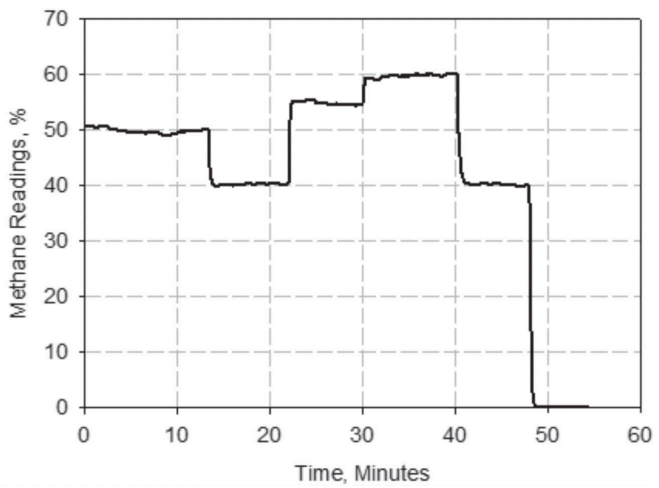

Figure 2. Instrument response to a series of methane challenges in the concentration range of 40 to 60%

SALES, SERVICE & MANUFACTURING

USA - Pennsylvania
150 Freeport Road
Pittsburgh PA 15238
Tel: +1 412 828 9040
Fax: +1 412 826 0399

USA - Delaware
455 Corporate Blvd.
Newark DE 19702
Tel: +1 302 456 4400
Fax: +1 302 456 4444

Canada - Alberta
2876 Sunridge Way NE
Calgary AB T1Y 7H9
Tel: +1 403 235 8400
Fax: +1 403 248 3550

WORLDWIDE SALES AND SERVICE LOCATIONS

USA
Tel: +1 713 466 4900
Fax: +1 713 849 1924

Brazil
Tel: +55 19 2107 4100

France
Tel: +33 1 30 68 89 20
Fax: +33 1 30 68 89 99

Germany
Tel: +49 2159 9136 0
Fax: +49 2159 9136 39

India
Tel: +91 80 6782 3200
Fax: +91 80 6780 3232

Singapore
Tel: +65 6484 2388
Fax: +65 6481 6588

China
Beijing
Tel: +86 10 8526 2111
Fax: +86 10 8526 2141
Chengdu
Tel: +86 28 8675 8111
Fax: +86 28 8675 8141
Shanghai
Tel: +86 21 5868 5111
Fax: +86 21 5866 0969

AMETEK® PROCESS INSTRUMENTS

One of a family of innovative process analyzer solutions from AMETEK Process Instruments. Specifications subject to change without notice.