



Field Monitoring - With Fixed, Remote Wireless Equipment.

Remote and wireless monitoring technology to meet CDM requirements is in its infancy in Europe. Carbon trading is driving it globally, especially in North and South America. That experience and technology is now finding a demand in Europe and Asia in landfill, biogas from food and animal waste in digesters and water treatment sludge digestion.

Methane recovery from landfill and anaerobic digesters is a targeted goal for green house gas reduction. Methane is known to be twenty-one times more destructive to the ozone layer than carbon dioxide and can be used effectively as an alternative fuel source for generating electricity. Landfill and other biogas processes have been under fire to dispose of the gas responsibly. In countries where environmental regulation is a serious commitment there are mechanisms in place to encourage the capture, destruction or use of the gas. In many of these areas, the processes are mature with entire technologies developed specifically for these environmental industries.

Because of a growing sense of urgency and public awareness of the effects of global warming, other regions are responding with interest.

The interest is driven by the availability of outside investor funding and the potential to develop alternative energy sources. Faced with limited exposure to modern methods of landfill or biogas recovery and utilisation, these developing regions seek seasoned and experienced talent from more developed countries. Ironically, the field of biogas recovery is still burgeoning, even in developed nations. Because this field is a niche segment of the larger energy market there is not a wealth of available talent to expand the market as demanded.

Making best use of technology to monitor operations from around the globe enables a few to do the work of many. Technology by itself does not eliminate the need for human action in the field. But technology can provide timely information to make better decisions. With the available talent constraining the number of projects being managed properly, technology enables those who use the system to better manage their time, their projects and their success.

Money Talks

Ultimately it comes down to money. What are the savings? How much is being earned? How can an operator do more with less? Will investing more now deliver rewards down the road? Today, stakeholders measure a Clean Development Mechanism (CDM) project's success by payment for Certified Emissions Reductions (CERs). Making the most of available technology can improve operational efficiencies and streamline the validation process towards that final payoff.

While landfills and digesters both generate methane in similar biological processes, there are differences in how the recovery process is monitored and operated. There is no doubt that advanced technology and automation can improve system monitoring. Since gas quality and quantity determine the project payoff, tight control on system operation is crucial to a project's success. Optimising a process for maximum gas production while maintaining compliance with environmental protection regulations is a delicate balance requiring constant attention. Naturally, there are many manufactures of like products, some borrowed from other industries, rushing to the CDM marketplace. With all the choices available, and more technologies appearing, what technologies are best suited for methane recovery? A comprehensive system should include components that address sampling the gas, analysing the composition of the gas, collecting and validating that sample data and reporting the information accurately.

At the Source

In a landfill, the point where the gas sample is taken can provide much information about the health of the gas generation process. This sample point can be used to measure the quantity of gas as well as quality directly at the source. Ideally the gas flow also will be controlled here to maximise production while helping to maintain the proper anaerobic balance throughout the life of the landfill. Using independent control an entire field of wells can be balanced for the benefit of the operation. The accuracy and repeatability of sample point measurement devices is a prime technology investment that is commonly overlooked. Because this balance between production and environmental compliance is a dynamic process, employing reliable technology at the gas source is paramount to the success of the entire operation.

Sacrificing the quality of gas sampling, flow measurement and control devices at this primary level of operation will sacrifice the quality of data that can be collected from these sampling points.

Typical flow devices for this purpose are the Pitot tube, orifice plate or a modified impact tube. All can be assembled with a control valve and sample ports for measuring pressures, gas composition and temperature. The Pitot tube is typically a hand-held device.

Analytical Instrumentation

A wide variety of instrumentation is available for measuring methane gas concentration. Portable instruments are practical for taking sample readings at independent well locations. In the landfill field, multifunctional instruments are preferable to single-purpose devices since there are a number of required readings at each point. The technology of these field instruments most commonly includes Infrared detection or electrochemical cells because of convenient size, weight and lower cost. Other detection technologies may be more accurate but are typically better suited for laboratory use or are otherwise cost prohibitive. Additionally, workflow plays a significant role in a landfill technician's day when hundreds of sample points must be monitored routinely. Field instruments with streamlined operations and onboard data storage for gases, pressures and temperature enable users to capture field data accurately and efficiently.

Stationary analysers are typically used at the end of the line, near the flare or engine. Stationary monitoring systems should be flexible systems that integrate to collect data from other sources on site. Interchangeable analysers for ease of service as well as an emergency backup are recent expansions in the whole marketplace. Stationary installations offer a more stable platform for continuous, remote monitoring. Technology advances enable communication via wired, wireless and satellite communications. Additional features should include onboard storage to avoid data loss caused by catastrophic component or system failure, remote updating for monitoring system functionality, self-monitoring, data encryption, third party interconnectivity, uninterruptible stand-by power supply, installation, startup, training and support.

Once again, accuracy and repeatability are crucial for this step in the process. Calibration of the analyser should be standard practice in verifying the analytical instrument is performing accurately. Most analysers are factory calibrated, but for the most accurate results the instrument should also be calibrated in the field.

- Proper in-field calibration confirms the accuracy of the instrument under the same climatic and barometric conditions where the sample readings are to take place. Typical field practice includes zeroing the specific gas channel in the absence of the specific gas being calibrated, then setting a calibration point using a known quality of the same gas. Manual field calibrations are appropriate for portable instruments. Although, many stationary systems allow manual calibration, CDM projects typically require an accuracy that can only be verified with automated calibration.
- Auto-calibration for stationary monitoring systems ensure the accuracy of the analyser by routinely passing a known quality of gas through the analyser as a gas check. Resulting readings that are outside acceptable parameters force the system to automatically recalibrate the instrument before continuing any further data collection. Auto-calibrations are also stored for future reference with data records.
- Periodic calibration and service by the manufacturer to maintain optimum instrument performance should be an accepted cost of system maintenance. Factory-authorized technicians should perform this work. On-site service requires that systems to be temporarily shut down. To avoid downtime of several hours or days in some cases, which can be costly for stakeholders in CDM projects, having a spare analyser allows for the gas analyser to be replaced in minutes with the spare by on-site personnel. The original analyser is then returned to the factory for proper service and calibration. This can dramatically reduce system down time.
- For validation purposes field and factory calibration reports should be maintained along with field data.



Sampling to Balance Total Field

Monitoring Frequencies

The requirements of each project vary from site to site. Compared with landfill, an anaerobic digester is more predictable in gas production. The fuel stock enters the process and moves through the digester based on time and temperature. Monitoring confirms the process and measures the gas quality of the collective system. In the well field on landfill, monitoring each source point can be as frequent as daily, monthly or quarterly. Depending on the amount of gas generated, monitoring frequency is dictated by what is needed to balance the field properly. Balance is achieved by adjusting individual wells. This dynamic

nature of the landfill gas system can be tedious and time consuming. Software technology is available to determine best practices in balancing or tuning and landfill gas field thereby generating as much gas as possible without killing the anaerobic process. At the other end of the spectrum are automated systems which can collect readings every few minutes. For CDM this method is necessary to validate how much gas is consumed.

These methods of data collection render a tremendous amount of data. Turning that data into useful information can be accomplished with software technology. Another advantage of using a progressive software technology is maintaining the appropriate chain of custody.

To avoid errors and omissions during collection, portable and stationary field instruments should store readings and not rely on hand written reports that require transcription or other redundant efforts. The data collected accurately at the site is then encrypted and transmitted securely. With stakeholders of CDM based around the globe, a web-based software system is accessible only to authorised parties.

Reporting

Any software technology used for CDM needs to be able to withstand the scrutiny of the validation process. Establishing an audit trail from the source of the gas, through collection, analysis and reporting will streamline the project certification. Security equivalent to banks and other financial institutions is achieved in more robust systems. Software technology can be configured in many ways to display undated site information and reduce the need to hunt for 'last month's' reports. This display should also have graphic interfaces showing gas production in relative terms, gas concentration maps and access to more comprehensive data. Alerts and alarms are managed by software on the project site. Direct communication via wireless connection allows the alarms to go out immediately. The data stream to the online software system resumes when the line is open again.

Conclusion

Experience in the methane recovery field where technologies have been proven effective over time is an important factor in choosing the right manufacturer. Many have rushed into the market with half-baked solutions and questionable results. Many questions need to be answered before a system is installed. The right technology can enable people to do more in less time. The wrong technology can prove to be more expensive and not deliver the desired results. Success can be achieved with the right team and technology manufacturers need to be a part of that team. Buying products off the shelf places the responsibility of success on the buyer. Working closely with an experienced technology partner greatly increases the likelihood of success.

Questions and answers

Q. What are the problems to overcome with remote or wireless monitoring?

A. Reliability of: equipment, data transmission and remote system debugging and access to the Internet which is critical for communication. Landlines are not always available in remote parts of the world where infrastructure is not fully developed.



Automatic Extraction Monitoring Equipment in Brazil showing panels and gas bottles for calibration all in a security cage.

Cellular communication is rapidly becoming more readily available and satellite data uplink is also possible, albeit expensive. Establishing accounts overseas can be challenging, but once connected to the world wide web, there are rarely problems.

Q. How do we power remote stations?

A. Mains power is required for other equipment on site and is usually available for remote monitoring systems. Solar power supplies are an option where no other power is available, but also require periodic maintenance to replace batteries. Methane powered micro turbines are another option to provide the electric power required on site but are a significant investment on their own. For most CDM projects the primary goal is to generate carbon credits through methane destruction to recover capital investments Remote and Wireless Monitoring Field server unit collects and transmits all data of the stakeholders. Secondary plans include expanding gas systems to generate electricity for sale.

Q. What happens if a power supply fails?

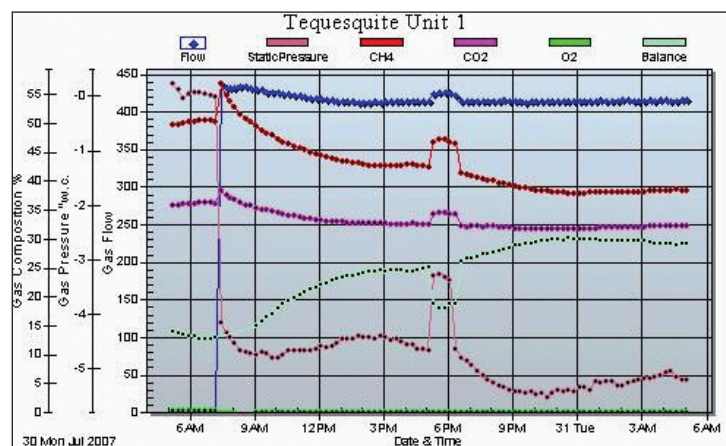
A. Normally installations have uninterruptible stand-by power from rechargeable batteries.

Q. How and by what method is data stored, then transferred and to where?

A. For CDM stakeholders, often separated by oceans, visibility of how their investment is performing on a regular basis is crucial. Carbon credits are a hot commodity and increasingly valuable. To satisfy these needs, production reports must be current and accessible from anywhere in the world. Using a secure web site enables rapid communication between all parties regardless of location.

On site, the most recent data is stored locally for recovery in the event of a communication failure. The historical record should be stored off site in redundancy to ensure its preservation. Communication between all locations is best accomplished via the web. Connection to the web is by the most cost effective and efficient manner available via landline, cellular or satellite.

In practice, from the analysers and flow meters data goes to a field server unit and then via modem to transfer, through landline or cellular networks, to a phone modem attached to a server which uploads the data to a secure website - viewable from anywhere by an authorised user.



Graphical representation of up to date site data gathered remotely

Q. Does the remote facility store collected data?

A. No. Once transferred, and ideally verified via feedback, the remote unit discards that data. Data should be stored then archived permanently on the remote server. In the event of a communication failure the most recent data is stored locally until communications are recovered.

Q. What data and when do these systems measure?

A. Varies by site requirements, and is typically defined by the Project Design Document. Typically every 10-15 minutes the systems sample gas quality measured in methane percent and, via a mass flow meter, they measure the quantity of gas produced thus providing continuously updated data confirming, for CDM and carbon credits, the amount of gas flared - or sent for generating electricity.

Q. What do these systems cost to buy, install and run?

A. As to be expected costs vary with specification and project requirements but for a CDM installation. Configured equipment, including auto-calibration system, would probably cost c. £20- 25,000GBP/ €29,400-36,800 in the Americas, Landtec AEMS systems start at US\$40,955.

Installation and training and start up vary on use and maintenance c. £6500 GBP / c. €9600. Those costs should include technical support and 12-month guarantee on equipment provided it is maintained as specified.

Operational budgets should include calibration, gas analyser maintenance and software agreements. Initial costs will probably include six-monthly service and calibration for the gas analyser units.

Q. What are the savings in man-hours and equipment?

A. These units are unmanned. Extracting landfill gas for carbon credits in the CDM market, the focus is on gas production. Improving operation efficiency will increase profitability in this market. Immediate access to site information enables faster response time to field conditions and the opportunity to improve gas production. As this measurement for CDM has to be done continuously at preset 10-15 minute intervals 24/7/365, it would be close to impossible to maintain manually or to the audit trail standards required.

Q. What are the deliverables in money-for-carbon credits or for energy?

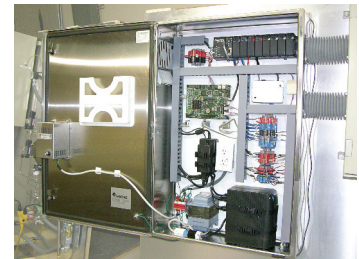
A. Output can vary tremendously but experience so far indicates that with substantial sites, return on investment with carbon credits is very fast. In more detail, deliverables include current gas concentrations, flow readings, operational status and CER calculations. Other deliverables include gas production maps, comprehensive reporting and graphing and historical reporting.

Q. Who wants what data?

A. Operators, owners, stakeholders/investors and auditors. Each party has their own requirements of what information is most important. Therefore, the presentation should be in simple summary form that can be backed up with comprehensive documentation. The data must be secure and unalterable. Carbon credits are verified by a division of the United Nations (United Nations Framework Convention on Climate Change) and these can be sold or traded through many financial institutions.



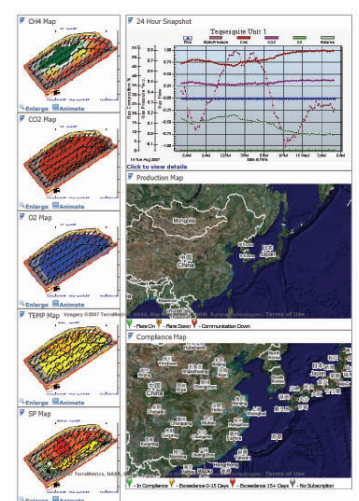
Field analytical unit - The remote gas analysis panel passes data to field server unit.



Field server unit collects and transmits all data.



Unmanned Automatic Extraction Monitoring System (AEMS) Equipment



Output in carbon credits to trade is wanted in real time 24/7 at any point on the globe making Internet-based data transmission and access essential.

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