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The Value of Continuous Environmental Monitoring in Respect of Landfill Gas, Onshore Petroleum and Contaminated Land

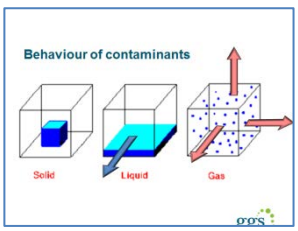
Introduction

Moving to a 'Low Carbon Economy' is vital if we are to reduce the impacts of global warming and achieve a sustainable future for the planet. And 'Low Carbon Technologies' are the vehicles that will take us to that destination. Through innovation, re-design and new technologies we are beginning to reduce energy demand, green-house gas emissions and the consumption of raw materials. We are also changing the way we think; instead of talking about 'waste management' we refer to 'resource management' where we reduce, re-use, recycle before final disposal.

My area of expertise is Environmental Monitoring and I see this as one of the key tools that will help us achieve a sustainable future. It is only by monitoring our environmental impacts that we can measure the effectiveness of the changes we make.

And Environmental Monitoring itself is also being transformed by innovation - making it more reliable, faster, cheaper and with a reduced carbon footprint. Ground-Gas Solutions is leading the way in this innovation and this presentation discusses some of the changes that have already occurred and some that are on the way.

Traditional Environmental Monitoring Techniques

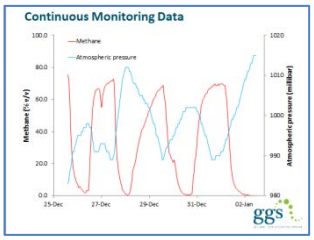


Solid contaminants will generally stay where they were deposited; liquid contaminants will form a plume that flows down gradient; gaseous contaminants in the ground expand and contract in response to changes in atmospheric pressure and temperature and are highly mobile and can travel quickly in any and all directions; contaminants in the air will be diluted and dispersed wherever the wind blows them.

Traditionally, environmental monitoring has consisted of professional staff travelling to a site, collecting samples, taking them to a laboratory, having them analysed and then reporting on the results. This approach has been used since the early days of environmental concern and the emergence of environmental science. It is an approach that is labour intensive, time consuming, expensive and not very accurate as it doesn't pick up the variation through time. If your sampling soil this isn't a problem; for everything that flows it is a problem.

Continuous Environmental Monitoring

Continuous monitoring technologies and data loggers have substantially improved the quality and quantity of environmental data. Continuous monitoring devices have been available for several years and are now used regularly for a range of situations. Ground-Gas Solutions (GGS) helped develop the GasClam; the world's first in-borehole, ground-gas monitoring device. GGS has provided a specialist service, using the GasClam and other continuous monitoring devices, for the last six years. The GGS approach is now well established and has been written into the British Standard for ground-gas monitoring[1].

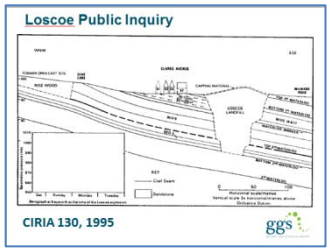


The GasClam was originally designed to monitor for landfill and other hazardous gases in proximity to proposed and existing development to assist in the design of appropriate ground gas protection measures.

Landfill Gas

The organic content within landfill wastes breaks-down and in the process produces landfill gas. This is a mixture of 70% methane 30% carbon dioxide. The methane is explosive and the carbon dioxide is an asphyxiant and both are powerful green-house gases. While the ACUMEN research is looking at ways of utilising methane from former landfill, much of GGS's work has been associated with monitoring the lateral migration of landfill gas and managing the hazard in relation to people and property.

In the UK the turning point that led to the recognition of this hazard was the explosion in the village of Loscoe. The subsequent public inquiry found that migrating landfill gas built up to explosive concentrations in the sub-floor void beneath the house and was ignited when the central heating switched on. The inquiry also established the now familiar 'source – pathway – receptor' pollutant linkage model. However, unique to ground-gas contamination events it identified a fourth factor - a driving force that pushed the gas through the ground. In the Loscoe case it was a dramatic drop in atmospheric pressure associated with a weather system that passed over the village.



It is estimated that there are 23,000 former landfills in the UK – I would expect

[1] BS 8576:2013 Guidance on the investigations for Ground-Gas. Permanent Gases and Volatile Organic Compounds (VOCs), British Standards Institute, 2013.

that Poland has a similar number. Poland has a population of 38 million. There are about 18 large cities and thousands of towns and villages - each one will have a landfill.

Originally landfills were tipped beyond the town boundary, but as the town grew those landfills which were on the edge of the town have been subsumed into the built-up landscape. Now we have high density housing, offices and commercial premises located around and over former gassing landfills.

In respect of gas monitoring the GasClam solved the problem of measuring something that was highly variable – sometimes landfill gas was there, sometimes it wasn't. It was almost impossible to get useful information from readings taken once a week using hand held equipment. It was only by continuously measuring the ground-gases that an understanding of the actual gas regime at a site could be formed. Importantly, continuous monitoring data can capture useful information in a couple of weeks instead of several months worth of weekly 'spot' readings.


Former Landfills – Now Next to Housing

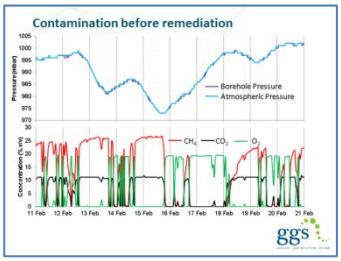
Commercially this means that effective monitoring is carried out faster and with more certainty resulting in the need for expensive gas proof membranes can be restricted to those sites that have a real hazard saving developers money and the environment resources.

Contaminated Sites


Former Quarry – Contaminated Site

This is a housing estate built in the 1980's on a backfilled quarry. The local authority believed there was a risk of ground-gas contamination and required a venting layer and a gas proof membrane to be built into the foundations of each house.

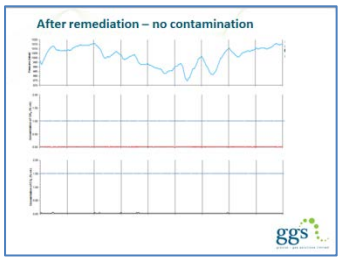
Twenty five years on some of the residents were complaining of gas odours in the houses and subsequent testing measured dangerous concentrations of methane in the houses – clearly the gas protection measures were not working.



GGS was contracted to investigate the houses in the estate and identify those houses at risk using continuous monitoring techniques. A remediation plan was designed and carried out and GGS monitored the houses again and was able to demonstrate that the houses were now safe**.**

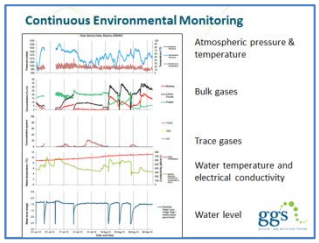

Gorebridge, Scotland – Carbon Dioxide Contamination - 64 houses demolished

A carbon dioxide problem from backfilled opencast coal mines led to a similar situation at the Gorebridge housing estate in Scotland. This resulted in the demolition of 64 houses.



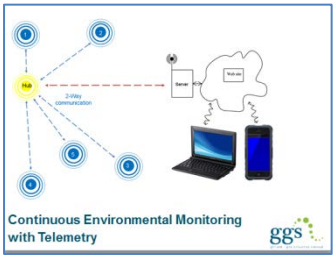
Shale Gas

Some will argue that Shale Gas and the associated hydraulic fracturing are not Low Carbon Technologies but they are lower carbon than coal. The USA has reduced its GHG emissions by switching its power generation from coal fired to gas fired plant. In Europe there is public concern over the potential environmental impacts associated with shale gas and continuous high quality monitoring before, during and after shale gas operations will be needed to address these concerns.



Over the last four years GGS has been working closely with operators and regulators to develop cost effective environmental monitoring techniques based on continuous monitoring technologies. GGS has used these on all of Cuadrilla's Bowland Shale sites and on other operator's sites. By continuously monitoring the Baseline conditions we have been able to establish the natural variations in the soil and groundwater before drilling commenced. Continuous monitoring during drilling and hydraulic fracking operations demonstrate that the operator's environmental management systems are working and no damage has occurred. This is almost impossible to do with traditional weekly monitoring techniques. GGS was commissioned to write Best Practice Guidance for Baseline Monitoring for Shale Gas Exploration and Production Sites[2]

The Next Generation of Continuous Monitoring Devices



For a range of situations, continuous monitoring has provided significant improvements to the quality and quantity of environmental data. This has not only led to cost and time savings within environmental monitoring programmes themselves, but better quality information has led to improved decision making that has saved project costs and resources.

To-date most continuous monitoring devices deployed for relatively short periods of time have been managed manually. For instance a GasClam will be taken to site, installed in a monitoring well and then collected four weeks later. Then, data is downloaded, interpreted and a report given to the client - two site visits instead of four - hundreds of readings instead of just four. But there is still that four week delay before the data is seen.

However, the next generation of devices that are available and being developed have telemetry. These new devices will allow two way communications so that data can be downloaded at any time. And, more importantly, the devices will be able to send alerts if site conditions change.

This innovation will allow environmental monitoring to be done in real-time, providing earlier interpretation and advance warnings of possible pollution incidents.

Continuous monitoring technologies with telemetry provide another step change, improving system efficiency, reducing environmental impacts and further reducing the carbon footprint for a range of sectors.

[2] Guidelines for the Establishment of Environmental Baselines for UK Onshore Oil & Gas, UKOOG, January 2015.