

Monitoring of Spanish Landfill sealings by Leakdetection and –location systems – An Example for European high standards in environmental protection and lining technology?

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Under the public pressure, mobilized by the media and additionally pushed by organized environmental protection groups, the Spanish authorities were searching for new solutions in the landfill sector. The concept for new technology landfills became contours: The base sealing system should be controlled by a suitable leakdetection and –location system to increase the safety, the required electrical energy to run the landfill operation should be supplied by natural energy-sources as e.g. solar- and/or wind energy.

Monitoring of Landfill sealings by Leak-detection and –location systems

Why a landfill sealing should be monitored?

The installation of a monitoring system can significantly reduce fears in the local population caused by a certain mistrust of modern technology and the danger of potential undetected leakages. It can help dispel worries about uncontrolled technological processes and increases the acceptance of the site by the local inhabitants.

During the construction and the depositing of the first layer of waste, leakages in the sealing can be discovered promptly. The sealing can be removed and repaired at reasonable costs. Innovative sealing conceptions can be tested under objective operational conditions to recognize the specific weak points. This could deliver important information for the development of new construction technics to avoid inherent problems.

The product liability regulations provide for a change in the burden of proof. The same applies to the burden of proof in the environmental liability regulations in pollution cases. With the help of a monitoring system the operator of the landfill site can put himself in the position of demonstrating that the site sealing system functions correctly and that the site is not the cause of the problem.

Requirements on a monitoring at landfills

Long-term durability

Sealing systems must be guaranteed to function for a period of well over several decades.

The life span of a monitoring system must be at least as long as that of the sealings.

Simplicity

A monitoring system must be as simple as possible in its function and in its installation. It should be based on a clear, unambiguous measuring principle. The simpler the construction the less likely there is to be a component failure. It should not negatively influence the construction or function of the sealing.

Back up

Systems that must be guaranteed to function properly over long time periods must be able to continue in operation if one of the individual components fails. This requirement is met when various components and measuring principles back each other up

Direct monitoring of the sealing

Monitoring systems can either directly check the state of the sealing and so determine any deterioration of its condition, or they can operate indirectly by detecting the consequences of any such deterioration. Direct monitoring is fundamentally preferable in that it detects problems within the sealing before pollution arises.

Self-testing

Monitoring systems must possess the possibility to regularly test their own functions. This prevents false alarms from arising or what could have more serious consequences - a failure in the sealing going undetected

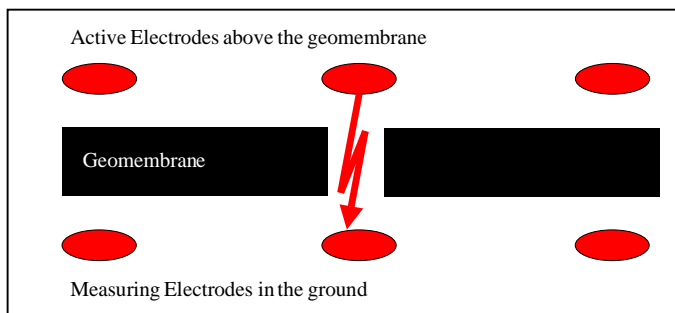
An experienced supplier of Leakdetection and location systems which could reach all requirements was found in Germany. The company GEOLOGGER SYSTEMS had realized already several comparable projects in the landfill sector with its product GEOLOGGER. The company is part of the PROGEO Holding AG group. PROGEO AG is at the German stock market.

GEOLOGGER

Are there any leaks? - The Measuring Principle of Leakdetection:

The sealing in base liner systems of landfills is made of HDPE, a non conductive Polyethylene. This liner is a perfect electrical insulator and works as a full-area electrical barrier.

GEOLOGGER is measuring the electrical resistance of the HDPE membrane. Measuring electrodes are installed below the liner in a distance of approx. 6m x 6m. A set of active electrodes is installed above the liner. Through the active electrodes above the liner an input of measuring voltage is brought into the layer above the membrane. As long as there is no leakage in the liner, the electrical potential remains above the liner. As a result, a high electrical resistance value is measured at the control box. In case of a leak in the liner, the electrical current will pass from the layer above through the leak to the ground below the liner. As a consequence the electrical resistance decrease to nearly zero.

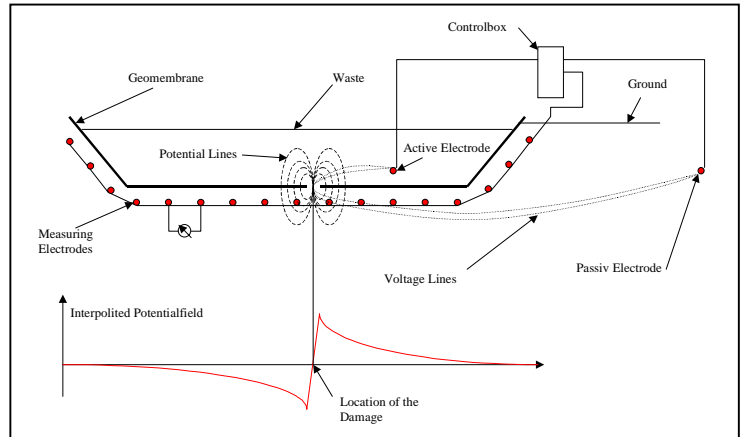


Where is the leak? - The Measuring Principle of Leaklocation

After the detection of leaks the coordinates of the leak has to be determined, to allow a quick and cost-effective repair of the liner:

The electrical potential above the liner introduced by the active electrodes is spreading through the leak to the ground below the liner and the passive electrode which is installed outside the landfill. Around the voltage lines an electrical potential field is build up. This potential field has its maximum at the leak.

The measuring electrodes below the liner are able to measure potential differences in the ground. With the help of these electrodes the correct position of the leak can be measured.

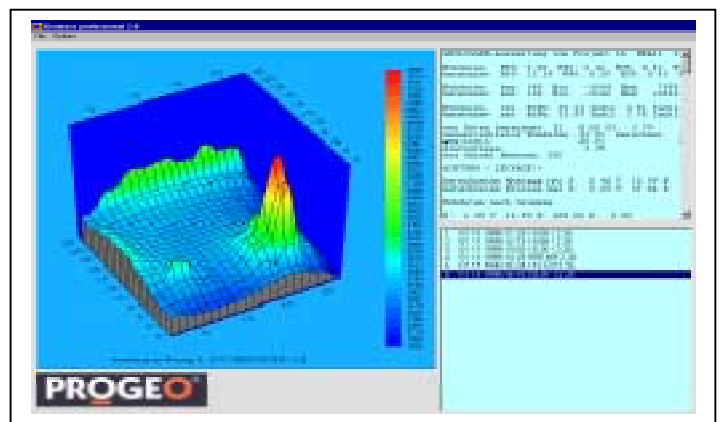


Components:

The components of GEOLOGGER are especially developed for the landfill requirements. The electrodes are made of carbonfibre, a material which is resistant against biological, mechanical, chemical, electrical stresses and corrosion. All connection wires are insulated by HDPE, the material which is used for the liner. The measuring equipment is available in a fully automatically operating online-version with datatransmission and maintenance by modem and a power supply realized by solar panel. Selftest-procedures are performed before the measuring.

Evaluation Software

The results of a measuring are visualized by a special Evaluation Software delivered by PROGEO



Case Studies

The benefits of a leakdetection and localisation system shall be introduced by three case studys

– landfills built in Spain within the last two years. “La Cerdanya” is a good example for the benefits of the Online technology, “Montoliu” which was installed in a record time reaching up to 8.000m² per day and last but not least “Gijon” as an example for industrial waste.

Case Study I : Example for Online-Monitoring - Landfill “La Cerdanya”

Catalunia was the first region of the federalist Spain, coming up with a realization in summer 1998. In the middle of the pyrenees right next to the French border, the first landfill project started with the new concept:

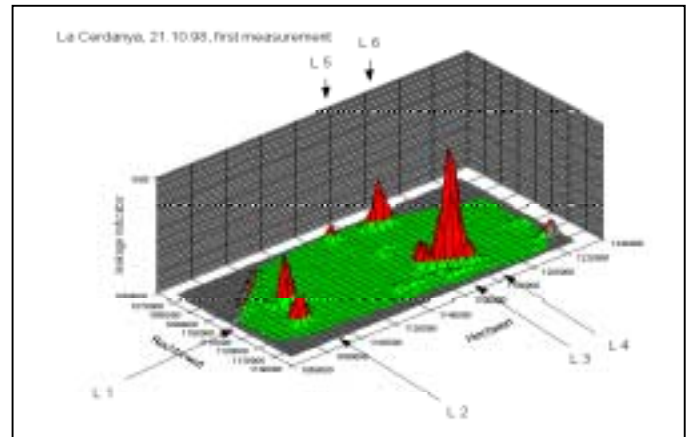
The landfill La Cerdanya is situated on the slopes of the pyrenees, next to the towns Belver de Cerdanya and Puigcerda. It is a new landfill founded in 1998 with a planned maximum capacity of 500.000m³ municipal waste. The total area of the landfill base will be 50.000m². In 1998 the works for the Base Sealing System began for the first construction part on an area of approx. 10.000m². The landfill lies on the slope of a mountain. During the excavation works three walls were built around the landfill. The wall slopes are steep, approx. 45 degrees. The construction company and future operator of the landfill was ROMA, Lleida. The installation of the liner was performed by TERRATEST GROUP, Madrid.



The measuring system contain approx. 400 measuring points connected by 16 connection wires to the control box. The system is set up as an online version for continuous measurements and is generated by solar energy. Datatransmission is carried out by modem. The system has a warranty of 4 years.

After the installation of a 1m mineral layer, the measuring electrodes were installed in a distance of 5m x 5m and then covered by a 1,5mm

HDPE liner. Three active electrodes were fixed upon the liner, then the liner was covered by a 10cm sand layer for protection. After the covering of the liner was completed the measurements could start.

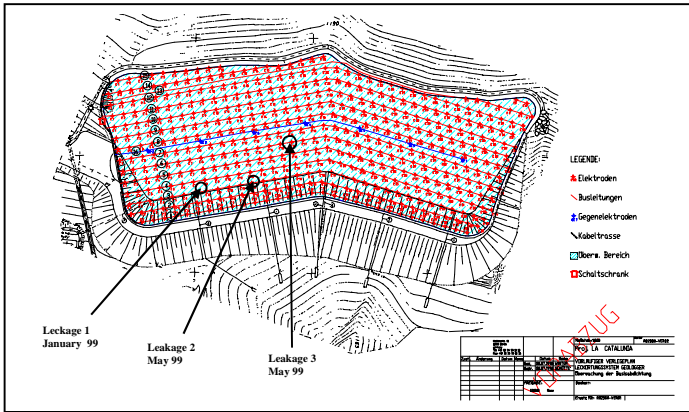


Several leaks were detected and located during the first measurements in November 1998. All leaks were caused by installation works. The size of the leaks varied from 5 mm up to over 1m. The geometry differed in relation to the situation that caused the leak between round and indefinite. Size, geometry and the position of the leaks allowed in most cases a detailed reconstruction of the situation which consequently led to the reason how the liner was penetrated: Stones being pressed through the liner, as well as knife-cuts, incorrect weldings or big damages caused by bulldozers or trucks during the phase of distributing the sand upon the liner. Bearing this in mind it is remarkable to note that the biggest leak in that project lay quite close to the lowest point of the sealing right next to the main collecting drainage tube. A leak like that, remaining undetected would have weakened the stability of the wall extraordinarily over the years. The detection of that single leak already amortized the investment in the monitoring system.

After the first measurements the system was tested by the local authorities: Representatives of the Junta de Residus, Barcelona. Testleaks of different sizes were applied and had to be detected and located by the system. After the successful test, the system was handed over to the customer and operated continuously online.

In January and May 1999 the system gave an automatic alarm. An alarm light switched on and the data was transmitted to Berlin to evaluate

the location of the leaks. The coordinates were sent to the operator and the excavation of approx. 1m of waste guided directly to new leaks.



On May 21st 1999 the official inauguration of the landfill La Cerdanya took place in the presence of members of regional politicians and spanish landfill experts. The press feedback focussed especially on the integrated concept with a mix of solar-, wind-energy and the monitoring system in operation for the first time on a spanish landfill.

Case Study II: An example for installation progress - Landfill Montoliu

The landfill Montoliu is the new central landfill for the region around Lerida. The size of the base liner sealing system is approx. 34.000m². The construction began in August 1999 and was completed in December 1999. The topographic situation is flat and the geometric form is rectangular. The landfill is surrounded by four walls with a slope angle of approx. 45 degrees. The construction company was the company FCC, Madrid, the installation of the liner was performed by TERRATEST GROUP, Madrid.



The measuring system contain approx. 1000 measuring points connected by 48 connection wires to the control box. The system is built as an offline version for periodic measurements. The warranty of the electrodes is 1 year for the first half of the area and 3 years for the second half. After the installation of a 1m mineral layer, the measuring electrodes were installed in a distance of 5m x 5m and then covered by a 1,5mm HDPE liner. Eight active electrodes were fixed upon the liner, then the liner was covered by a 300gr/m² geotextile as protection layer and then with 50cm of gravel.

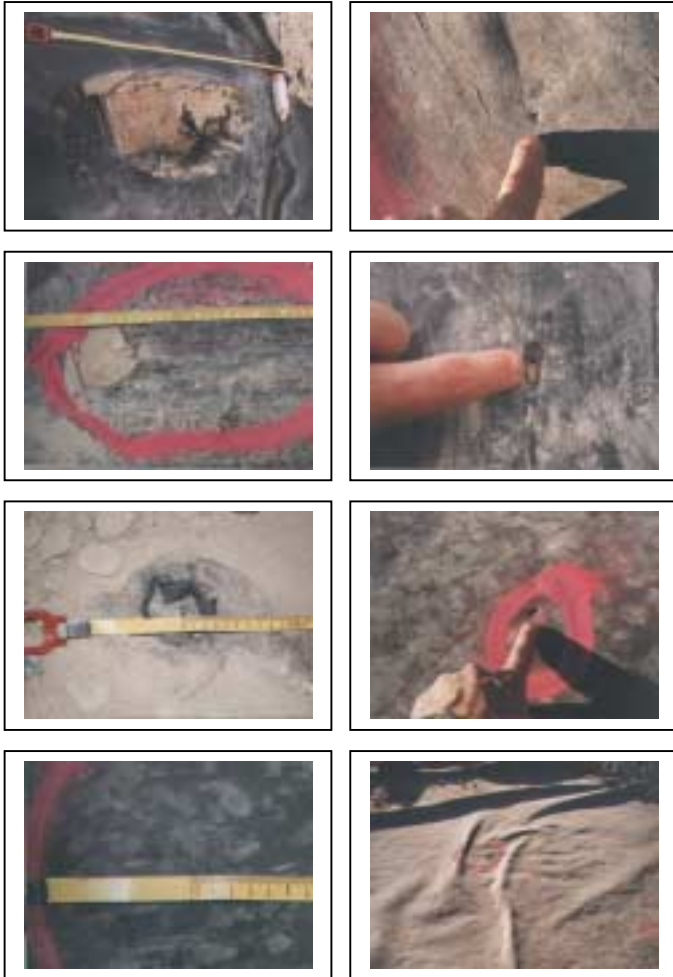
The installation of the lower GEOLOGGER electrodes was optimized. Instead of digging the cables into the mineral layer in a defined depth of 2cm, the electrodes were layed upon the mineral sealing and covered with a sand line to prevent the liner from mechanical stresses. Consequently the daily installation progress could be augmented up to 8.000m² per day.

The controlbox in the offline version contains connection platforms for every single wire followed by a socket, to allow "plug and play" periodic measurements with a mobile measuring equipment. A new connection technique fastened the connection process.

After the covering of the liner was completed, the measurements could start. Several leaks were detected and located during the first measurements in December 1999. All leaks were caused by installation works. The size of the leaks varied from less then 1mm up to over 1,5 m. The geometry differed in relation to the situation that caused the leak between round and indefinite. In most cases the reason for the damages



could be reconstructed. The distribution of the gravel above the liner was performed by bulldozers. The installation of the drainage pipes into the gravel layer partly was carried out with heavy machines. The overwhelming part of the leakages were caused by stones being pressed through the liner. The required forces were delivered in some cases by the great weight of the used machines, in other cases high wheel forces of pulling machines led to big damages in the liner.



After the first measurements the system was tested by the local authorities: Representatives of the Junta de Residus, Barcelona. Testleaks of different sizes were applied and had to be detected and located by the system. After the successful test, the system was handed over to the customer.

The landfill Montoliu is in operation since the 1st of January 2000. The measuring will be repeated once a year.

Case Study III: An example for industrial waste treatment – Landfill Gijon

The landfill Gijon is based in the region of Asturias. In contrast to Cerdanya and Montoliu – both are landfills for municipal waste – the Gijon landfill will be used for industrial waste from the company ACERALIA. The size of the base liner sealing system is approx. 22.000m². The construction began in December 1999 and was completed in February 2000. The topographic situation is flat and the geometric form is a complicated multiangle. The landfill is surrounded by four walls with a slope angle of approx. 45 degrees. Construction Company was the ACS, Asturia, the installation of the liner was performed by TERRATEST GROUP, Madrid.

The measuring system contain approx. 600 measuring points connected by 31 connection wires to the control box. The system is built as an online version for continuous measurements. Datatransmission is carried out by e-mail and modem. The system has a warranty of 5 years. After the installation of a 1m mineral layer, the measuring electrodes were installed in a distance of 6m x 6m and then covered by a 400gr/m² geotextile followed by a 2 mm HDPE liner. Six active electrodes were fixed upon the liner, then the liner was covered by industrial sand.



The first measuring is due to be performed in March 2000.

Summary

The described landfills are examples for the new high Spanish standard in landfill technology. The key to more safety for these sensible constructions is a reliable monitoring system.

Spain nowadays is on the way to becoming a leading European country in environmental protection.