

Case Study

application | Hydraulic works – Dams, Dikes, Canals and Levees
location | Europe
product | TenCate GeoDetect® S-BR

TenCate™ develops and produces materials that function to increase performance, reduce costs and deliver measurable results by working with our customers to provide advanced solutions.

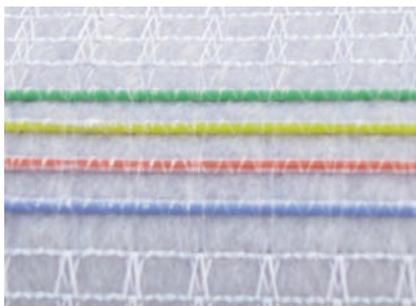
THE CHALLENGE

Owners of waterways are managing a large number of aging structures with a wide variety of service and function. The problem facing the canal, dike and levee owner today is to limit the impact of this aging phenomenon. The most serious issue is safety and reducing the risk of failure. One of the key ways to maintain safe, working structures is by the proper management of the water resource. Leakage and erosion control are the most important issue for both maintaining the health and safety of waterway structures as well as maintaining the most important resource: water.

Monitoring the behavior of new and old earth dams is also a key issue in the field of dam maintenance. Thanks to the early detection of a malfunction such as leakage, erosion, relative deformation or settlement, it is possible to react very fast or to verify the performance. Monitoring allows for better planning for repair and maintenance work.

THE PRODUCT

The TenCate GeoDetect® monitoring solution



The TenCate GeoDetect® S-BR sensor with the embedded colored optical cables.

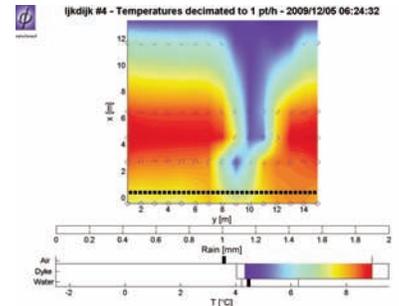
detects both internal erosion and instability. It is based on the combination of a geotextile with embedded fiber optic cables that are connected to appropriate optical instrumentation. The detection of the leaks, at the early stage of the internal erosion process, is assessed through temperature change measurements using either the passive method or the active heat pulse method. The first stages of dike settlement or sliding are detected by strain measurement. The global solution incorporates the system design within the structure and the interpretation of the raw thermal and strain data which was carried out in partnership with the geophyConsult company. The physico-statistical and signal processing methods allow the system to send “early warnings” and are compatible with long-term monitoring.

THE CONSTRUCTION

To validate the TenCate GeoDetect® solution of detecting and quantifying leaks in a dike, a full-scale experimental structure was built on the Cemagref site in Aix-en-Provence, France. The main result from the experimental program validated the ability of TenCate GeoDetect® to detect leaks through an earthdike with the order of magnitude of less than 1 l/min/m. Another experimental dyke was built within the Dutch IJkdijk (Smart Calibration Dyke) project to test the ability of sensing systems to detect the first signs of internal erosion.



The TenCate GeoDetect® BR sensors installed under a liner (Cemagref Aix).



Temperature profile from the TenCate GeoDetect® sensor analyzed with the EDF model by geophyConsult (view from top of the dike).

The piping channel was detected from 2 days to 5 days before collapse, depending on the data processing level. The strain into the subsoil resulting in the build-up of the piping channel was also observed with the TenCate GeoDetect® S-BR system several hours before collapse.

Another important application for water resources management in waterways is leakage detection through a thin geomembrane lining system. The ability of the TenCate GeoDetect® system to perform this function was assessed within a trial carried out at the Cemagref basin. Leaks of the order of magnitude of 0.2 l/min per meter through the liner were detected.



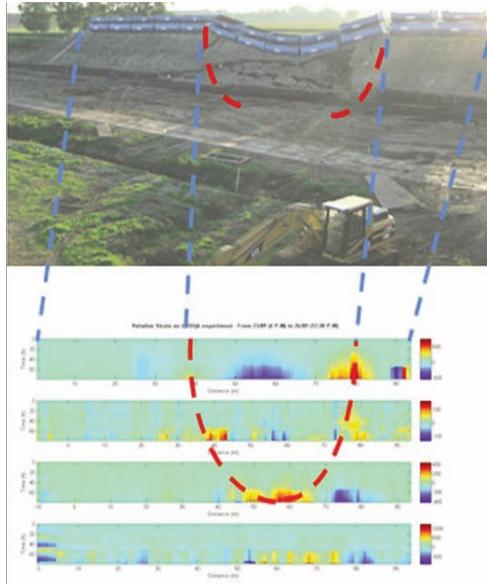
The IJkdijk piping test model after collapse due to piping.

The TenCate GeoDetect® solution was installed on the dike built for the first phase of the IJkdijk project which was focused on the macro stability of dikes. The TenCate GeoDetect® sensor was placed under the clay revetment, to measure the strain of the embankment. During the test, the global factor of safety of the dike was decreased step-by-step until failure occurs. The monitoring system worked perfectly by being the first solution among ten other monitoring techniques to detect and localize the border of the instable zone. Strains inside the dike body as low as 0.02 % were detected localizing the failure zone about two days before the dike collapsed

THE PERFORMANCE

Several real sites are being monitored with the TenCate GeoDetect® monitoring solution. Among them, a dike section of about 100 m long and 3 m high along the canal from the Marne to the Rhine owned by the French Waterways in the eastern part of France. It has been monitored since 2008 and one temporary leak and a settlement have been detected.

Another 1km long section of the Authion Loire river levee is being monitored. The purpose is the detection of weak points occurring during a flood event.



The experimental dike after failure and the corresponding measurement of the strain several hours before failure.



Three TenCate GeoDetect® S-BR strips on the Loire river levee.



The GeoDetect® S-BR strips on the Marne to Rhine canal.

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