

A FLEXIBLE WELL INTEGRITY MONITORING SOLUTION OF THE ENTIRE THERMAL OBSERVATION WELL WITHOUT THE NEED FOR TUBING, OR A SERVICE RIG OR A HOIST

Sensornet's revolutionary FibreDip™ system is an extremely versatile Digital Monitoring solution. The easily deployed, self-supported system is used to understand the boundaries and communication layering of the steam front while condition monitoring the casing integrity of the surrounding production wells. To date FibreDip™ has been successfully installed by Sensornet in Alberta, Canada and Oman.

Vertical wells that benefit from Sensornet's FibreDip™ monitoring solution include:

- Thermal observation wells
- Limited rig / hoist availability / accessibility
- Remote well locations

CLOSE THE MONITORING GAP

With conventional technology there is a gap between what you believe is occurring in your well and what is actually happening. This information gap can result in a delay in reacting to an inwell problem leading to potential loss of production or impact to well integrity. Sensornet's revolutionary technology overcomes the limitations of measurement technologies available today to close the Monitoring Gap and improve well integrity and performance.

MONITORING GAP WITH EXISTING TECHNOLOGY

Conventional monitoring technology such as periodic PLT intervention or tubing conveyed monitoring systems require downhole tubing or undesirable well intervention. These intervention techniques often have to be carried out on a regular basis, can be very expensive and also can increase the risk of logging equipment becoming stuck in the wellbore.

SENSORNET FIBREDIP™ SOLUTION

The FibreDip™ system is an extremely effective, retro-fittable installation technique that eliminates the need for a tubing conveyed system. Once the completion is installed, the Sensornet team can install the FibreDip™ system at any time, without delay to operations. The FibreDip™ sensing cable is reeled into the well by itself using a sinker bar system in conjunction with a spooler unit and a sheave wheel (suspended on shear legs or wireline boom) and is a low-risk, quick installation method. Depending on customer requirement, the FibreDip™ system can be combined with a pressure gauge upon request.

BENEFITS OF FIBREDIP™

The self-supporting FibreDip™ system has a number of key advantages over a tubing conveyed system or periodic intervention by wireline temperature log namely:

- Permanent installation that can be retrieved months or years later and installed elsewhere
- Continuous condition monitoring of thermal process and well integrity
- Deployed without the need for a workover rig or hoist at well site
- Retro-fit into existing completions
- Production tubing is not necessary
- System can be deployed in any hole size – either cased or open hole
- No tubing hanger or bypass ports required for the sensing cable
- Simple and fast, one-time sensing cable installation
- System is retrievable and can be redeployed in other wells
- No modification to existing wellheads – with no requirement for by-pass ports to be drilled.

Further advantages with the FibreDip™ system over other retro-fittable installations techniques (e.g. pumped fibre techniques) also include improved protection to the fibre, which eliminates possible micro-bending during installation (which can compromise the temperature measurement due to increased signal attenuation). The lean approach of the FibreDip™ also results in a lower cost from both an operational standpoint (less rig time needed) and a material standpoint (no dual 0.25" tube required). Due to these low risk operating conditions there is a lower possibility of any need to retrieve the sensing cable and increased probability of success.

PRINCIPLE OF MEASUREMENT

The FibreDip™ system comprises of Sensornet's world class fibre optic distributed temperature sensing (DTS) technology and services, as well as our leading expertise in data interpretation with our partner FloQuest. With Sensornet's FibreDip™ system the sensing cables are installed down the well without requiring well intervention or any tubing down the well. The distributed fibre sensors provide temperature and information every 1m along the length of the wellbore, thus providing complete integrity.

The key to obtaining valuable production or injection well performance data using distributed temperature sensing data relies on two key factors. Firstly, the DTS must be able to detect very fine temperature changes. The Sensornet DTS is able to measure temperature changes of less than 0.01°C at all points along the reservoir, thus detecting any nearby steam front/breakthroughs very quickly. Secondly, in order to extract valuable information from the temperature data it is essential to combine the data with information on the geology, reservoir fluids and the completion. Our partner FloQuest has both the interpretation engineers and software modelling to provide you the valuable information from this data.

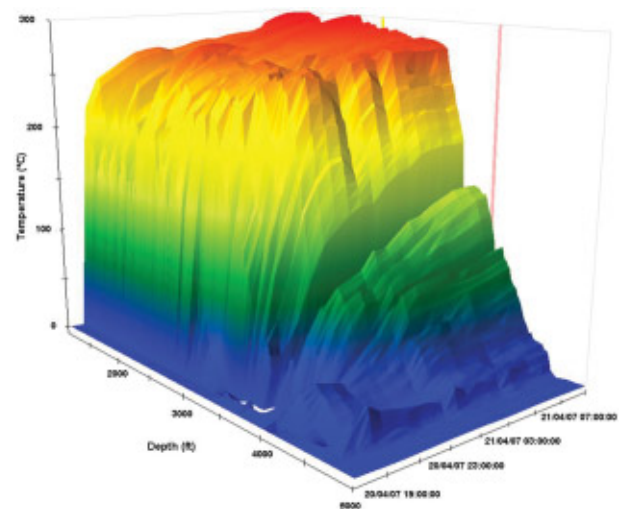
DATA INTERPRETATION

With meticulous and incisive analysis we create real value from your temperature information. By partnering with FloQuest Sensornet are able to provide you with high quality data as well as the knowledge required to optimise your asset. With strengths in inflow modelling and permanent sensing we have the tools and skills to make a difference throughout your well's production life. Founded in 2006, FloQuest is the industry leader in providing petroleum engineering consulting and product development services within the oilfield sector.

VALUE OF DTS MONITORING

Monitoring of the complete well provides a simple method of identifying the reservoir layer and understanding the growth of the steam front over time. The trending data gives an indication of the applied steam pressure and the effectiveness of steam placement and the ensuing heating of the reservoir zone - see FibreDip™ DTS graph below.

Reservoir description can be corroborated by the identification, or not, of any heating events in the well. Integrity of the well can be monitored for any steam breakthrough in unknown channels.



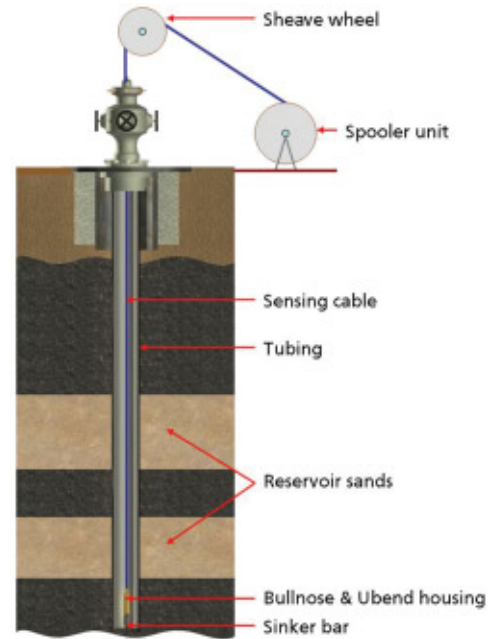
Sensornet high temperature DTS well monitoring

DEPLOYMENT METHOD

The FibreDip™ system is designed to be retrievable once the steam front has passed and then redeployed in another thermal observation well. The FibreDip™ system utilises self supported fibre cable eliminating the need for any tubing. The 0.125" or 0.25" O.D. cable is reeled into the well by itself with a sinker bar to encourage deployment. As before, the sensing cable has an optical u-bend housing at the downhole end, to protect the fibre splice and provide a double-ended configuration. Once the sensing cable is deployed into the well the bull plug is replaced with a pressure pack-off to seal and suspend the weight at the wellhead.



SensorNet FibreDip™ system in operation – spooling of self-supported sensing cable through the wellhead



FibreDip™ setup

MECHANICAL INTERFACES

- The Optical U-bend housing is connected onto the cable prior to arriving at the wellsite. This assembly provides protection for the fusion splice fibre connection or Miniature U-Bend. The U-bend housing is designed to connect to a series of sinker bars when additional weight is required.
- The wellhead bull plug is replaced with a pressure pack-off (Coil Tubing hanger) to seal and suspend the cable weight at the wellhead. In practice the weight is negligible.

SENSING CABLE DESIGN

SensorNet's proprietary cables have been specially developed to survive in hostile, high pressure and hydrogen rich atmospheres. The rugged design of our sensing cable protects the fibre more effectively during installation, as well as against the effects of hydrogen and corrosion through the life of the well.

SensorNet's range of sensing cables are designed to provide a number of benefits over pumped fibre (fluid drag of bare fibre). Pumping of bare fibre, using fluid drag, generally results in:

- Fibre damage (micro bending)
- Poor resistance to hydrogen damage
- Expensive additional rig-time when installing the completion
- Increased risk to wellbore integrity and personnel exposed to wellsite hazards.



SensorNet Data Engineer performing a drive-by data service on a water injection well

PERMANENT OR PERIODIC FIBREDIP™

Depending on the production engineer's requirements, the sensing cable can either be installed on a permanent basis or can be simply retrieved and re-deployed in new observation wells. The wells can either be connected into a central DTS unit or drive-by surveys can be performed on a periodic basis using SensorNet's mobile ruggedised DTS surface unit. These regular drive-by surveys can be taken without any need for well intervention.



SENSORNET PROVIDES THE COMPLETE SOLUTION

Providing the full suite of hardware, installation, project management and interpretation services SensorNet is able to offer a simple one-stop solution for your permanent monitoring requirements. As a part of our commitments to our ISO 9001 procedures we are dedicated to providing you with the highest level of service at all times.

ENGINEERING DESIGN

The SensorNet team will design the entire engineering solution for you. This includes the fibre optic cable, all required in well components (splices, housing) and termination and junction boxes. All components are environmentally certified and approved for use in hazardous zones.

INSTALLATION SERVICES

For more details on the SensorNet FibreDip™ system or for a custom engineered solution to meet your well specifications, please contact your local SensorNet representative.

SensorNet has highly trained personnel and equipment to perform fibre optic installations across a number of industries. Each specific installation requires specialised knowledge and equipment as well as dedicated fibre optic cable designs. SensorNet has built this knowledge over a number of years and together with installation partners is able to tackle the most challenging of installations.

PROJECT MANAGEMENT

The SensorNet team will manage your entire project right through to its handover. We operate to the highest standards of quality; our solution is, after all, about increased safety and security. We are ISO 9001 accredited and meet all Health & Safety Executive requirements.

For more details on the SensorNet system or for a custom engineered solution to your well specifications please contact your local SensorNet representative.

SensorNet has offices in Europe, North America, Middle East & Asia – please see our website for details

www.sensor.net.co.uk

To close your monitoring gap,
call +44 20 8236 2550
or visit www.sensor.net.co.uk

DATA INTERPRETATION

To extract real value from Distributed Temperature Sensing data, it's essential to have the expertise to interpret the distributed temperature data and to provide valuable information to help you both manage risk effectively and to optimise your operations. SensorNet works with the leading experts such as FloQuest who provide the expertise, experience and advanced modelling algorithms required for Digital Flow Profiling and Digital Well Integrity monitoring.

TRAINING AND SUPPORT

SensorNet offers a full range of training options to ensure that your staff are proficiently equipped with the knowledge that they need to get the very most out of our monitoring solutions that we offer you. SensorNet has an international client base and operates in all of the major industrial markets. SensorNet services numerous international projects and has offices and support centres in Europe, North America, Middle East and Asia. We offer numerous after-sales service options to ensure continuous piece of mind.