Real time monitoring for oil production and drilling

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Sensorlink AS
About Sensorlink

• Sensorlink is a Hi-Tech company
  – concentrating on real time monitoring of important data for oil production and drilling.

• Our products can be accessed in real time from offshore and onshore locations
  – enabling field and office teams to share data and make joint decisions quickly.
About Sensorlink

- Established in 1997
  - Trondheim, Stavanger, and Houston
- High level of technical competence and experience
  - Electronics, physics, acoustics, IT, signal processing, mathematical modelling, materials and production (corrosion)
- Cooperation with NTNU, thesis work (good place for recruitment!)
  - Master students
  - PhD students
Sensorlink technology

- ELF (electromagnetic Extremely Low Frequency) system for through steel wall communication
  - Spin-off: Pistontrack, an accumulator monitoring system on floating rigs

- Ultramonit, multichannel ultrasound for monitoring purposes
Ultramonit™ – what is it used for

- Real time corrosion and erosion monitoring
- Benchmarking of results from other inspection methods
- Monitoring of found defects
- Effects of corrosion inhibitors
- High resolution
  - detects corrosion rates of 0.1 mm per year or better
Ultrasound

- Sound waves with frequencies higher than 20kHz
- Applications:
  - Medicine (ultrasound imaging, intravascular flow measurement, tissue characterization)
  - NDT (thickness measurement, flaw detection, imaging)
  - Flow measurements
  - etc...
Ultrasound at Sensorlink

- Direct wall thickness measurements
- Multiple (hundreds of) ultrasonic transducers are built into a clamp, shaped to fit the pipe
- New pipes or retrofit
- Real time monitoring
In-house developed electronics for ultrasound

- Designed for high pressure, marine operations
- Extremely good signal to noise ratio
- Low power consumption
Datalogger

- The datalogger includes
  - a mini PC
  - memory card
  - batteries

It controls the clamp, records data and provides real time communication.
Transducer design

Cross section of pipe wall with defect

Wave propagation computed by 2D numerical model
Ultrasound pulse - echo waveform

\[ \text{thickness} = \frac{t \cdot c}{2} \]
On-line long term laboratory testing

- Data logger
- Internet
- Ultrasound instrumentation
- Plastic sleeve
- Ultrasonic transducer
- Neutral fluid
- Steel test sample
- Salt water or added acid
Three weeks of data, showing the effect on corrosion rate of changing pH

- **From 2007/08/15 00:00:00 To 2007/09/05 00:00:00**

  - **Journal entry 1**: Emptied tank, filled with tap water, pH from 4.0 to 7.1

http://www.sensorlink.no
Corrosion measured in 24 hours in the laboratory

http://lab.sensorlink.no
Pilot installation, onshore gas processing plant
Long term field measurements at processing plant

CO2 corrosion in pipeline bend

Wall thickness [mm]

Date

Position 0° (upwards)
Position 90° (inwards)
Results from the gas plant installation:

- Results in excellent agreement with other NDT methods
- Corrosion was consistently detected, and the pipe was replaced earlier than planned
- The high resolution gives very rapid estimation of corrosion rates, at an accuracy of 0.1 mm/year or better
Real oil field installation

- The clamp is installed by a Remote Operated Vehicle
Ultramonit Clamp for a 34” export pipeline
A whole lot of equipment goes to sea
Installation completed
Latest installation, on a 14” water injection riser
Movie taken by ROV during installation