NDT DEVICE SERIES

the next generation NON DESTRUCTIVE TESTING
reduce risks and optimize lifetime of your equipment
Locations

Kurotec-KTS Kunststofftechnik
Stade GmbH
Am Bullenhof 25
21680 Stade
http://www.kurotec-kt.de

Kurotec- KTS Niederlassung
Schkopau

KUROTEC POLSKA Pyskowice /
Kozielice

KTS EOOD
Bulgaria

KUROTEC International
Abu Dhabi UAE

RTD Dülmen GmbH
Dülmen
Online monitoring of FRP Fiber Reinforced Plastic equipment

NDT VISION FOR FRP INSPECTION
What kind of system?

- It is a procedure for non-destructive testing (NDT):
  - online 24/7 days, network based online monitoring

What's new?

- Measuring of material disturbances as a result of outside influences – > online

What do we measure in the material FRP?

- static strain (statics, temperature, impacts)
- dynamic strain (e.g., oscillations by bearing damage of pumps)
- degradation (material aging, crack development, material damage)
# FRP Inspection methods – status quo

<table>
<thead>
<tr>
<th>Method</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>External visual control</td>
<td>Cracks, discoloration delaminations, mechanical damages</td>
</tr>
<tr>
<td>US-Measurement</td>
<td>Wall thickness reduction, compare actual value with specified value</td>
</tr>
<tr>
<td>Illumination from outside (only in the dark)</td>
<td>Damages to be seen as dark spots</td>
</tr>
<tr>
<td>X-ray</td>
<td>Wall thickness reduction, delaminations, deposits, quality of joint laminate</td>
</tr>
<tr>
<td>Core hole drilling (2&quot;)</td>
<td>Condition of laminate, wall thickness measurement by hand</td>
</tr>
<tr>
<td>Camera inspection, Endoscopy</td>
<td>Visual control from inside: condition of internal surface</td>
</tr>
</tbody>
</table>
NDT Vision for FRP Inspection

A predictive approach to monitor FRP equipment with an online device using **SHM (Structural Health Monitoring)** and **CMS (Condition Monitoring System)**

- Damage detection and characterization using:
  - Lamb wave based sensor technology
  - Analytical software
  - IoT / Industry 4.0 dashboard and data transfer
IoT Architecture & Application

- Equipment starts showing signs of failure
- Capture and send data
- Cloud based data analytics and failure detection
- Repair and replacement can be planned and scheduled
- Monitoring alerts 24/7, Dashboard & Software
- Real time
Stages of development

- Ideation 2013
- Lab Tests 2014
- Scale up 2015
- Field Tests & Pilot 2016
- Realization 2017 Q1
SHM with Lamb-Waves

Interaction of defects with lamb waves in complex geometries

Presentation of lamb waves in defect areas

Fatigue crack detection with lamb waves
Lab Tests and Pilot

**Impact test**
Load applied in 3m distance from sensor monitored

**Chemical degradation test**
Accelerated chemical attack monitored

**Field test**
Monitored results verified by cut out sample
Field installation

Microcontroller radio - sensor with QR Code
direct link to dashboard

Gateway installation industrial park
Long Range Wide Area Network – LoRaWAN

Online sensor technology to improve ...

- safety
- productivity & efficiency
- lifetime extension of your FRP assets

• Gateway

Network coverage
Applications

**Realised**
- SHM monitoring of FRP equipment

**Pilot phase**
- Wall thickness measurement of FRP and CS Equipment

**Future planning**
- Sound-level measuring
- Gasket settlement stress monitoring
- Bolt torque monitoring
- GPS Tracking
- Temperature
- Gas detection
- Custom made solutions and much more
Dashboard

- **Data management e.g.**:
  - Localization
  - Condition visualization
  - Data analytics
  - Alert management
  - Multi functional platform
### Sensor 0004A30B001BE7A4

<table>
<thead>
<tr>
<th>Status</th>
<th>Karte</th>
<th>Diagramm</th>
</tr>
</thead>
</table>

- **Status:**
  - 6.96V / 3.48V
  - 23°C
  - 222kHz
  - MAX 2945 / 2704
  - MIN 1289 / 1473

- **Degradation:** Warnung
- **Statische Belastung:** Kritisch
- **Dynamische Belastung:** Warnung

- System funktioniert einwandfrei
- Browmout detektiert
- Letzter Systemtest
- System OK

- **Anzahl Anregungen:** 13
- **Anzahl Messungen seit letztem Reset:** 362
- **Anzahl Watchdogs Restes:** 0

**Adresse:** Am Bullenhof 27
21680 Stade
Deutschland

**Breitengrad:** 53.605586
**Längengrad:** 9.488461

### Diagramm

- **Degradation**
- **Dynamische Belastung**
- **Statische Belastung**
Advantages

Reduce maintenance cost
Reduce labour cost, less maintenance time and universal test method

Reduce downtimes
Avoid output losses

Improves safety and reliability
Enables plant to stopped safely
Alarm settings

Overview about pipesystem and equipment in real time
Predictive maintenance
Thank you for your attention!