

Industry 4.0 – Online Monitoring of FRP Equipment Communication with FRP- Materials



LOCATIONS

Kurotec-KTS Kunststofftechnik Stade GmbH
Am Bullenhof 25
21680 Stade

<http://www.kurotec-kts.de>
Tel.: +49 (0)4141 9995-0
Fax: +49 (0)4141 9995-55
Email: info@kurotec-kts.de

Kurotec KTS Niederlassung Schkopau

Branch Office Schkopau
Value Park Bau A60
06258 Schkopau

RTD Dülmen GmbH

Wierlings Busch 58
48249 Dülmen
Tel. +49 (0)2594 / 787213
Fax +49 (0)2594 / 787215

KUROTEC-POLSKA Sp. z o.o.

<http://www.kurotec.com.pl>
Ul. Gliwicka 18
PL-44-120 Pyskowice

KUROTEC-POLSKA Sp. z o.o.

Kozielice 109
PL-74-204 Kozielice

KTS EOOD

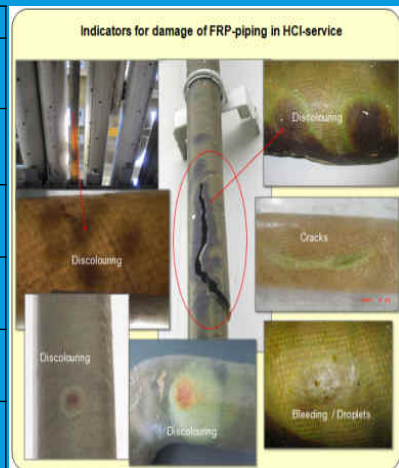
<http://kts-bg.com>
Tsar Simeon Veliki 158
BG-6000 Stara Zagora





FRP INSPECTION METHODS – STATUS QUO

Method	Result	Picture
External visual control	Cracks, discoloration delaminations, mechanical damages	
US-Measurement	Wall thickness reduction, compare actual value with specified value	
Illumination from outside (only in the dark)	Damages to be seen as dark spots	
X-ray	Wall thickness reduction, delaminations, deposits, quality of joint laminate	
Core hole drilling (2")	Condition of laminate, wall thickness measurement by hand	
Camera inspection, Endoscopy	Visual control from inside: condition of internal surface	



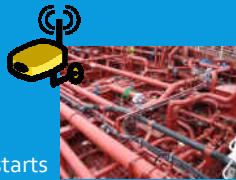
NDT VISION FOR FRP INSPECTION

- A predictive approach to monitor FRP (Fiber Reinforced Plastic) 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

In close cooperation and partnership with Dow Chemical Stade !



IoT ARCHITECTURE & APPLICATION



Equipment starts showing signs of failure



Capture and send data



Cloud based data analytics and failure detection



Real time data & alerts 24/7




Repair and replacement can be planned and scheduled



NO SURPRISES – STOP INTERPRETATION

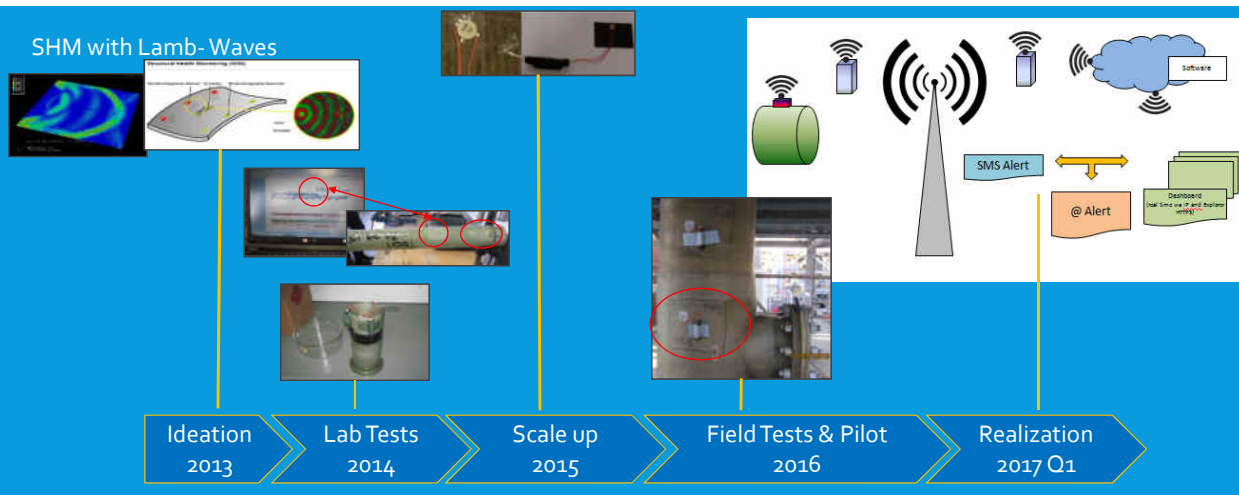





IoT/ INDUSTRY 4.0

ONLINE MONITORING OF FRP EQUIPMENT

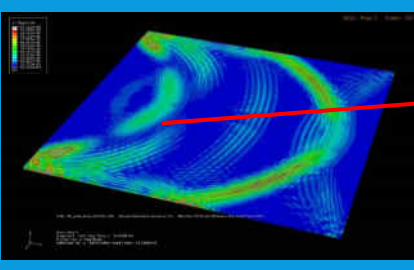
SHM with Lamb- Waves



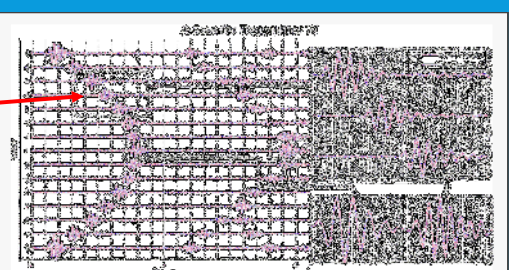
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SHM WITH LAMB-WAVES



Interaction of defects with lamb waves in complex geometries



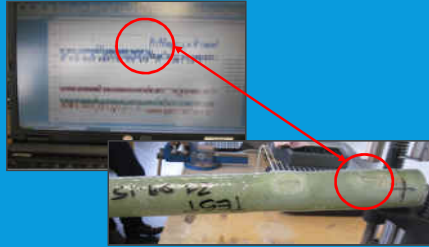
Attenuation of lamb waves in defect area



Fatigue crack detection with lamb waves



LAB TESTS AND PILOT



Impact test
-> Load applied in 3 m distance
from sensor monitored



Chemical degradation test
-> Accelerated chemical
attack monitored



Field test
-> monitored results verified
by cut out sample



FIELD INSTALLATION



Gateway installation Dow Stade



Micro controller radio sensor unit on
FRP Pipeline



Micro controller radio
sensor with QR Code –
direct link to dashboard

Smart phone
QR-Reader





LoRaWAN GATEWAY INSTALLATION Dow STADE

*LONG RANGE WIDE AREA NETWORK



• Gateway Network coverage

Online sensor technology to improve:

- safety
- productivity and efficiency
- lifetime extension of your assets

Applications:

- SHM monitoring of FRP equipment
- Wall thickness measurement of FRP and CS Equipment
- Sound-level measuring
- Gasket seating stress monitoring
- Bolt load monitoring
- GPS Tracking
- Temperature
- Gas detection
- Costume made solutions and much more

Realized

Pilot Q2 & Q3

Further opportunities



DASHBOARD

Data management e.g.:

- Localization
- Condition visualization
- Data analytics
- Alert management
- Multi functional platform



THE ECONOMICS OF CMS

Reduce maintenance cost

- Reduce labour cost, less maintenance time

Reduce downtimes

- Avoid output losses

Improves safety and reliability

- Enables plant to stopped safely , Alarm settings

Optimize lifetime of your equipment

- Predictive maintenance



Thank you for your attention!

**Please visit us at booth #29/30 and
watch our live demo!**

Sensor + Communication + Display + Analysis = next generation NDT reduce risk & optimize your equipment lifetime