

INDUSCOL

Instrumentation and durability
of glued multi-material structures for ORE systems

DURATION: 50 months (2016-2020) | BUDGET: €910K

CONTEXT

The durability of ORE systems over periods of more than 15 years remains a major issue. Their manufacture is based on combinations of glued multi-material structure. The long-term behaviour (fatigue, resistance to the marine environment) of this type of hybrid structure is still poorly understood and requires research. This lack of knowledge leads to the use of overestimated safety coefficients and limits the introduction of innovative assemblies. **It is therefore essential to study the in-service life of these glued multi-material structures and to monitor in particular the health of the glued seal in service.**

OBJECTIVE

To gain a full understanding of the behaviour over time of glued multi-material structures in a saturated environment.

MAIN ACHIEVEMENTS

- Development and demonstration of instrumentation inside the glue seal and at the glue/substrate interface
- Proposal of analytical models to optimise glued multi-material structures in the marine environment and meet normative requirements
- Updating and development of design and maintenance rules for underwater glued structures

CONCLUSION

INDUSCOL has improved the understanding of the behaviour of glued multi-material structures as a function of time spent in a humid environment. The project also provided scientific arguments and a state of the art of numerical tools to make a choice regarding the glued multi-material structures and the instrumentation of glue seals. The tools developed during INDUSCOL will allow the design of glue seals in the healthy state as well as in the aged state.



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TECHNOLOGIES



STAGES OF THE VALUE CHAIN



Design



O&M

GENERATED RESOURCES

- Protocol for the integration of carbon nanotube-based piezoresistive sensors and fibre optic sensors (Fresnel sensor, BRAGG gratings, DTS fibres) in a glue seal
- Tool for calculating the hygro-mechanical volume fields inside a glue seal
- Characterisation of the cohesive and adhesive behaviour of glue and assemblies according to the ageing stage
- Numerical model of long-term behaviour of glued seals in a humid environment
- Analytical tool for glued multi-material structures design

PARTNERS

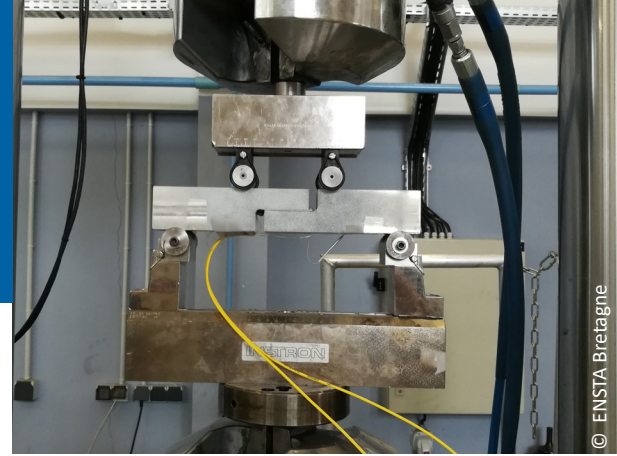


This project received a €539K French State funding managed by the National Research Agency under the Investments for the Future Programme (ANR-10-IEED-0006-08).



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LIST OF SCIENTIFIC PUBLICATIONS FROM THE PROJECT

2020

- Grangeat *et al.* **Measurement of the local water content of an epoxy adhesive by fiber optic sensor based on Fresnel reflection.** *Mechanical Systems and Signal Processing*, Vol. 141, 106439
-> <https://doi.org/10.1016/j.ymsp.2019.106439>
- Grangeat *et al.* **Method of characterizing the interphase's mean water diffusion properties of a bonded assembly in immersion.** *The Journal of Adhesion*, Vol. 21, pp. 1-20
-> <https://doi.org/10.1080/00218464.2020.1828080>
- Leplat *et al.* **Investigation of the mode I fracture properties of adhesively bonded joints after water ageing.** *The Journal of Adhesion*, Vol. 21, pp. 1-22
-> <https://doi.org/10.1080/00218464.2020.1818561>

2019

- Grangeat *et al.* **Revealing of interphases in bonded joints with a fiber optic sensor based on Fresnel reflection.** *International Journal of Adhesion and Adhesives*, Vol. 91, pp.12-18
-> <https://doi.org/10.1016/j.ijadhadh.2019.02.009>

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