MARITIME

FIRE RESIST

Background

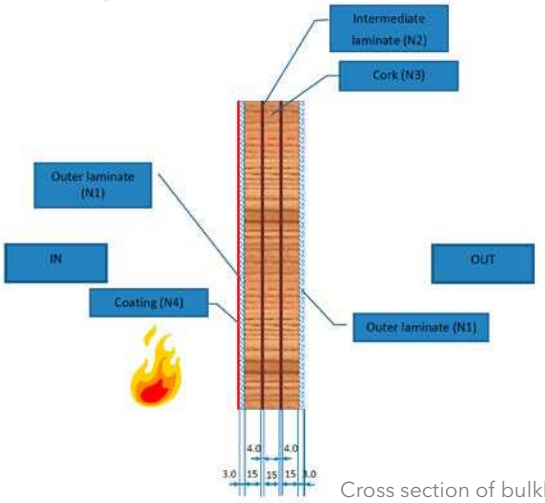
Polymer matrix composites or simple fibre reinforced plastics have several advantages compared to steel – the traditional backbone of maritime constructions: less weight, reduced corrosion affinity and more shaping possibilities. Unfortunately, so far these advantages are achieved at the expense of reduced fire resistance and higher fabrication costs.

The four-year EU funded research project Fire-Resist (www.fire-resist.eu) was started in February 2011 with a consortium of 18 partners bringing together experiences and requirements from aerospace, railway and maritime industry. Fire-Resist is aimed at further reduction of the main barrier preventing a more widespread use of lightweight polymer matrix composite materials (fibre reinforced plastics) i.e. their relatively poor fire performance.

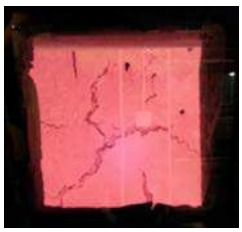
DNV GL contribution

In the shipping industry, there is a relatively restrictive set of mandatory requirements with respect to material behaviour in fire. They are justified by the operational conditions for ships, meaning that in case of on board fires there are generally no external fire-fighting resources quickly available. Hence, the use of fibre reinforced materials was limited either to elements for which no requirements exist with respect to the passage of smoke, flame or heat for ships with limited operational profile, i.e. high-speed crafts, where external fire-fighting support is more quickly available due to shorter distances to shore-based facilities. The use may be enhanced if safety equivalence to a regulation-compliant design can be demonstrated in an Alternative Design process. Developing fibre-reinforced plastics with improved fire resistance will generally increase the potential for using these materials in the shipping industry directly and indirectly. Directly by complying with mandatory requirements for more and more applications and indirectly by scaling effects and reduced effort for demonstrating safety equivalence. Additionally, a further development of numerical simulation capabilities for the fire behaviour of such materials will provide the basis for computer-based design optimization, resulting in a more efficient design process.

Outer surface of bulkhead after 76 mins.



Cross section of bulkhead



Inner surface after 30 mins.

Project results

Novel Fibre reinforced Plastics

In total six novel polymer composites with improved fire resistance capabilities were developed in Fire-Resist. One of the most promising materials for the shipping industry was a furan resin combined with cork agglomeration developed by the project partners Gaiker and TransFurans. This material fulfils fire requirements for wall, ceiling and floor coverings according to IMO's FTP Code (2010).

Based on this material a bulkhead was fabricated and tested in accordance with the requirements for High Speed Crafts bulkheads with fire insulation class A-60. Without any additional insulation on the fire- facing surface the bulkhead passed this test successfully.

Thermo-mechanical analysis

Another outcome of the project was the development of a complete process for numerical fire simulation of polymer composite materials (FRP) and a thermo-mechanical analysis. This process allows the simulation of a fire using the software FDS (Fire Dynamics Simulator) and transfer of the thermal surface loads to the finite element program ANSYS© for calculating the temperature distribution and subsequently related thermal strains. Using this simulation it is possible to analyse the behaviour of structural elements in fire with respect to heat transfer, deflection and remaining load bearing capacity.

FIRE-RESIST PARTNERS

Fire-Resist was a consortium of 18 partners under the coordination of the NewRail research centre at Newcastle University, comprising of: APC-Composite, Amorim Cork Composites, Anthony, Patrick and Murta Exportação, BALance Technology Consulting, Bombardier Transportation (UK), CYTEC, EADS Deutschland, Flensburger Schiffbau-Gesellschaft, Fundación Gaiker, Institut National des Sciences Appliquées de Lyon, PROPLAST, SP SVERIGES TEKNISKA FORSKNINGSINSITUT, SWEREA SICOMP, Steinbeis Advanced Risk Technologies, Teknologian tutkimuskeskus VTT, TransFurans Chemicals as well as DNV GL SE.

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