The KOMPIS project and fire safe surfaces

E-LASS November 18, 2021

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RISE Fire Technology

Outline

- Objective of project
- Material selection
- Mechanical testing
- Fire testing
- Conclusion
- Further research

Objective of project

- Increase the knowledge and usage of composites of regional companies
- Evaluate mechanical and fire performance of selected composite materials.

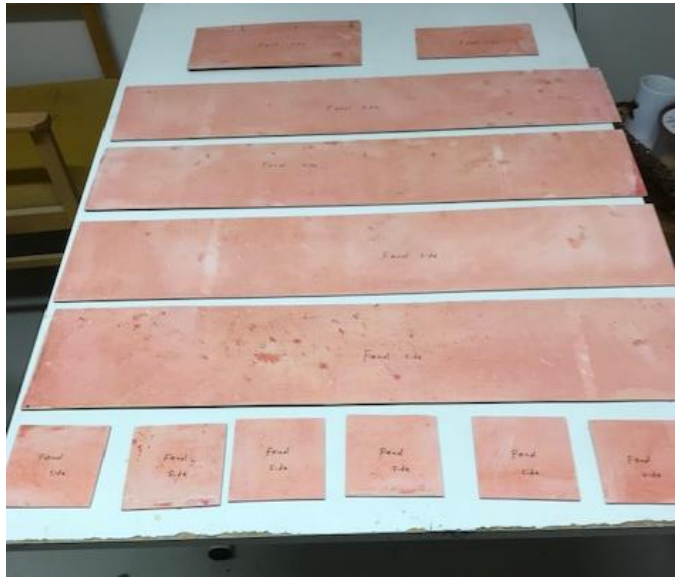
Funded by:

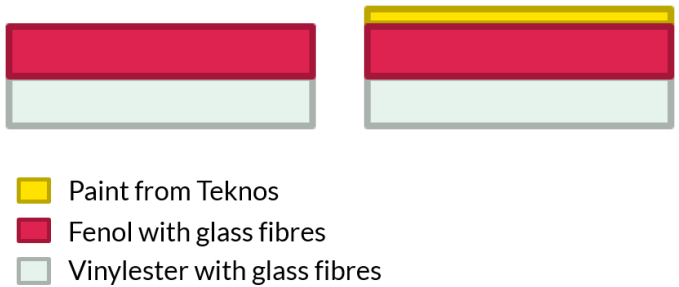
Partners:

RI.
SE

Material selection

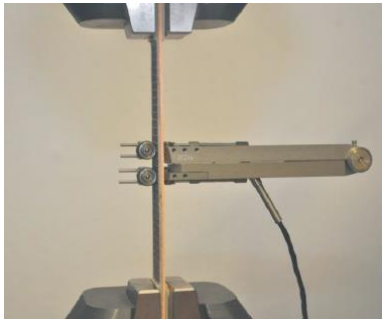
- Hybrid with vinylester and phenol
  - Reinforced with glass fibres
  - Phenolic skin acting as fire barrier
  - Vinylester provides strength
- Fibre content: 52 %

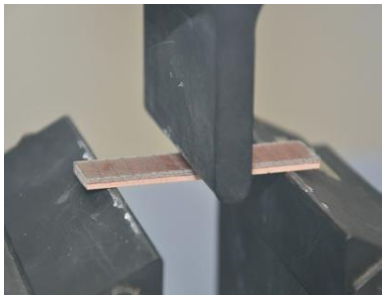


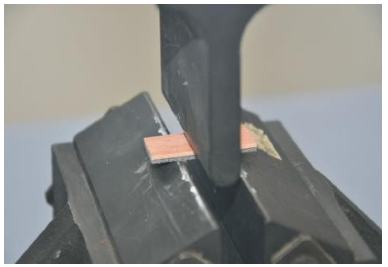


Mechanical testing

- Tensile testing, ASTM D3039, 100 kN load cell
  - ~100 MPa
- 3-point bending, ATSM D790, 100 kN load cell
  - ~190 MPa
- Interlaminar shear strength, ISO 14130, 100 kN load cell
  - ~ 30 MPa
- Bonding between glass fibre/vinylester as well as glass fibre/phenol strong.



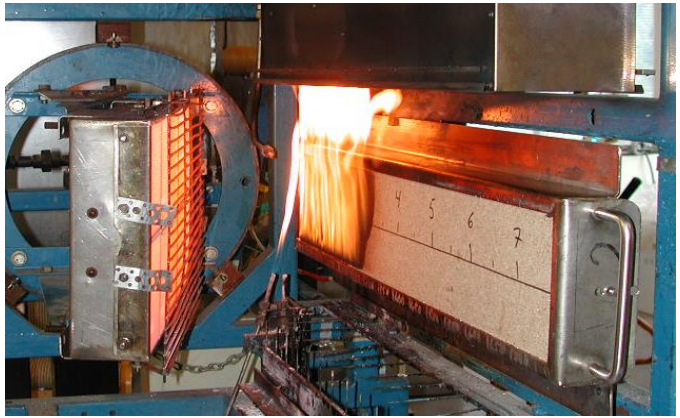




Fire testing

- Cone calorimeter – ISO 5660-1

- Surface flammability – IMO FTP Code Part 5



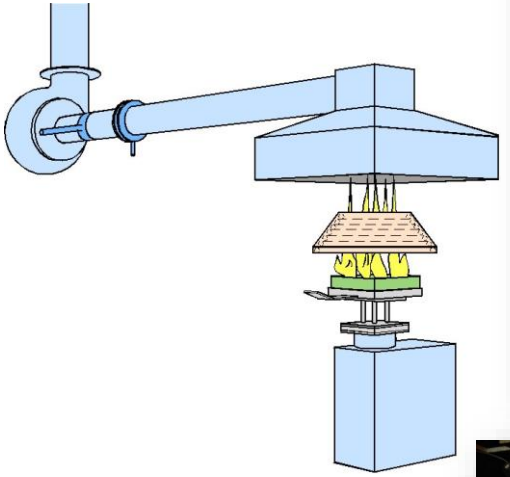
ISO 5660-1 – Cone Calorimeter

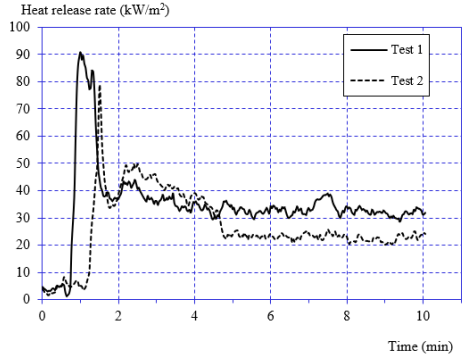
The sample is subjected to a specific irradiance level. The surface of the sample is heated and starts to emit pyrolysis gases that ignite by a spark igniter.

The emitted gases are collected in a hood and the heat release is measured using the data on measured oxygen concentration in the emitted smoke. The smoke production is measured continually throughout the test with a laser system.

Test parameters to evaluate:

- ✓ Time to ignition
- ✓ Heat release
- ✓ Smoke production

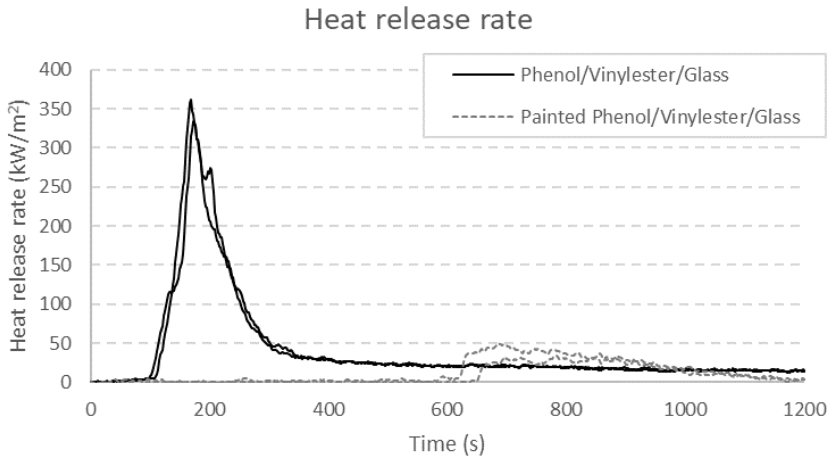




Fire testing – Cone calorimeter

Product		Time to ignition (s)	pHRR (kW/m²)	THR (MJ/m²)	TSP (m²/m²)
Phenol/Vinylester/Glass	Test 1	104	334	48	477
	Test 2	74	361	49	575
Painted Phenol/Vinylester/Glass	Test 1	NI	34	10	160
	Test 2	NI	50	15	261

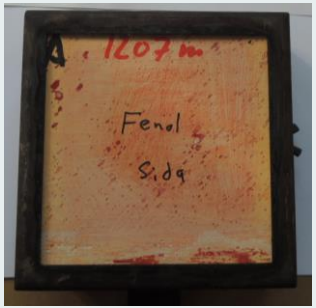
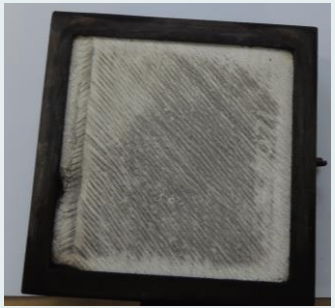
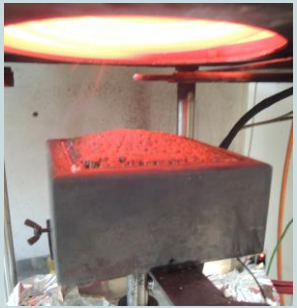
NI: No Ignition
pHRR: peak Heat Release Rate
THR: Total Heat Release
TSP: Total smoke production



Heat flux level: 50 kW/m²

Test duration: 20 min

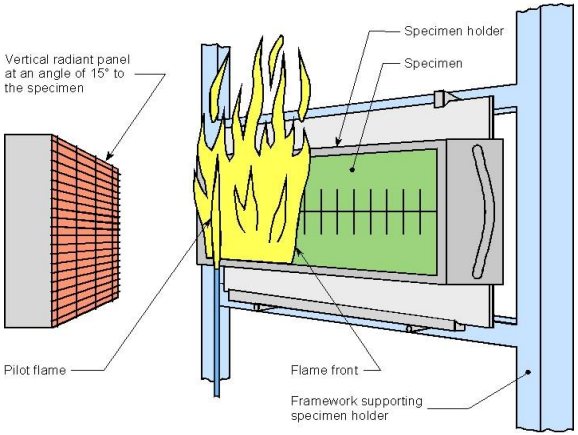
Fire testing – Cone calorimeter

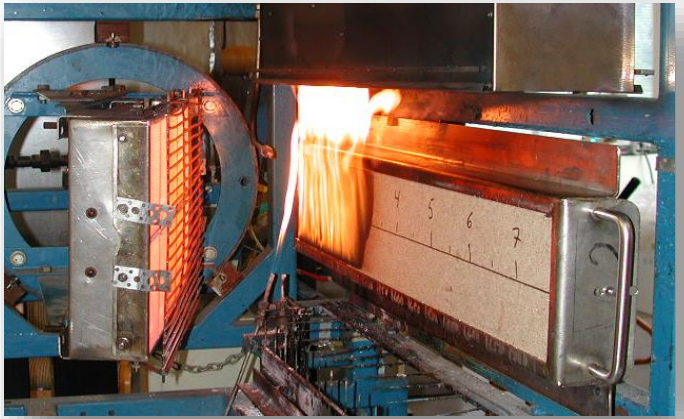
Product	Before test	1 min	2 min	After test
Phenol/ Vinylester/ Glass				
Painted Phenol/ Vinylester/ Glass				

Surface flammability, Spread of flame – IMO FTP Code Part 5

The specimen is vertically positioned during test and exposed to heat radiation from a radiation panel and a pilot flame.

The time when the specimen is ignited and the time when the flame reaches every 50 mm mark along the specimen is noted. Time to flame out of the flame front on the center line, burnt length and any occurrence of burning droplets are noted.

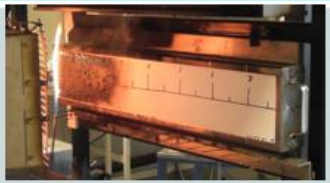




Fire testing – Spread of flame

NI – No Ignition
CFE – Critical Flux at Extinguishment
Qsb – Heat for sustained burning
Qt – Total heat release
Qp – Peak heat release rate

Product	Test no	CFE (kW/m²)	Qsb (MJ/m²)	Qt (MJ)	Qp (kW)	Burning droplets
Painted Phenol/Vinylester/Glass	1	>50	NI	NI	NI	No
	2	>50	NI	NI	NI	No
	3	>50	NI	NI	NI	No
Criteria for bulkheads		≥ 20.0	≥ 1.5	≤ 0.7	≤ 4.0	Not produced

Time in test 30s	1 min	2 min	10 min
			

Conclusions

- Mechanical testing showed good mechanical performance and strong bonding between fibres and resins.
- Fire testing of laminate with intumescent coating did not ignite in any of the tests.
- Laminate fulfils the test requirement according to IMO FTP Code Part 5.

Further research

- Evaluate the intumescent coating with other laminates

- Evaluation of fire performance of the composite laminate as a part of a sandwich material
  - Small-scale fire tests
  - Surface flammability – IMO FTP Code Part 5
  - Fire Restricting Material (FRM) – IMO FTP Code Part 10

Thank you!

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