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Static and Fatigue Performance of Wind Turbine Blade Epoxy Adhesives

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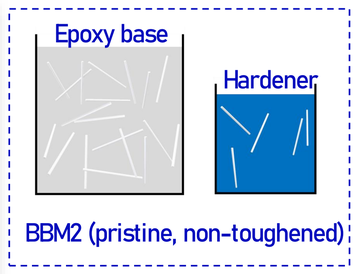
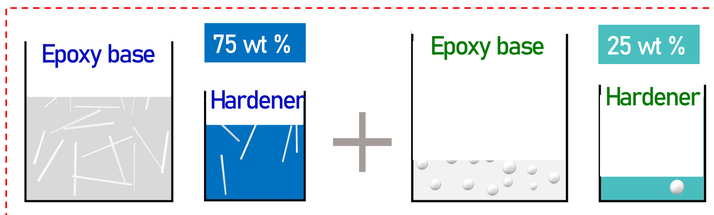
GURIT WIND TURBINE BLADE ADHESIVES

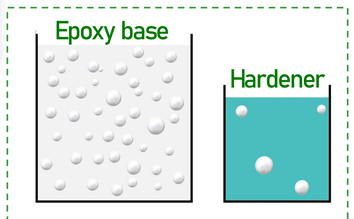
Non-toughened (Spabond 820, short-glass fiber modified) and toughened (Spabond 840 : Core-shell rubber modified) epoxy adhesives are used in assembly of long wind turbine rotor blades. Adhesives and their joint performance under different loading conditions need to be investigated for a better product-life cycle.



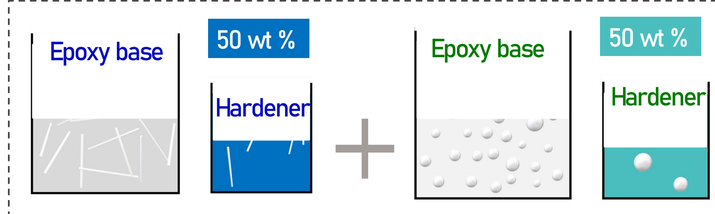
BBM2 (pristine, non-toughened)



BTM2 (hybrid, non toughened (75%) + toughened (25%)

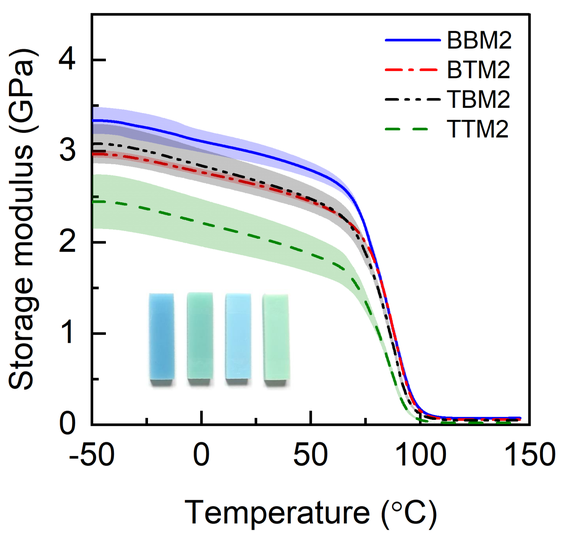


TTM2 (pristine, toughened)

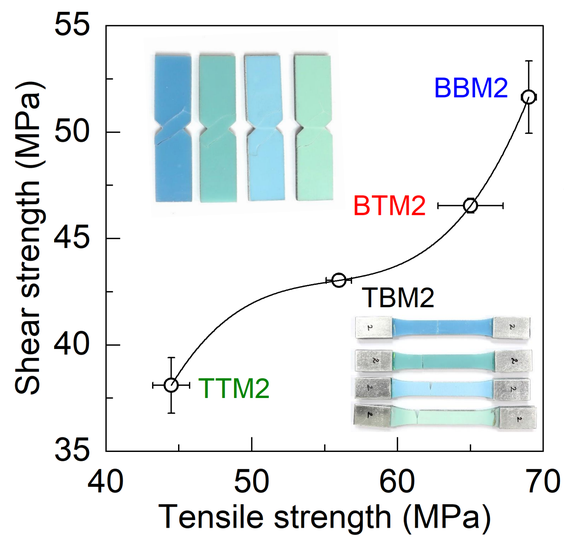


BTM2 (hybrid, non toughened (50%) + toughened (50%)

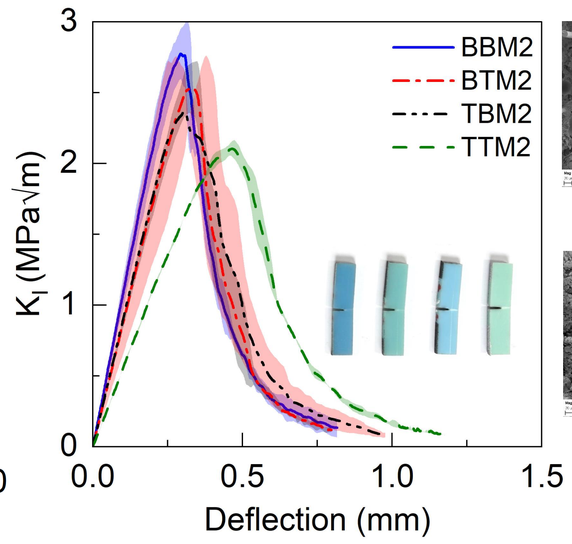
TOUGHENING EFFECT ON STATIC PERFORMANCE



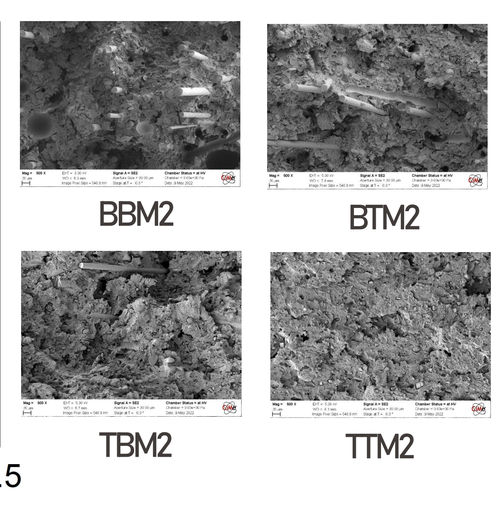
Storage modulus vs Temperature



Tensile strengh vs shear strength

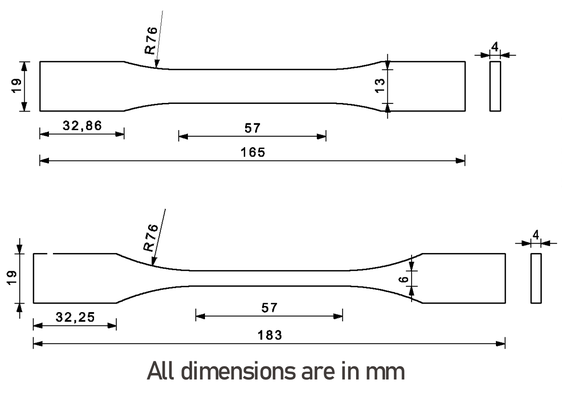


Plane-strain fracture toughness



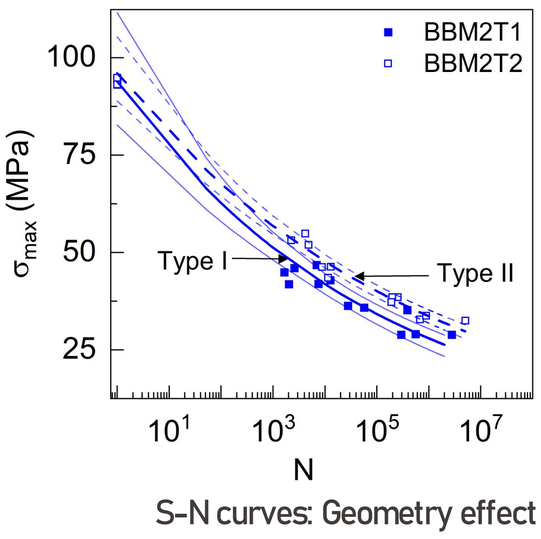
Fracture surfaces

TOUGHENING AND SPECIMEN GEOMETRY EFFECTS ON FATIGUE PERFORMANCE

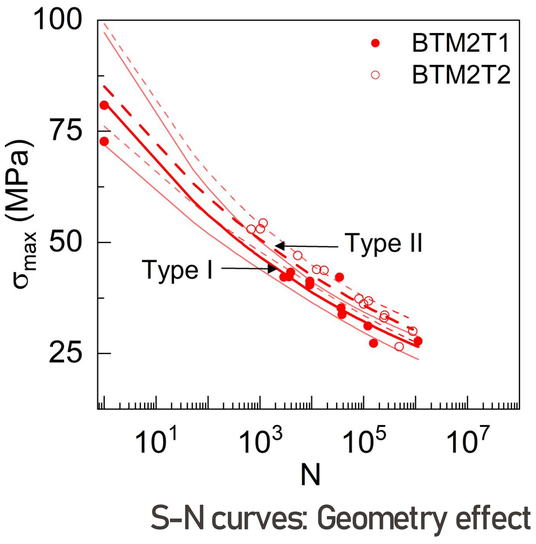


All dimensions are in mm

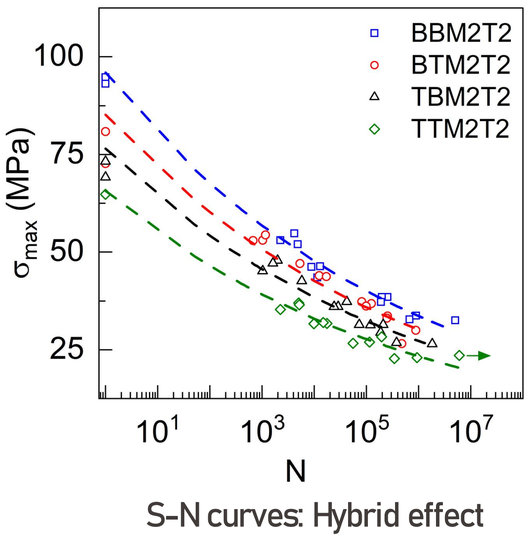
ASTM D638-22 Type I and II specimen



S-N curves: Geometry effect



S-N curves: Geometry effect



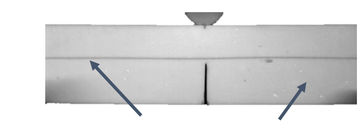
S-N curves: Hybrid effect

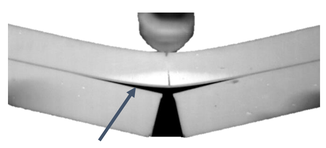
CONCLUSIONS

- Toughnening improves the strain to failure, tensile toughness; decreases the strength and modulus without affecting the glass transition temperature.
- Type II specimens outperform Type I specimens under fatigue loading.
- The slope of S-N curves of pristine and hybrid adhesives are similar (0.075).
- Adhesives with high quasi-static strength have high fatigue life validating the strength-life equal rank assumption (SLERA).

ONGOING WORKS

- Developing a machine learning framework for fatigue life prediction with minimal data.
- Investigating fracture and fatigue of PVDF and PEI thermoplastic interlayered epoxy adhesives and
- Mode-I fracture and fatigue of thick GFRP adhesive joints.





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