UHMWPE COMPOSITES: EFFECT OF FLAME RETARDANT TANNIC ACID AS COATING AGENT AND HARDENER FOR EPOXY RESIN SYSTEMS

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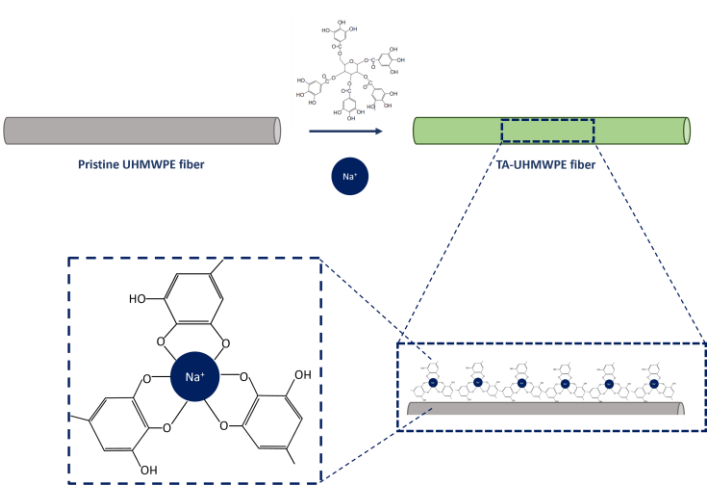
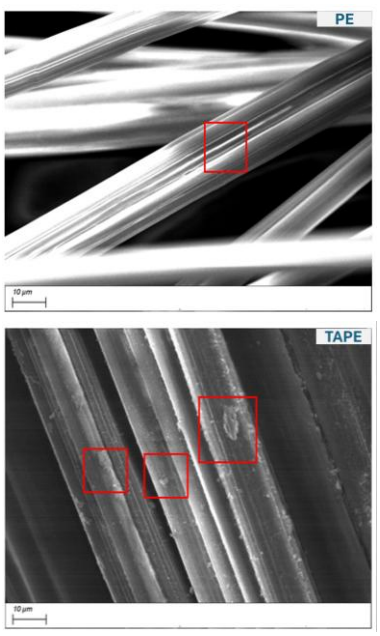
MAIN MESSAGE: The research explores the use of Tannic Acid (TA), a bio-derived polyphenol, for improving the performance and sustainability of ultra-high molecular weight polyethylene(UHMWPE) fiber composites by using it both as surface coater and epoxy matrix hardener. TA enhances fiber-matrix adhesion, increases thermal stability, and improves mechanical and fire resistance properties, offering a promising bio-based alternative for composite materials.

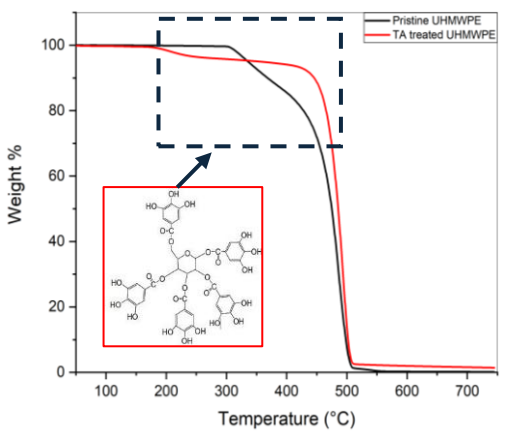
TA as coating agent for UHMWPE fibers

TA-Na^+ metal-organic complex coating

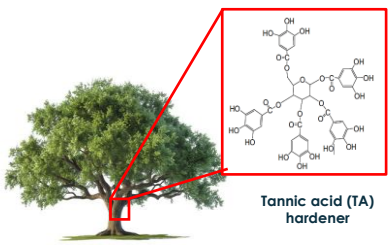


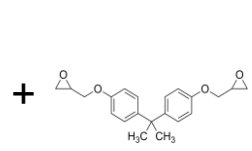


Thermal behavior of TA-treated UHMWPE fiber



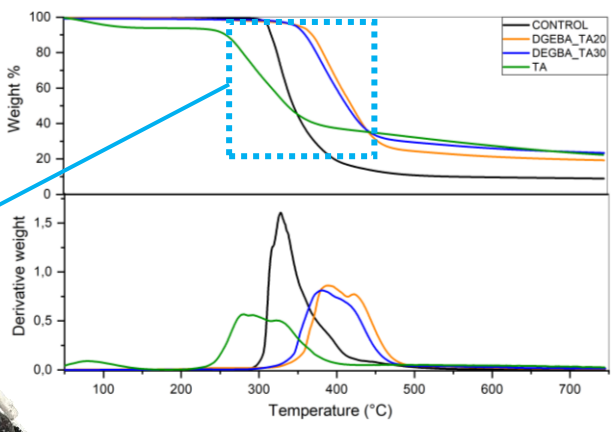
TA as bio-based hardener for epoxy resin





Curing

Thermal behavior of TA-hardened resins

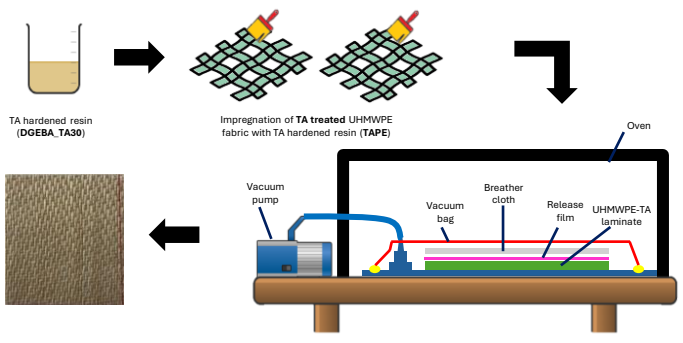


Sample Label	Wt.% DGEBA	Wt.% TA (hardener)	Wt.% amine (hardener)
CONTROL	70	-	30
DGEBA_TA10	90	10	-
DGEBA_TA20	80	20	-
DGEBA_TA30	70	30	-

- ✓ T_{onset} +16%
- ✓ T_{max} +19%
- ✓ Intumescent behavior

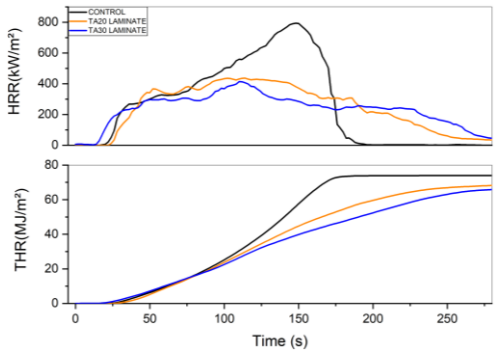
UHMWPE-TA fibers composite with TA-hardened resin

UHMWPE-TA composite lamination



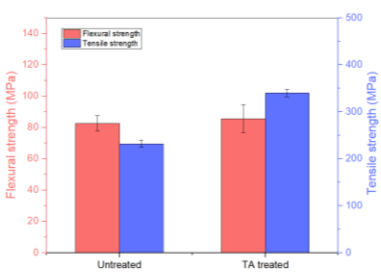
- ✓Cone calorimeter results indicated a substantial **reduction in the Peak heat Release Rate (PHRR)** and an **extended flame-out time** for TA-hardened samples
- ✓Tannic Acid promotes a **slower** and **more controlled** combustion process, primarily by forming a **protective char layer**

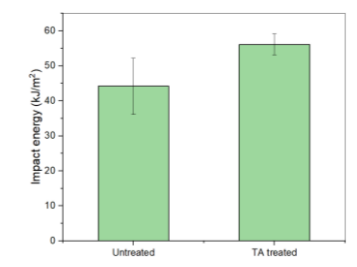
Cone calorimetry



Sample	TTI (s)	Flame Out (s)	PHRR (KW/m²)	Time to peak (s)	THR (MJ/m²)	TSR (m²/ m²)	MLR (g/s*m²)	FPI (%) (s*m²/kW)
CONTROL LAMINATE	25	191	748	158	73	2453	8.88	0.0334
TA20 LAMINATE	24	284	456	115	69	2224	6.42	0.0548
TA30 LAMINATE	17	298	416	114	71	2259	6.08	0.0570

Mechanical properties





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