01 / UNDERSTANDING THE DIFFERENCE

Thermoplastic vs. Thermoset Composites

A practical guide to material selection, manufacturing and circularity.

Both families combine reinforcing fibres with a polymer matrix. The fibres, their direction and the laminate design govern much of the structural performance; the matrix influences processing, joining and environmental behaviour. [1, 4]

THERMOPLASTIC

The matrix softens or melts when heated and solidifies on cooling. Suitable material can be reheated for forming or fusion joining, within its processing window. [1, 2]

Examples: PP, HDPE, PA6, PET; higher-performance families include PPS, PEEK and PEKK.

THERMOSET

Curing creates a cross-linked polymer network. Once cured, a conventional thermoset cannot be remelted and reshaped; excessive heat eventually degrades it. [1]

Examples: epoxy, unsaturated polyester, vinyl ester and phenolic resin.

THE PROCESS LOGIC

Thermoplastic	Heat / Form & consolidate / Cool
Thermoset	Impregnate / Shape / Cure

These are simplified process sequences. Reactive thermoplastic systems and emerging reprocessable thermosets need separate assessment.

02 / ENGINEERING COMPARISON

Compare the complete system

General tendencies, not guaranteed values for every resin or composite grade.

Selection factor	Thermoplastic composites	Thermoset composites
Forming & cycle [2, 3, 4]	Pre-impregnated tapes form without a resin cure. Heating, consolidation and cooling set the cycle.	Resin must cure. Infusion, RTM and prepregs offer different production routes; fast-cure systems also exist.
Joining & rework [1, 2]	Compatible matrices can be fusion welded. Re-forming depends on fibre architecture and material condition.	Cured parts are bonded or mechanically joined. Re-melting the matrix is not a joining route.
Strength & stiffness [1, 4]	High structural performance is possible. Compare equivalent fibre type, content, direction and test conditions.	High structural performance is also possible. Resin family alone does not establish the stronger or lighter design.
Impact & toughness [2, 3]	Many matrices offer useful toughness. Temperature and laminate design affect the finished component.	Untoughened resins may be brittle; toughened epoxies can offer high damage tolerance. Test the laminate.
Temperature & creep [1, 3]	Softening and time under load matter. PP and HDPE do not share PEEK or PPS temperature limits.	Cure state and glass-transition temperature matter. Cured resin can soften under heat without melting.
Environment & fire [1, 2, 3]	Moisture, chemical, UV and fire performance depend on the matrix and additives. Qualify the grade.	The same exposures need grade-specific evidence. Dedicated fire-resistant and chemically resistant formulations are available.
Storage & handling [1, 2]	Fully polymerised tapes have no curing-resin out-life. Keep clean and follow grade-specific drying guidance.	Reactive prepregs often have shelf-life and out-life limits, sometimes with cold storage. Follow supplier instructions.
Cost & equipment [2, 4]	Automation and part integration can help. Include heating, press capacity, tooling and material costs.	Wet lay-up can suit lower volumes. Infusion and RTM offer other options; include labour and cure time.

Selection rule: compare qualified parts at the same functional requirement, service life and production volume.

03 / CIRCULARITY AND PRACTICAL SELECTION

Design for the next use

Thermoplastic matrices open useful recovery routes. A workable recycling plan connects material design, collection, separation and a defined use for the recovered material. [5, 6]

Thermoplastic recovery

Sort clean offcuts by matrix before shredding, remoulding or compounding. Grinding shortens continuous fibres and changes their orientation; the recovered material may need a different end use. [5, 6]

Thermoset recovery

Recovery routes include grinding for filler, thermal or chemical fibre recovery, and cement co-processing for suitable glass-fibre waste. Commercial availability and recovered quality vary. [5]

Carbon footprint

Compare raw materials, production, transport, use and end of life for the same function and lifetime. Recyclability alone does not demonstrate a lower carbon footprint. [7]

For a UD Max Tapes application

Start with the required load and fibre direction, then choose a compatible matrix and processing route. Confirm the joining surfaces, environmental exposure and the recycling outlet. UD Max Tapes lists PP, HDPE and PA6 grades in its current product range. [8]

SOURCES & FURTHER READING

1. Composites UK - Materials
2. Toray Advanced Composites - Thermoplastic materials
3. Hexcel - HexPly prepregs and resin systems
4. Composites UK - Processes
5. Composites UK - End of Life and Recycling
6. Toray - Recycling Thermoplastic Composites, white paper (2019)
7. Composites UK - Design for Environment and LCA
8. UD Max Tapes - Product and technical information

Sources consulted September 2026. General comparison; use the selected grade data sheet and component validation for design decisions.