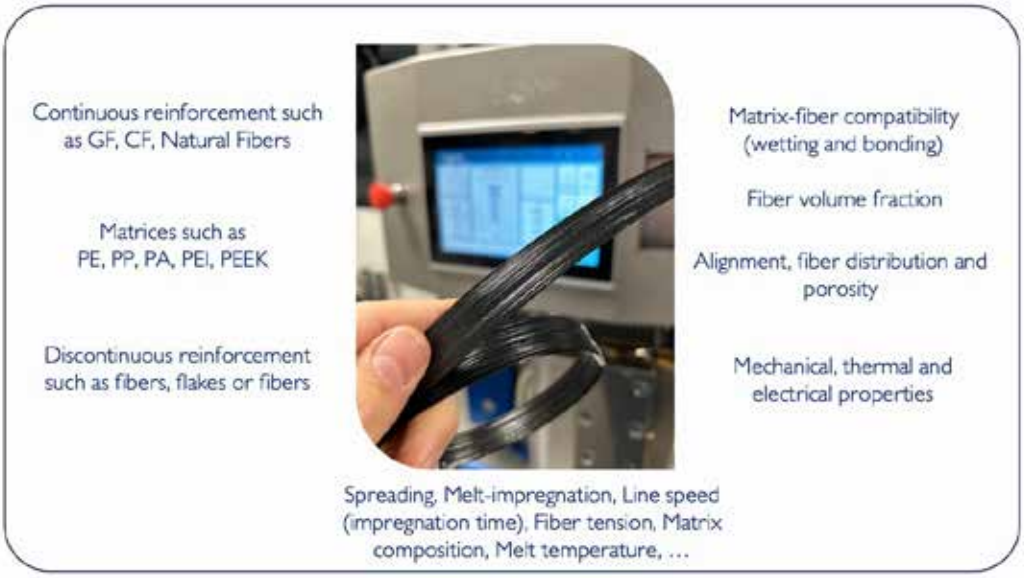
INFO NOTE

Xplore Micro-UD Tape Manufacturing Line



At the heart of the sustainability discourse lies the ability to reduce environmental impact throughout a product's lifecycle. Thermoplastic composites offer significant potential in this regard.

Unlike traditional thermoset composites, which are challenging to recycle due to irreversible curing processes, thermoplastics can be melted and reshaped multiple times without sacrificing their mechanical properties. This characteristic facilitates ease of recycling and remanufacturing, enabling a closed-loop approach where materials are reused rather than discarded after a single use.
Moreover, producing thermoplastic composites often entails lower energy consumption and emissions than their thermoset counterparts. The manufacturing process typically involves lower curing temperatures and shorter cycle times, contributing to reduced carbon footprints and energy requirements.
Thanks to the thermoplastic nature of the matrix, they are highly recyclable and repairable (hence reusable), contributing to their sustainability profile.

Additionally, advancements in composite manufacturing techniques, such as automated tape layup processes and additive manufacturing, further enhance efficiency and minimize material waste.

Among the many available materials, thermoplastic unidirectional tapes have emerged as a versatile and highly efficient option.

These tapes offer a range of advantages over traditional materials, making them increasingly popular in industries such as aerospace, automotive, and sporting goods.

Thermoplastic unidirectional tapes are composed of continuous fibres, such as carbon, glass, or aramid, impregnated with a thermoplastic matrix.
Scientific research on thermoplastic unidirectional tapes holds tremendous promise for revolutionizing advanced materials and manufacturing.
However, navigating the challenges of material characterization, processing optimization, durability prediction, scale-up, and sustainability requires interdisciplinary collaboration, innovative approaches, and persistent efforts.
By addressing these challenges, researchers can unlock the full potential of thermoplastic UD tapes and pave the way for their widespread adoption across diverse industries, driving progress toward a more sustainable and resilient future.

These challenges triggered Xplore to design a bench-top UD tape manufacturing line where researchers can quickly materialize their brilliant ideas into test samples.

Xplore's micro-UD tape line comprises two primary units: the microcompounder and the impregnation line (Fig. 1).

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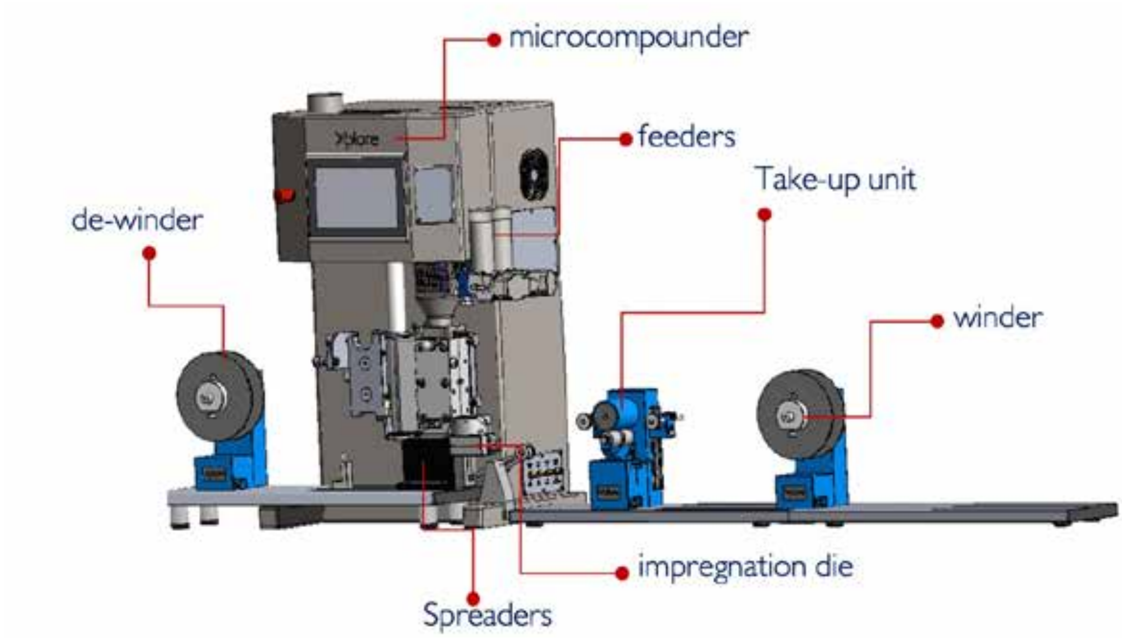


Figure 1. Xplore micro-UD tape manufacturing line

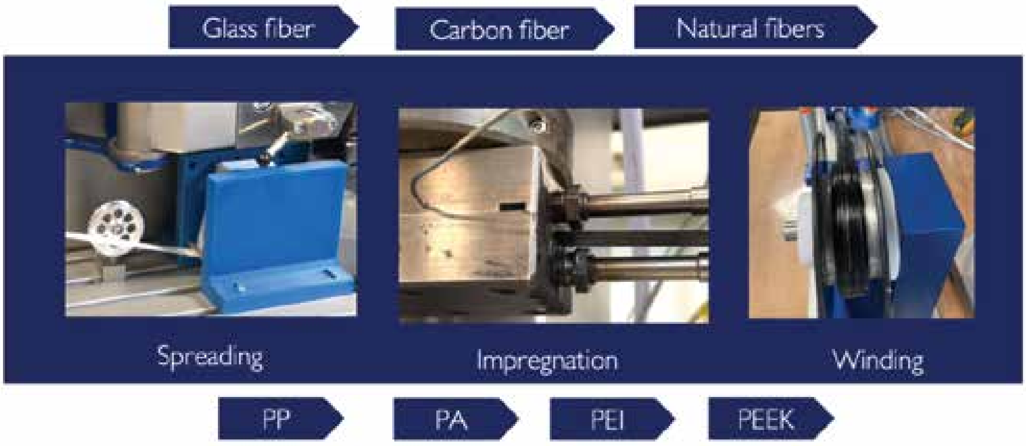
A micro-compounder, also known as a micro-extruder or mini-extruder, is a specialized laboratory-scale extrusion device used in polymer research. It is designed to mimic the process of larger-scale extrusion but operates on a much smaller scale, typically with sample sizes ranging from a few grams to a few hundred grams. With Xplore's conical, twin-screw MC 15 HT or MC 40 microcompounders (Figure 2), various resin compositions can be formulated, incorporating polymers like PE, PP, polyamides, PC, PEKK, or PEEK, along with additives such as nanoparticles, chopped reinforcing fibres, flame retardant additives, and more. Detailed information about Xplore's microcomputers can be found at: https://www.xplore-together.com.

Figure 2. Xplore's microcompounder https://www.xplore-together.com/products/micro-compounders

The impregnation lie consists of a de-winding unit where continuous fibers, such as carbon, glass, or aramid, are unwound under tension from a spool before entering the spreading unit. The spreading unit comprises multiple metal bars that spread the fibers forming the tow to a wider width, ensuring thorough impregnation. At the core of the unit lies the impregnation die, where the polymer is applied onto the fiber tow via state-of-the-art feeding bars. This resin impregnation step enhances the mechanical properties and structural integrity of the UD tape.

Figure 3. below shows a cross section of an impregnated demo sample. The entrance and exit ports of the impregnation die can be customized with respect to the continuous fiber type and application.

The temperature of the die can be set and controlled with an external controller. At the exit of the die, the cooling pillars are located to solidify the tape. The take-up roll controls the line speed (typically 3000 cm/min), and the winding roll collects the UD tape on a mandrel at a constant torque.



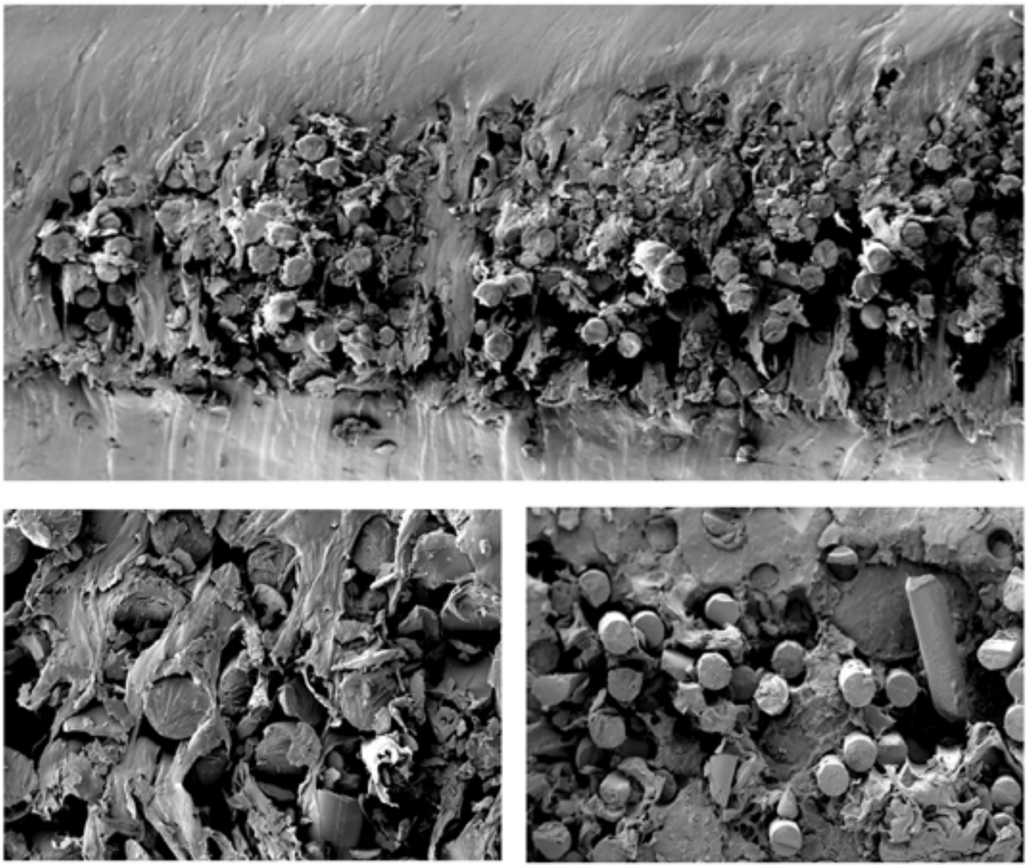


Figure 3. Cross sectional images of a 2400 tex glass fiber/PP UD Tape

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