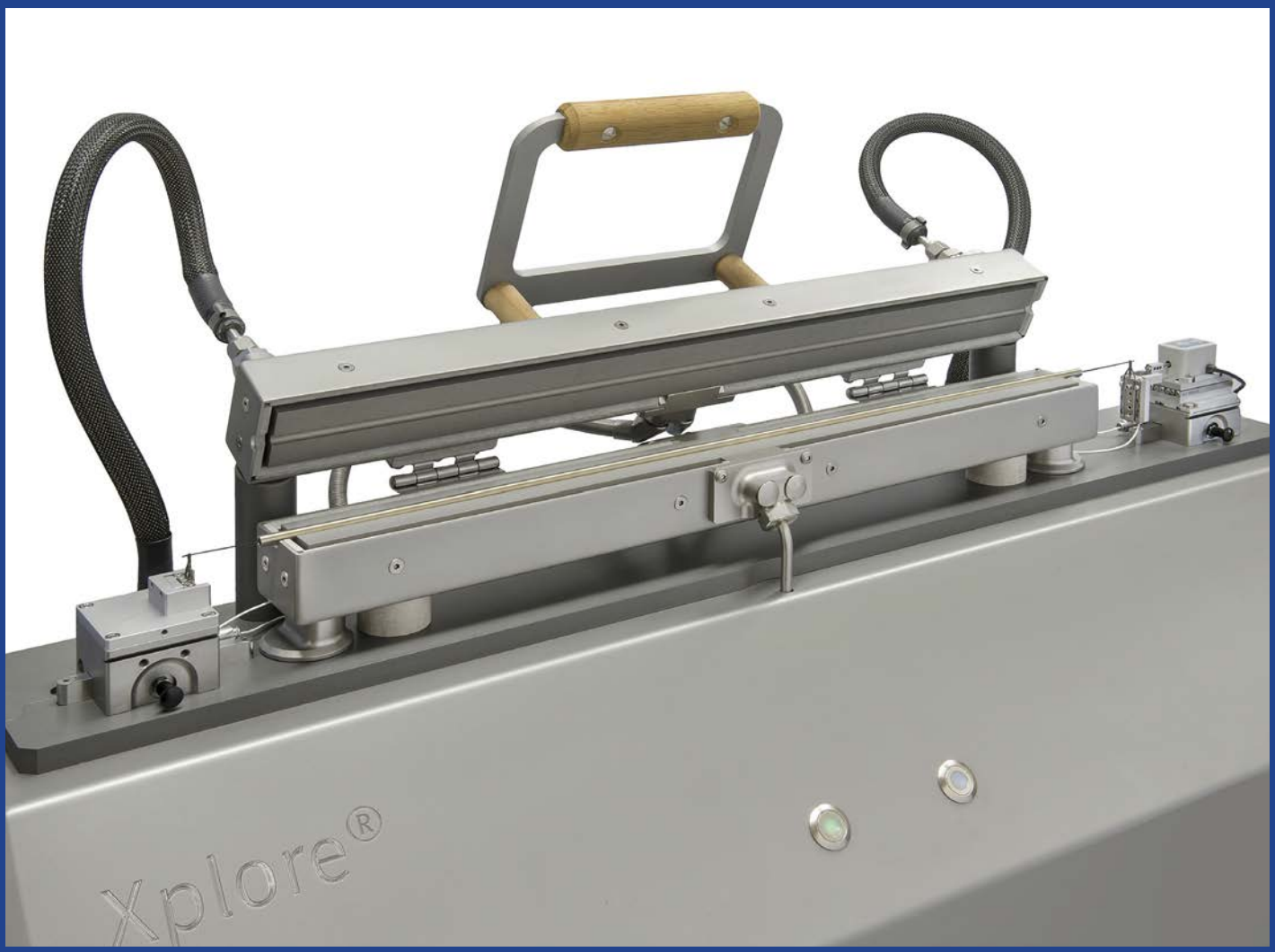
Xplore LFL lignin fibre line

Table top R&D instrument for fibre process development



Xplore

The platform for
polymer and rubber R&D

Conditioning of lignin fibres is now possible with the Xplore lignin fibre line

Lignin forms, with cellulose, the chief constituent of wood, and is, second only to cellulose, the most abundant organic material on earth. It is a mixture of complex dendritic aromatic compounds of poorly known structure. It is a by-product of the paper industry that is currently mainly used as biofuel and as a binding or dispersing agent.
Recently it was discovered that it also has the potential to be the raw material for high tensile strength, high stiffness carbon fibres. This offers the tremendous advantage of producing a high value-added product while simultaneously minimising the carbon footprint and cost price.

However, lignin fibre is exceptionally brittle and simply cannot be handled manually. The challenge was to design an instrument that can collect lignin fibre of sufficient length without breaking and condition it subsequently to improve its mechanical properties to enable a further processing step (carbonisation).

Xplore now presents a new, dedicated R&D lignin fibre line (LFL) that consists of a unique winder and conditioning unit. The winder, just behind the die of an Xplore micro compounder, enables the melt spinning and collecting of brittle lignin fibres.

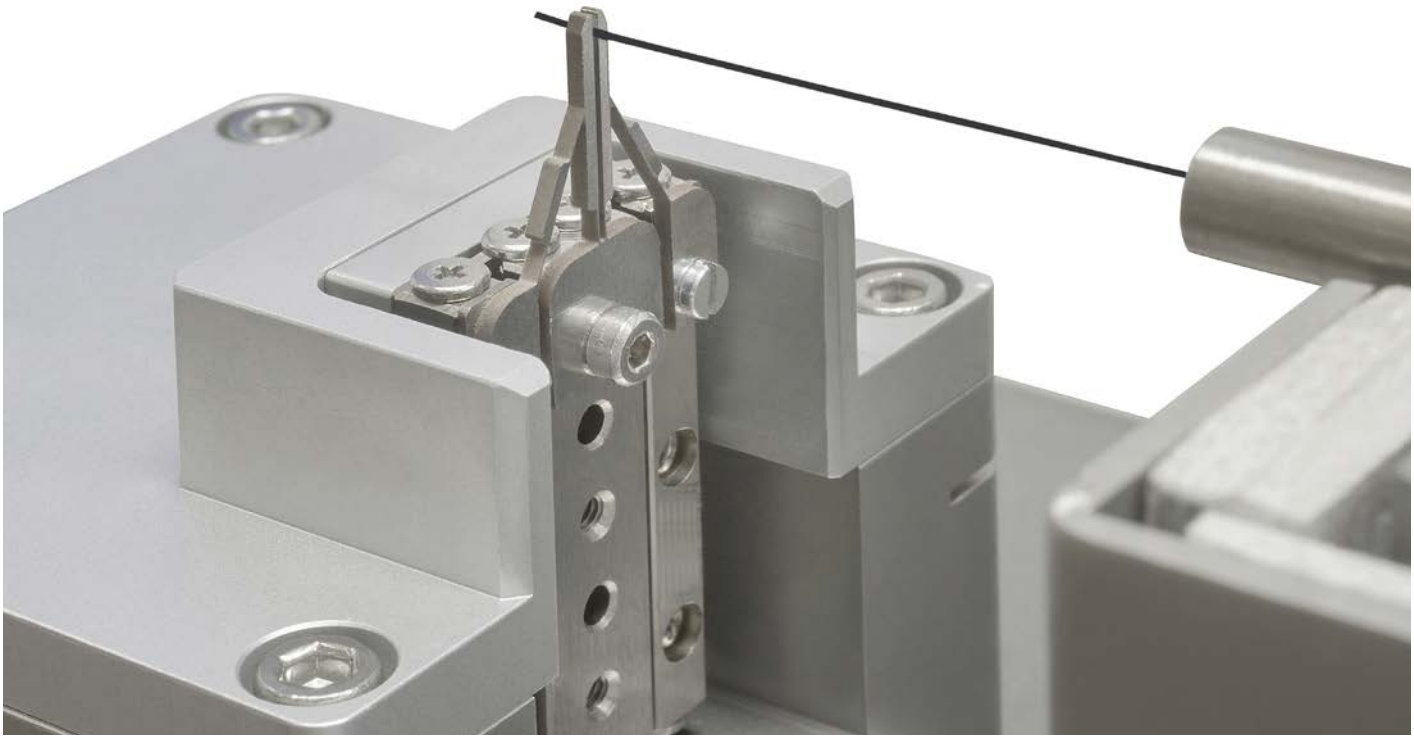
The conditioner provides a large window of processing conditions to produce a crosslinked lignin fibre with sufficient mechanical properties to allow manual, albeit gentle, handling for the final carbonisation process.

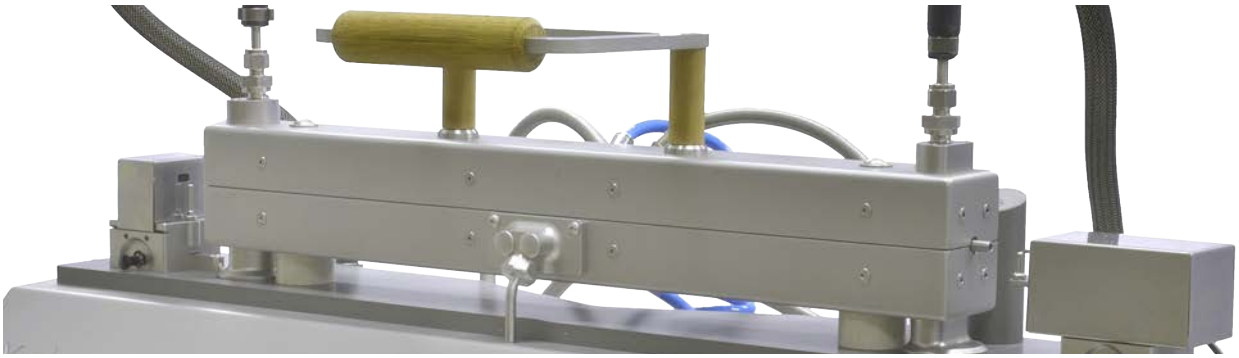
The Xplore LFL thus enables you to screen and optimise the delicate thermochemical conditioning process.

This new LFL is precise, reproducible, rugged, reliable and built to standards researchers expect from Xplore.
The Xplore LFL is a screening instrument for exploring optimum processing conditions for a major part of the lignin to C-fibre process. It is designed to enable an experienced process-engineer to produce a very fragile lignin monofilament on the winder and subsequently condition this monofilament in a separate conditioning unit to improve its mechanical properties. After proper conditioning, the monofilament is strong enough to be carbonised in a special oven to a C-fibre (conditioning unit or carbonisation oven is not included).

The lignin fibre line consists of two independent units:
1. a winding unit (winder, see last page)
2. a conditioning unit (conditioner).

The winder allows to collect and wind the brittle, neat lignin monofilament from a die attached to an Xplore micro compounder.





The large winder diameter (with an anodised nickel-plated surface finish) reduces the chance that the brittle monofilament will break during winding. One turn around delivers a monofilament of suitable length for further treatment in the conditioner. The winder has an integrated control touch screen.

The winder is controlled via the touch screen in the footage of the unit. The winding speed of the collecting roll is continuously digitally adjustable from 5 to 200 m/min (± 0.01 m/min) in steps of minimum 0,01 m/min; maximum torque is 250 Nmm. During the spinning process, the winding width is adjustable between 10 and 160 mm and the pitch between adjacent mono filament windings can be controlled between 0.1 mm and 4 mm. The dimensions of the collecting roll are Ø 32 cm, W 20 cm, and it has a polished nickel surface finish.

The conditioner is designed in such a way that a brittle, fragile lignin monofilament can be transferred and clamped under a chosen force or elongation in a heat and atmosphere conditioned oven for a specified time. The very delicate monofilament is transferred with a special tool from the winder into the oven, where it is clamped between the two small gripper units.

The distance between the grippers can be varied with a linear motor, with measured increments of 1 nm (1 nanometre). The conditioner allows for crosslinking of the lignin monofilament under defined time, atmosphere, heat and force or elongation conditions.

50 cm long) that accurately heats the lignin monofilament (from 30 to 305 ± 1 °C via PI control) in a chosen atmosphere under a constant, chosen force or displacement for a specified time.

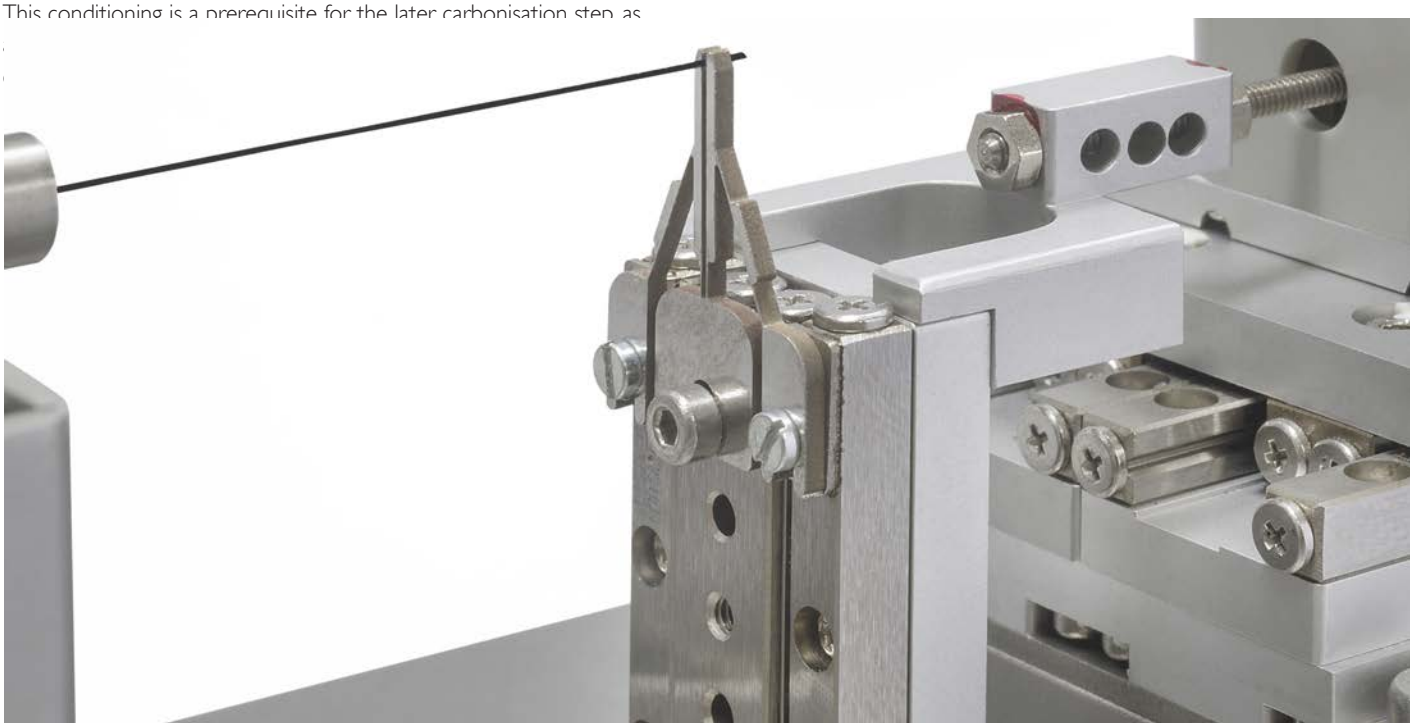
The hot shoe atmosphere can be either air, or nitrogen, or another gas; this medium is already pre-heated when entering the hot shoe. The temperature can be controlled in 1 -10 programmable time/ temperature steps. During these time/temperature steps, the force or the displacement can be programmed independently.

The stretching force can be measured or maintained in a range from 0.001 - 1.000 N (± 0.001 N), or another range, depending on the load cell chosen. All processing data are logged in an ASCI file format.

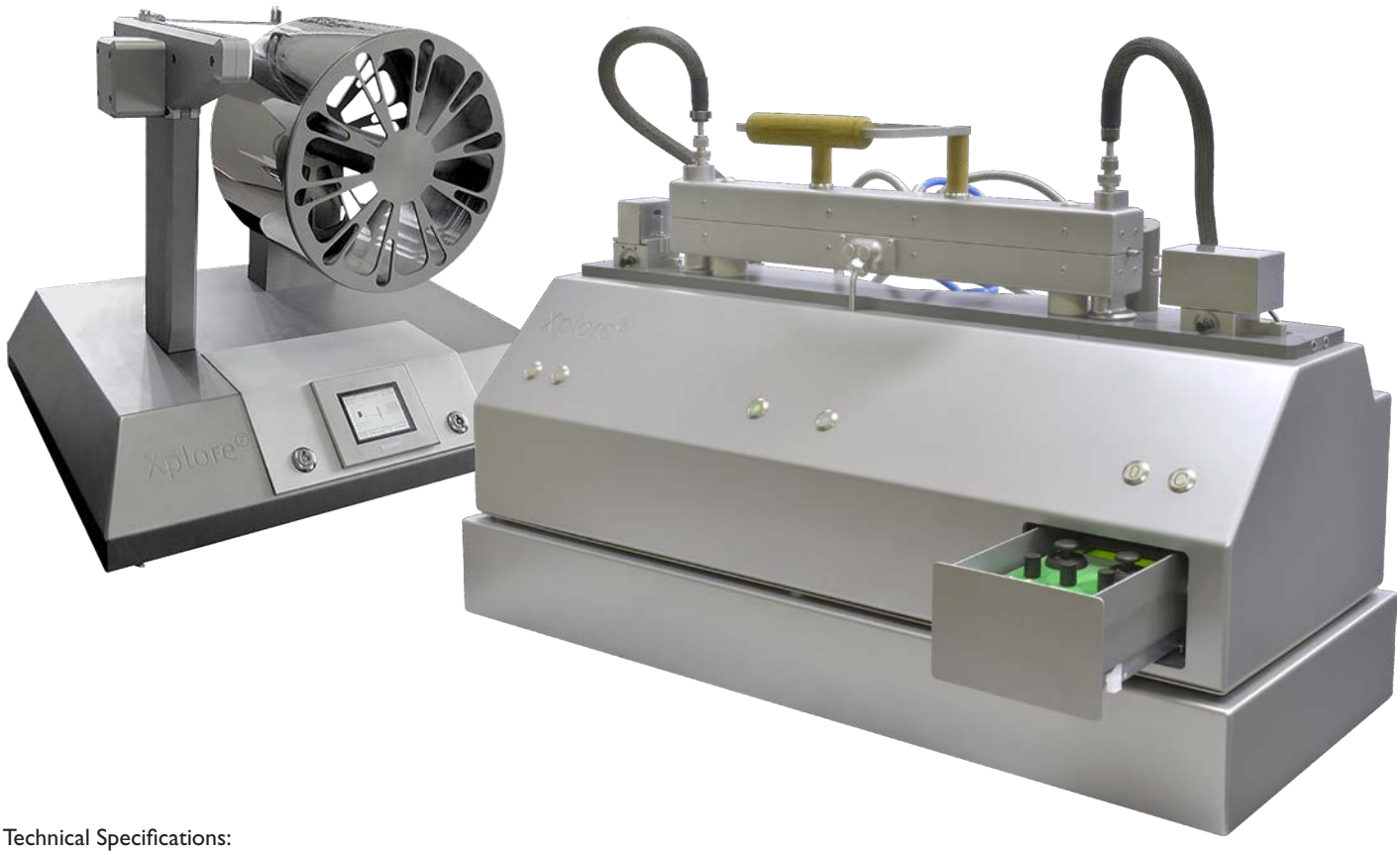
The conditioner is controlled, and the processing data logged, via dedicated software for which a PC is needed (not included). This operation and control can also be performed with the control box that is located in the drawer of the conditioner. The hot shoe is only a small part of the conditioner; the main part consists of control units for accurately heating, measuring displacement and force, and cooling.

The monofilament can thus be programmed to get a reproducible atmosphere/temperature/stress/time history. The oven can be cooled down via a particular air-cooling circuit.

This conditioning is a prerequisite for the later carbonisation step, as



Based on our long and proven experience in custom design and manufacture of R&D instruments, this LFL can also be modified for other fibre applications where fragile fibre spinning and conditioning is required. Please contact us at info@xplore-together.com for solving your specific R&D challenges.



Technical Specifications:

Winder Unit

- Winder dimensions: L 67 x W 50 x H 54 cm
- Winder weight: ca. 35 kg
- Winder drum width: Ø 32 cm, W 20 cm
- Winder torque: max. 250 Nmm
- Winding width: 10 - 160 mm
- Winding pitch: 0.1 - 4 mm
- Winding speed: 5 - 200 m/min
- Supply voltage: 208 - 240 Vac

Conditioner

- Conditioner dimensions: L 75 x W 50 x H 40 cm
- Conditioner weight: ca. 65 kg
- Hot shoe length: 500 mm
- Temperature range hot shoe: 30 - 305 °C (± 1 °C)
- Minimal adjustable increment of displacement to control fibre force: 1.10-9 m (1 nanometre measured)
- Fibre force measurement range: 0.001 N - 1.000 N (±0.001 N)
- Supply voltage: 208 - 240 Vac

Controls

Winder Unit

- Winder, via an integrated touch screen

Conditioner

- Conditioner, manual or via GUI PC software

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