

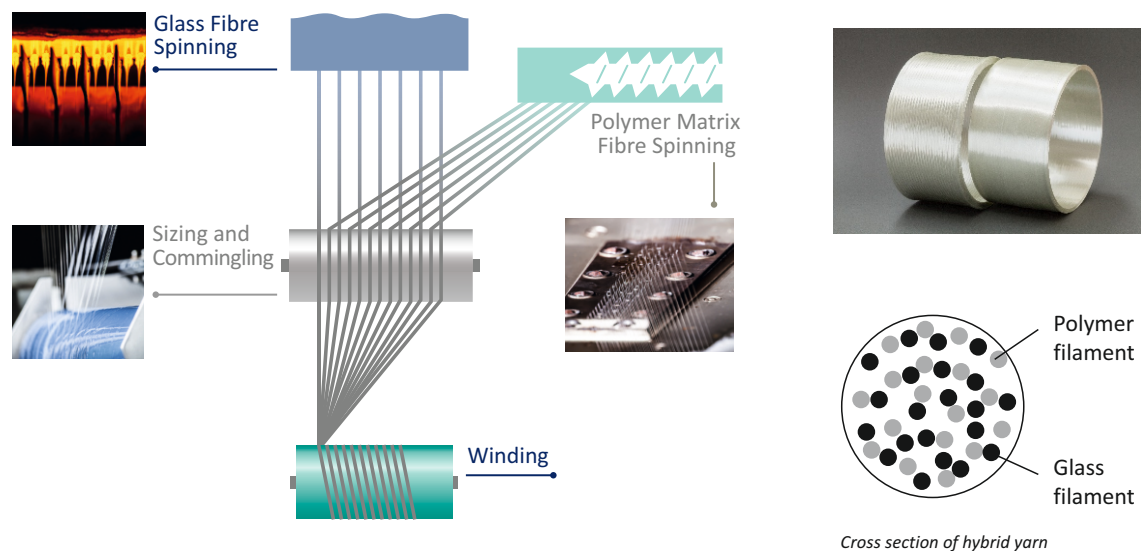
# ONLINE HYBRID YARNS For Advanced Thermoplastic Composites

## Motivation

Thermoplastic composites offer the advantages of short production cycle capabilities which make them feasible for high volume productions.

However, fibre wetting is more complex than for thermosets due to the high melt viscosity of the thermoplastic matrix. Different impregnation techniques have been proposed and practically applied. The most promising routine is provided by Online Hybrid Yarns which is based on the principle of homogeneously mixing matrix and reinforcing fibres during simultaneously melt spinning. In contrast to other commingling techniques, such as air jet texturing, the reinforcement fibres are not damaged during commingling. The homogeneous fibre/matrix distribution of Online Hybrid Yarns but also the adapted sizing applied during spinning are responsible for the high mechanical performance of the thermoplastic composites.

## Principle of Online Hybrid Yarn Spinning

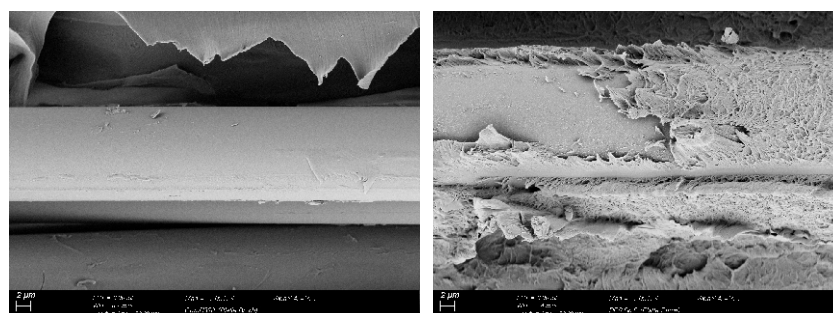


## Approach

- Online surface modification (sizing) of the glass and polymer filaments
- Combination with various thermoplastics possible (e.g. PP, PA6, PLA, PBT, PPS)
- Development of high performance composites with improved interfacial interaction
- Good impregnation due to short flow paths of thermoplastic matrix
- Subsequent processing to textile structures

## Technical Parameters

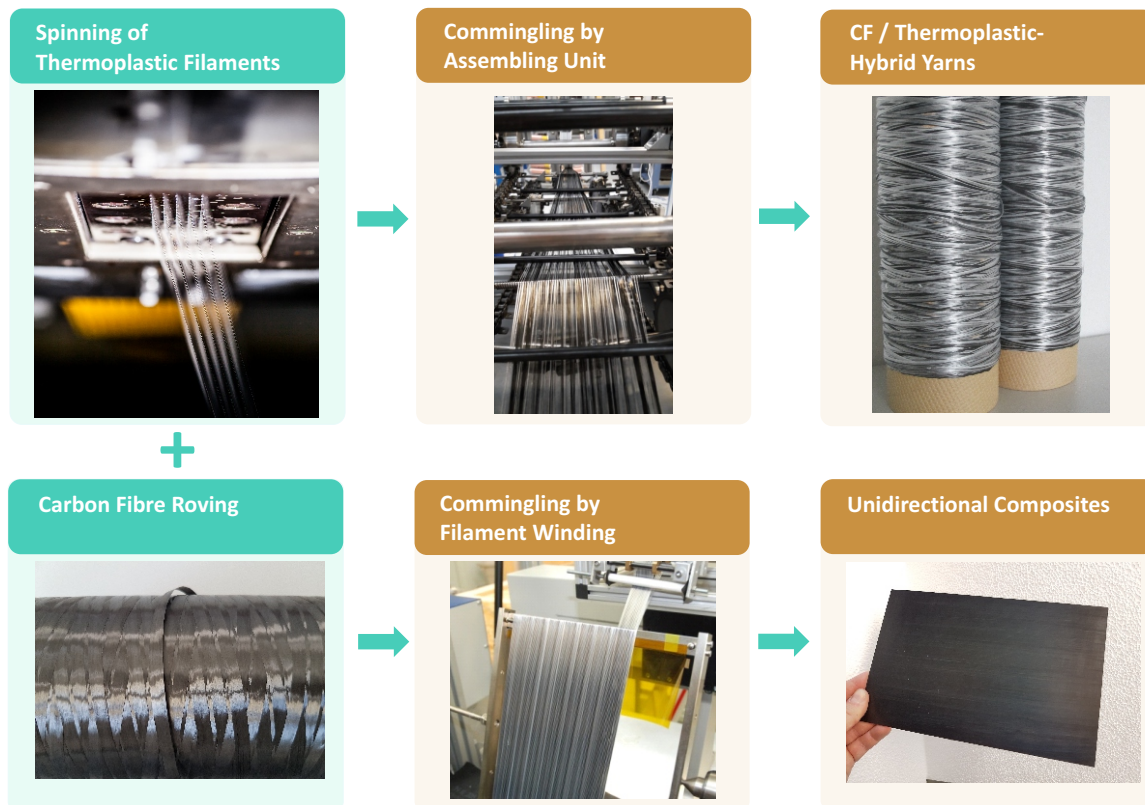
- Range of hybrid yarn fineness between 100 and 200 tex
- Variation of fibre/matrix volume content 40/60 % to 65/35 %
- Glass and polymer filaments can also be spun and modified separately



Fractured surfaces of glass fibre / PPS-composites: low fibre-matrix adhesion was observed for the commercial reference material (left) compared to the new developed glass fibre / PPS-hybrid yarn with adapted sizing (right)

## Polymer Spinning and Surface Modification for CF / Thermoplastic-Hybrid Yarns

- Melt Spinning of thermoplastic filaments
- Commingling of the thermoplastic filaments with carbon filaments using an self-developed assembling unit for the manufacturing of hybrid yarns
- Commingling by a winding equipment for the manufacturing of high-quality consolidated UD-composites
- New sizing formulations can be applied on thermoplastic filaments, carbon fibres and / or the produced hybrid yarns



## Processing of hybrid yarns to reinforcing structures:

Online Hybrid yarns provide fast consolidation capability and can be used for:

- Textile fabrics (weaves, warp-knits, braids, weft-knits)
- UD-Tapes
- Long-fibre reinforced thermoplastics (LFT)
- Preforming by Tailored Fibre Placement (TFP)



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