Textile Innovations
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Bundesministerium für Forschung, Technologie und Raumfahrt

Zukunftscluster H_2 Wasserstoff

ITA | RWTH AACHEN UNIVERSITY

Continuous manufacturing of multifilament wound FRP-pipes for hydrogen

Motivation

- **Mitigation** of conventional steel pipes addressing hydrogen embrittlement and corrosion limitations
- **Fiber-Reinforced Plastic (FRP)** pipes as a lightweight, chemically resistant & pressure capable alternative
- **Continuous Multi-filament pull winding** addresses the production limits of conventional batch filament winding

Objective

- **Process Development** for continuous production of multifilament wound pipes
- **Limiting Permeability** of the FRP-material through liner materials or inner coating process
- **Digital Integration** monitoring the manufacturing process ensuring high product quality

Approach

- **Multifilament pull winding:** continuous pull winding process with 4 rotating winding rings, producing up to 4 closed layers
- **Towpreg process:** duroplast pre-impregnated rovings eliminating separate impregnation step
- **Lab-Scale Testing:** combining extrusion, calibration & cooling, pull winding and consolidation processes
- **Permeation barrier:** creating permeation barrier through PE-liner or inner HS-DED (High-Speed-Direct-Energy-Deposition) applied metal coating
- **Process Monitoring:** installing process visualization for fiber placement

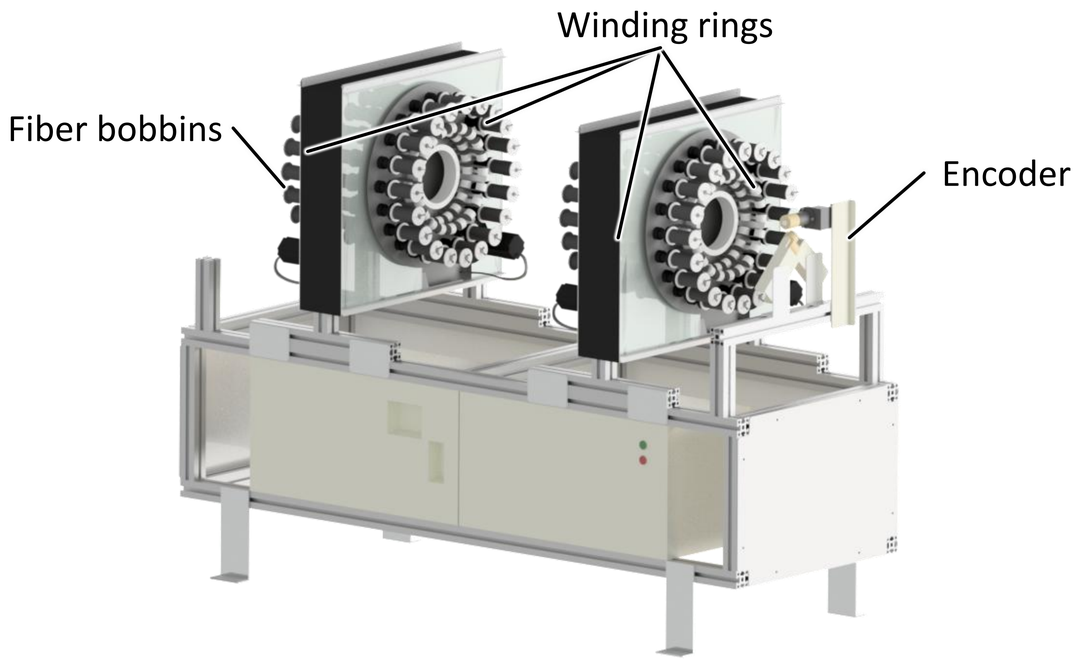


Figure 1: Multifilament pull winding machine at ITA,



Figure 2: Lab-scale production line at ITA

Results and Conclusion

- Production of FRP pipes demonstrated on a continuous lab-scale line integrating extrusion, calibration & cooling, pull winding, consolidation, and haul-off.
- Permeation barrier: Liner material or inner/outer coating to prevent hydrogen permeation
  - Multi-layer PE-Liner: hydrogen permeation remained below detection limit during testing at up to 70 bars
- Process monitoring integrated via real-time image processing at multifilament pull winding machine, allowing for automated winding angle recognition

Outlook

- **Consolidation:** assess in-line/on-site curing and connection effects on fibre performance
- **Industrial Scaling**: integrate multifilament pull winding process into an industrial extrusion line to increase production speed and volume.
- **In-Situ Manufacturing**: investigate on-site pipeline fabrication and curing to simplify installation.
- **Coreless Pipes:** Investigating Type V-style structures by applying metallic barriers directly to internal FRP surfaces.

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SupplHyInno Rhineland

Clusters4Future Hydrogen

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