

Conbility GmbH

Advanced Machine Systems for Composite Production



Conbility – Profile

- Founded 2015 in Aachen
- Location since 2019: Technology Parc TPH, Herzogenrath
- Strong Background in:
 - Production Technology and Material Science
 - Development of Special Purpose Machines
 - Laser Processing Technology
- Portfolio:
 - Tape/ Fiber Placement Machines for Composite Production
 - Software for Cost and Eco Assessment
 - Technology Evaluation
 - Digital Transformation

Spin-off Award Eine Auszeichnung der RWTH













A A C H E N EXCELLENCEIN LIGHTWEIGHT PRODUCTION PREMIUM PARTNER

Conbility – Premium Partner of the AZL-Network

Process Chains for Hybrid Composite Materials

Plastic Material- and Processing Technology

Production Technologies

Machine Tools and Production Metrology

Laser Technology

Automotive Science and Engineering

Fiber- and Textile Technology

Welding and Bonding Technology

Structural Mechanics and Lightweight Design







Conbility – Fields of Activity

Digital Transformation Tape Placement Machines Wired Sensors Measurement CONBILITY setup for minimal invasive data Wireless Sensor acquisition: Modules (12x) 2D Tape Placement Machine at Conbility **3D Tape Placement Applicator** Study Procedure & How to read ∿X≛⊵⊕⊝<mark>⊠</mark>∎ ENERGY STORAGE SYSTEMS Market Segmentation Supply Chains 1 2 TO 1 1111111

Software for cost and eco assessment

Technology Evaluation -





Software for Costing and CO₂ Footprint Analysis,

Advisory Services



OPLYSIS® - Calculate Product Costs and Production Capacities





- Costing Software for calculating product costs and capacities of serial production scenarios
- Drag&Drop Workspace for easy and transparent modelling of production sequences
- Branch- and Technology Independent by using basic elements of Activity Based Costing methodology
- Expressive by providing cost structures and cycle times for every process stage
- **Fast** by adding and linking calculation elements by drag&drop
- **Easy-to-use** by guided input for the required information
- Reliable by using standard calculation routines and visual representations of interdependencies
- Inspiring by facilitating real-time modification and substitution of process sequences
- Affordable by flexible subscription model on monthly basis



OPLYSIS® - A Concurrent Engineering Tool to save Costs and Time

OPLYSIS helps to directly evaluate the impact of product design on the manufacturing costs and facilitates simultaneous optimization



OPLYSIS enables early

- Assessment of invest and production cost
- Identification of cost drivers and bottlenecks
- Effects analysis of different production scenarios or alternative resources (materials, machines, technologies, etc.)

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Transparent process flow on different levels of detail



Calculation of material, operating and invest cost on every level of detail

Calculation of cycle and throughput time and output per year in consideration of i.e. scrap and resource availability



Transparent process flow on different levels of detail





Our Products and Services



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CONBILITY

- Product: Process Costing Software "OPLYSIS"
 - Intuitive Drag&Drop Workspace
 - Advanced Analyses (Sensitivities, Scale-up, Capacities)
 - Assessment of Invest and Production cost
 - Identification of Cost Drivers and Bottlenecks
 - Effective Analysis of different Production Scenarios

Advisory: Modelling and Analysis with our Team

- Modelling of your existing Production or of different Production Scenarios
- Support in Production Planning
- Identification of Cost Drivers and Bottlenecks before Start of Production
- Technology Consulting



Transparent process flow on different levels of detail



Production Cost and Carbon Footprint Assessment using OPYLSIS-eco



- Integrated software for simultaneous calculation carbon footprint, product cost and production capacities of production scenarios
- Drag&drop workspace for easy, intuitive and transparent modelling of production scenarios
- Branch- and technology independent by using basic process chain elements suitable for any production scenario
- Efficient analysis of key performance drivers with sensitivity analysis and scale-up analysis
- Inspiring by facilitating real-time modification and substitution of process sequences

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Easily derive multiple production scenarios by parameter variations and sensitivity analysis

What we offer:

- OPLYSIS-eco software license
- Benchmarking of Material and Process Technologies as an Individual Service



Tape Placement Systems

Double Belt Press Systems





Laser-assisted Tape Placement Motivation





Laser-assisted Tape Placement with in-situ Consolidation Process Principle and Advantages



Advantages

- Energy-efficient heating of process zone due to usage of laser radiation
- Precisely and fast controllable laser-induced heating
 - Closed-loop control of laser power
 - Avoidance of over-heating

No post-consolidation processes

- Energy efficient and resource efficient
- Cost efficient (process and investment costs)

High flexibility

- Thickness variations within a laminate
- Usage of different tape materials within a laminate
- Production of tailored 2D composite sheets
- Final local reinforcements of parts or organic sheets

Advantages for subsequent thermoforming

- Better stability for handling operations
- Strong laminate fixation during injection molding
- Faster and more homogeneous heating before thermoforming due to complete contact of the tape surfaces



Exemplary Addressed Product Categories

Load- and cost optimized multi-material combinations



Composite vessels



Picture: Fraunhofer IPT, Aachen

Tailored Composite Blanks



Composite pipes



Picture: Fraunhofer IPT, Aachen



Our Standard Tape Placement and Winding Systems

2D Tape Placement Machine



3D Tape Placement Head "Multi-Material-Head"





Our Standard Tape Placement and Winding Systems

2D Tape Placement Machine



3D Tape Placement Head "Multi-Material-Head"





2D Tape Placement Machine

Laser-assisted Tape Placement with in-situ Consolidation

Laser-safe and Key-ready Maschine for laser-assisted Tape Placement with in-situ Consolidation



PrePro 2D for laser-assisted tape placement:



Video:



YouTube Video:



System Properties

- Table size: up to Ø 2 m
- Multiple tapes possible
- Process speed: up to 1 m/s

https://youtu.be/Q_pKDH006xo



Machine Characteristics



- Plug&Produce Production Machine for manufacturing tailored composite blanks by automated thermoplastic tape laying
- Small footprint of 5 x 2.5 x 2.5 m³
- Flexible arrange- and reconfigurable on the shop-floor by low weight of 3.2 t, moveable by forklift
- Integrable into fully automated production lines by automated unloading mechanism
- Direct further processing of laminates in thermoforming by using in-situ consolidation (no additional costly, energy-consuming and space-demanding consolidation step needed)
- High cost- and material efficiency by independent cut and add on-the-fly for each tape
- High productivity by consolidation of tapes with up to 1 m/s and simultaneous placement of three tapes in parallel
- Highest standard for the laminate quality by using aerospace proven laser heating
- Prevention of over-heating by temperature-control in the process zone
- Flexible adaptable of tape material by exchangeable modules to cover tape widths from 6 to 25 mm, thickness up to 0.3 mm
- Full control and documentation of all relevant process parameters by user-friendly HMI and machine control



Main Specifications





General Specifications:

- Machine dimensions: 5 m x 2,5 m, weight: 3,7 tons, (approx.)
- Laser safety class 1 (laser safe stand alone machine system)
- Process: laser-assisted tape placement with in-situ consolidation
- Free choice of tape (fiber) directions
- Variation of different thicknesses within a laminate
- No post-processing for consolidation

3 x Spool Applicator:

- Tape width: standard 25 mm (3x)
- Tape thickness: <0,3 mm, minimum length <95 mm (tape 1+3), <112 mm (tape 2)
- Translational Z-axis for applicator movement (vertical direction / blank thickness): 100 mm
- Translational Y-axis for applicator movement: TCP on complete table surface
- Automatic pneumatic cutting unit for "cut-and-add-on-the-fly"
- Exchangeable cooled compaction roller units: 1x rigid surface and 1x elastomer surface
- Adjustable consolidation force up to approx. 500 N
- Rotary Table with integrated Heating Functionality:
 - Table diameter: 1,500 mm, alternative 2,000 mm
 - Max. heating temperature table: 200 °C
 - Rotary table (+/- 90°) and translational X-axis for table movement
 - Max. speed in X-direction: 1m/s (typical process speed for PA-tape: 850 mm/s with laser)

Laser System:

- 4 kW high power diode laser incl. cooling, optical fiber and processing optics
- Control System:
 - Beckhoff industrial control system including HMI based on TwinCat 3.1 and G-code
 - Controlable process parameters: speed, laser power (temperature), compaction pressure
 - Recording of process parameters, IR-camera for monitoring of process zone and temp. control



Configurable and Scalable Machine Setup





System Properties

- Heating table: Ø 1,5 m (scalable up to 2m)
- 3-spool-applicator (scalable)
- Integrated 4 kW Laser system (scalable)
 - Process speed: up to 1 m/s



Our Standard Tape Placement and Winding Systems

2D Tape Placement Machine



3D Tape Placement Head "Multi-Material-Head"





3D-Multi-Technology-Tape Placement Unit

Compact and configurable placement system for automated 3D layup of rovings, prepregs and towpregs



Properties of the system:

- One investment for the processing of 3 different materials:
 - Thermoplastic CFRP and GFRP Tapes
 - Thermoset CFRP and GFRP Prepregs
 - Dry Fiber Rovings
 - Suitable for placement and winding operations
- Single tows/ tapes with width up to 50 mm
- Tape tension control
- Infrared heater to increase tack of resin
- Prepared for integration (plug-in) of a high-power diode laser system, e.g. 4 kW: mechanical interface for the optical systems, control system preparation
- BECKHOFF-based decentral control system communicating with robot control system, including process parameter close-loop-control and HMI
- Can be mounted to a standard robot and is compatible to standard robotic control systems, e.g. KUKA





Conbility's Tape Processing Applicator – Main Characteristics

- Closed-loop control of
 - laser power for defined temperatures in process zone (high-speed pyrometer for control, high-resolution thermal camera for quality and process monitoring),
 - tape tension,
 - Consolidation force pressure roller.
- Modular and Reconfigurable
 - Scalable tape widths, e.g. 6 mm, 12 mm, 25 mm up to 50 mm within the standard 50 mm tape processing applicator
 - Additional upgrade of max. tape width up to 100 mm for the tape processing applicator available
 - All parts (rollers, bearings, guidings, etc.) capable for heavy-duty operation, easily exchangeable for maintenance and adaption for special purposes (e.g. special fibre materials like ceramics)
 - Upgradeable for dry-fiber placement and prepreg placement with alternative resins as addition to thermoplastic tapes (thermoset prepreg, also with tension-controlled unwinding of backing paper)
 - Reconfigurable for e.g. multiple tapes, optimizations for vessel winding and special tasks like ring winding
 - Flexible platform for reliable and robust processing conditions





Conbility's Tape Processing Applicator – Additional Features

- Adjustable Laser-inclination (defines distribution of laser power incoming tape/substrate) via servo motor during process
- Scalable in width according to client's demand (e.g. 90° gear for spool drive, compact roller, compact robot interface, positioning of pyrometer/IR-camera)
- 78 kg weight
- Beckhoff Industrial PC-based control
- Laserline high-power diode laser, 24/7 capable
- Fluid-cooled laser homogenization optic with high working distance (low contamination potential) incl. easily exchangeable protection glass



Configuration for tape processing, max. tape width 50 mm

Configuration with backing-paper unwinding upgrade



Conbility – Reference Tape Winding Cell

Laser-safe Winding Cell for thermoset towpreg winding and thermoplastic tape winding at Conbility's technical center in Herzogenrath, Germany





CAD-CAM



simulation of created programs



generating of layup

post-processing



Conbility – References Tape Processing Systems

 AIMEN Centro Aplicaciones Láser, O Porriño - Pontevedra, Spain



 Bilsing Automation Tic. Ltd. Sti.-Bursa, Türkey



University of Limerick - Castletroy, Ireland



 Institute for Textile Technologies -Aachen, Germany





Exemplary integration @ AIMEN Technology Centre, Spain





ATL on FANUC robot



Integration @ AIMEN Technology Centre, Spain





3.5 months from PO to acceptance











Integration @ Limerick University in Ireland





Our Products and Services (Production Systems)



Tape Placement Machine Systems

- 2D Tape Placement Machine
- 3D Tape Placement/ Winding Head ("ATP-Head")
- Key-ready Manufacturing Cells (Customized - Including Robot, Laser Safety Cell, Winding Axis, etc.)

- Job-order Manufacturing (Job-Shop)
 - Manufacturing of Test Laminates (2D, 3D) by Tape Placement with in-situ Consolidation
 - Manufacturing of Test- or Prototype-Parts by Tape Placement or Tape Winding (e.g. Tubes, Pipes)
 - Local reinforcement of metal parts or thermoplastic parts (e.g. Injection Molded Parts or "Organo-Sheets")



Inductive Double Belt Press





Inductive Double Belt Press System



Impregnation example:



- Energy- and cost-efficient inductive heating system
- Consolidating and impregnating a wide variety of composite materials
- Highly flexible: all parameters adjustable within minutes (e.g. pressure, temperature, speed)
- Max. Temperature: 300 °C
- Max. Pressure: 24 bar
- Steel belt width: 350 mm (scalable)



Double Belt Press System

Start-up Video of the HMI



Start-up Video of the Machine





Impregnation Trials – PA6 and Glass Fiber Textile

Layup:

GF	PA

Comments:

- Processing speed: 500 mm/s
- Glossy and smooth surface without visible voids
- Minimal fiber washing
- Component flat and stiff

Microsection:



Material right out of the machine (no post-processing done)





Pressure distribution during trials (pressure per cylinder [bar])



Average temperature measurements





Consolidation Trials – 5 Layer PA12-CF Tape

Layup:

Material right out of the machine (no post-processing done)

PA 12 – CF Tape

Comments:

- Processing speed: 700 mm/s
- Glossy and smooth surface without visible voids
- Minimal fiber washing
- Component flat and stiff

Microsection:







Average temperature measurements [°C]



Pressure distribution during trials (pressure per cylinder [bar])





Consolidation trials - CF-PC tape



- Very good consolidation of layers
- Very smooth and glossy surface
- Local thickness variations of 3 tapes are no issue
- No issue with polymer sticking to belts





Consolidation trials: Huesker W8SVR



- Very good consolidation of layers
- Only little blurring of checkered pattern
- Higher process speeds possible, but currently limited by:
 - Inhomogeneous inductor temperature of machine width
 - Cooling module length
- Machine design can easily be adopted for a tailored consolidation line







Summary of Conbility's Machine Portfolio

Energy-efficient Double Belt Press







2D Tape Placement Machine with integrated Laser System



3D Tape Placement and Winding Systems













Exemplary Parts: Local Reinforcements and Tailored Blanks



thin injection molded parts

Pre-consolidated Flax-PP NFC-Sheets



DeliComp® Prepregs





Tailored blanks with / without cut outs





Your Contact



Dr.-Ing. Kai Fischer Founder & Managing Partner



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Founder & Managing Partner

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