

Project title "Increasing the competitiveness of TWEETOP Sp. z o.o. through the implementation of an innovative technology for the production of Pert II/Evoh/Pert II multilayer pipes with increased mechanical strength" No. RPZP.01.05.00-32-W043/21 as part of the Regional Operational Programme of the Zachodniopomorskie Voivodeship 2014–2020 Priority Axis 1 Economy, Innovation, Modern Technologies". Measure 1.5 "Investments of enterprises supporting the development of regional specializations and smart specializations.

Appendix TT 1 Components of a process line – minimum requirements

TECHNOLOGICAL LINE FOR THE PRODUCTION OF MULTILAYER PIPES ENABLING THE APPLICATION OF COATING

A. Multilayer pipe production module – minimum requirements

I. General technological line parameters

Production line for the production of PERT II/EVOH/PERT II multilayer pipes using a one-stage process enabling the manufacturing of products with increased mechanical strength.

Production of plastic PERT II/EVOH/PERT II multilayer pipes with the dimensions specified in Appendix TT 2 Final product – minimum requirements.

The production of the pipe and its coating with the thermal insulation will take place simultaneously; the product will also be laminated by extrusion of the protective polyethylene jacket at the same time.

Primary parameters:

- Possibility of producing pipes with diameters of 14-32 [mm]
- Production of pipes with geometries according to **Appendix TT 2 Final product – minimum requirements**.
- Overall wall thickness range of the finished product 1-5 [mm].
- Possibility of producing pipes in coils of 25 – 600 [m] (for $\varnothing = 16$ mm)
- Stable production speed for pipe with $\varnothing = 16$ mm required – min. 50 m/min.
- Working axis height – min. 1000 [mm]

II. Production line components – minimum requirements

1. "WT A" Inner layer extruder – Pert II type raw material

Extruder A is responsible for plasticising and feeding the pert material using a five-layer head – extruding the inner layer of the pipe. The extruder must provide the constant mass flow necessary to maintain a stable production of multilayer pipes with geometries and production line speed according to **Appendix TT 2 Final product – minimum requirements**. It should ensure the required homogeneous quality of the plasticised material, without cavities or air bubbles.

- Working diameter of the cylinder/screw – min. 60 [mm]
- "Mikael" type cylinder or equivalent
- Minimum L/D ratio – min. 30
- Minimum drive power – 80 [kW]
- Surface hardness – min. 1000 HV

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- Screw RPM sensor
- Complete control cabinet to manage speed and discharge temperatures

Raw material dosage

- System for precise dosing of min. 2 additional raw materials (process additive, colouring, etc.)
- Buffer tank for raw material
- Control system enabling remote reading of raw material consumption
- Control system enabling calibration of the current reading
- Set of service tools for screw extraction

2. "WT B" Inner adhesive layer extruder

Extruder B is responsible for plasticising and applying adhesion using a five-layer head to the inside of the pipe between the inner pipe and the EVOH layer. The extruder should provide the constant mass output necessary to maintain stable production. It should ensure the required homogeneous quality of the plasticised material, without cavities or air bubbles.

- Working diameter of the cylinder/screw – min. 30 [mm]
- Minimum L/D ratio – min. 24
- Minimum drive power – min. 7,5 [kW]
- Surface hardness – min. 1000 HV
- Screw RPM sensor
- Complete control cabinet to manage speed and discharge temperatures

Raw material dosage

- Device for monitoring raw material consumption
- Buffer tank for raw material
- Control system enabling remote reading of raw material consumption
- Control system enabling calibration of the current reading
- Set of service tools for screw extraction

3. "WT C" EVOH layer extruder

Extruder C is responsible for plasticising and feeding the EVOH layer using a five-layer head into the interior of the five-layer pipe to form a diffusion barrier. The extruder should provide the constant mass output necessary to maintain a stable production of multilayer pipes with the appropriate geometry and linear speed of 50 m/min. for $\varnothing = 16$ mm. It should ensure the required homogeneous quality of the plasticised material, without cavities or air bubbles.

- Working diameter of the cylinder/screw – min. 30 [mm]
- Minimum L/D ratio – min. 24
- Minimum drive power – min. 7,5 [kW]
- Surface hardness – min. 1000 HV
- Raw material dispenser mounting bracket
- Screw RPM sensor

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- Complete control cabinet to manage speed and discharge temperatures

Raw material dosage

- Device for monitoring raw material consumption
- Buffer tank for raw material
- Control system enabling remote reading of raw material consumption
- Control system enabling calibration of the current reading
- Set of service tools for screw extraction

4. "WT D" Outer adhesion layer extruder

Extruder D is responsible for plasticising and applying adhesion using a five-layer head to the inside of the pipe between the inner pipe and the EVOH layer. The extruder should provide the constant mass output necessary to maintain stable production. It should ensure the required homogeneous quality of the plasticised material, without cavities or air bubbles.

- Working diameter of the cylinder/screw – min. 30 [mm]
- Minimum L/D ratio – min. 24
- Minimum drive power – min. 7,5 [kW]
- Surface hardness – min. 1000 HV
- Screw RPM sensor
- Complete control cabinet to manage speed and discharge temperatures

Raw material dosage

- Device for monitoring raw material consumption
- Buffer tank for raw material
- Control system enabling remote reading of raw material consumption
- Control system enabling calibration of the current reading
- Pneumatic raw material transport
- Set of service tools for screw extraction

5. "WT E" Outer layer extruder

Extruder B is responsible for plasticising and feeding the pert material using a five-layer head – extruding the inner layer of the pipe. The extruder must provide the constant mass flow necessary to maintain a stable production of multilayer pipes with geometries and production line speed according to **Appendix TT 2 Final product – minimum requirements**. It should ensure the required homogeneous quality of the plasticised material, without cavities or air bubbles.

- Working diameter of the cylinder/screw – min. 45 [mm]
- Minimum L/D ratio – min. 30
- Minimum drive power – min. 22 [kW]
- Surface hardness – min. 1000 HV
- Screw RPM sensor
- Complete control cabinet to manage speed and discharge temperatures

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Raw material dosage

- Device for monitoring raw material consumption
- System for precise dosing of 2 additional raw materials (process additive, colouring, etc.)
- Buffer tank for raw material
- Control system enabling remote reading of raw material consumption
- Control system enabling calibration of the current reading
- Set of service tools for screw extraction

6. Five-layer cross head

The five-layer head is responsible for pre-forming and shaping the geometry of the multilayer pipe. The head enables five extruders to be connected for coextrusion, thus extruding a five-layer pipe with concentric layers.

- Material – nitrated steel
- Final product centering – solid core, movable die
- Maximum finished product diameter – 32 [mm]
- Set of connectors for mounting pressure sensors
- Temperature sensor set to be included
- The head must guarantee the formation of concentric layers with an eccentricity of not more than 0.02 mm
- The design of the head must ensure relatively easy disassembly and dismantling into its component parts for cleaning
- The head must have safeguards preventing incorrect assembly
- Surface hardness – min 1000 HV
- Nitrating depth – 0.5 mm
- Quick head removal and cleaning system

7. Cross head tooling

The tooling of the five-layer head is responsible for providing the appropriate pipe geometry in line with the finished product specification.

- Complete tooling set for the production of pipes with the geometry specified in **Appendix TT 2 Final product – minimum requirements**.
- A set of tools for the production of pipes of any required geometry, guaranteeing a stable, uninterrupted process with constant parameters, in line with the quality plan.
- Material: special steel for nitriding
- Working surface hardness after nitriding – about 60 HRC
- Each set shall consist of a die and a mandrel to guarantee the production of multilayer pipes according to the given geometrical specifications.

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8. Vacuum bathtube

The vacuum bath is responsible for vacuum forming the finished product using a disc or tube calibrator.

- Vacuum bath length – min. 6 [m]
- Number of chambers – min. 1[pcs.]
- Complete tooling set for the production of pipes with the geometry specified in **Appendix TT 2 Final product – minimum requirements.**
- Stainless steel baths with hinged, transparent covers
- Two-axis calibrator position adjustment
- One vacuum systems using silent vacuum pumps
- Automatic vacuum stabilization
- Automatic water level regulation in tanks linked with vacuum chambers
- Precise adjustment of water pressure to the pipe forming calibrator
- Precise regulation of the quantity of water supplied to the calibrator
- Moveable at a distance of min. 0.6m
- Vacuum level range from -35 to -500 mBar
- High-performance vacuum pumps
- All made of corrosion-resistant material.
- Temperature measurement system to be installed directly in the vacuum chamber
- High-quality soundproofing to reduce emitted noise

9. Equipment of the vacuum bath

- Plate calibrators for every pipe diameter (**Appendix TT 2 Final product – minimum requirements**).
- Water supply to the wetting section (calibrator nozzle) and cooling chamber (calibrator zone II) to be provided from four sides around the circumference
- Liners inside the chambers are to be adapted to the diameter of the manufactured pipe

10. Cooling bath

Cooling baths are used to cool the finished product using process water.

- Fixed cooling bath – min. 24 [m]
- Complete tooling set for the production of pipes with the geometry specified in **Appendix TT 2 Final product – minimum requirements.**
- Stainless steel baths with hinged, transparent lids. The baths must be placed on supporting steel structures that will make it possible to align them coaxially with other production line components.
- The baths must be fitted with a set of adjustable rollers/plates to keep the pipe aligned with the production line,
- The baths must be equipped with a system of rubber valves damming the water ,
- Water temperature measurement sensor.

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11. Dryer

A device for drying the finished product at a production speed of 50 m/min.

- Power supply – compressed air or electric air blower
- Complete tooling set for the drying of pipes with the geometry specified in **Appendix TT 2 Final product – minimum requirements.**
- Drying chamber soundproofing – reducing noise emissions

12. Rotary guillotine and quality control system

- Max product diameter 32 mm
- Number of blades min. 2
- Engine power min. 1.0 kW
- The guillotine is to be coupled with a quality control system that must control the entire product manufacturing process by reading all parameters such as heating currents, motor currents, temperatures of all measuring points along the line, product dimensions (outer diameter in three axes) and wall thickness
- The control algorithms must eliminate the possibility of producing a defective pipe – any deviation outside the acceptable standards must be registered, with the guillotine automatically cutting out any non-compliant product

13. QC device – LASER pipe geometry measurement

Line component responsible for measuring the outside diameter of the finished product with the ability to communicate with the main line controller for automatic analysis of its value.

- Measured diameter range: up to 34 [mm]
- HMI panel – display of current diameter (three-axis measurement), oval dimensions, plotting of variable trends, alarms, setting error tolerances, deviations,
- The panel must have a communication interface for networking with the main PLC,
- Network readout of measurement parameters – Three-axis measurement, oval dimensions and operating status,
- Tripod enabling safe operation,
- It is acceptable to use two two-axis laser heads mounted at a 45° offset that will enable measurement in four planes

14. QC device – ultrasonic pipe geometry measurement

The QC device is a line component responsible for measuring the geometry of the finished product with the ability to communicate with the main line controller for automatic analysis of its value.

- Thickness measurement at 8 points on the circumference
- Measurement method – ultrasound
- Measurement in water environment
- Outer diameter measuring range: 6-32 mm
- Wall thickness measuring range: 0.5-5 mm
- Accuracy (outer diam.): ±0.05 mm

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- Accuracy (wall): ± 0.001 mm
- Accuracy (concentricity): $\pm 0.1\%$

15. QC device – visual quality control of the outer layer

The QC device is responsible for checking the quality of the outer layer in terms of such defects as burnt material, holes and inclusions in the layers, discoloration, water stains, etc.

- Continuous omnidirectional inspection of the pipe's external surface (geometry set out in **Appendix TT 2 Final product – minimum requirements**).
- The device is based on a system of four cameras with an appropriate lighting system enabling the pipe to be scanned
- Network connection to the master control unit must be provided for all cameras to enable a two-way exchange of data with the camera controller,
- Sending error and device status information, as well as information on detected anomalies, depending on fault type,
- The PLC and SCADA system notify the controller about the start/stop of the surface inspection process, parameters of the inspection patterns, as well as data about the set properties of the inspection patterns,

Screenshots of abnormalities to be saved on disk and sent over the network to a designated computer along with characteristic parameters to identify them

16. Pulling of the finished product

The caterpillar haul-off is responsible for the movement of the finished product.

Basic requirements:

- Provides a constant, preset tension of the line,
- Autonomous control system with a network connection to the line's main PLC with full diagnostics and parameter setting via a SCADA-type system
- Must feature guards to ensure operator safety
- Easy and quick replacement of belts replacing

Basic parameters:

- Max. diameter of the pulled pipe $\varnothing 32$ mm
- Min. diameter of the pulled pipe $\varnothing 12$ mm
- Axis height min. 1000 mm
- Setting range (2 – 100) N
- Nominal speed min. 50 m/min.
- Space after opening the chains min. 40 mm
- Drive – gear-motor: min. 2 x 1.0 kW

17. Printer – marking finished products.

The finished product labelling machine is responsible for applying the necessary product information onto the manufactured pipe in accordance with the requirements.

- Marking must be done reliably and permanently,

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- The control panel must provide easy, intuitive operation,
- Control over the machine should be effected by means of a touch screen with a minimum size of 10.4",
- It must be possible to optionally fit the printer with a suction tube that seals itself hermetically at the end of the printing process, ensuring that the remaining ink does not dry out and eliminating the problem of ink splatter caused when the jet is reintroduced into the suction tube
- Basic printing parameters:
 - Possibility of printing 16 mm high characters
 - Print speed up to 3,200 characters/sec.
 - Fast/two-line print modes
 - Matrix type from 5x5 to 32x32
 - Printing of different fonts, both upper and lower case letters
 - Possibility of combining different fonts in one print
 - The printer should have an imprint print organizer,
 - Possibility of copying print files from various storage media,
 - Counter printing,
 - Work shift code printing,
 - Graphic sign printing,

18. Production line control

The line control system must include:

- Main power/control cabinet
- Control systems for individual production line components
- Production process monitoring
- Production process quality control
- Finished product geometry check
- Visual quality control of the product's outer layer
- Control of material quantities consumed in the production process per unit of time
- Non-compliance alarm system
- Line control programme source code with full access and complete descriptions
- PLC-based control system with a central unit, input/output modules, communication and special modules and distributed network structure system – distributed inputs/outputs, inverters and other network devices
- All line equipment should have a network interface and be connected to the central unit for real-time exchange of operating and diagnostic data,
- The control system should comply with work safety requirements, enabling emergency system shutdown in a manner that prioritises the safety of the operator and any nearby persons, with preventing damage to the machine being the secondary priority.
- Provision of control algorithms for continuous, optimal and technologically compliant operation across the entire product spectrum,
- Access to production data from an external industrial SQL database system,

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- Control system featuring an industrial computer with a touch screen and SCADA-class software of a globally recognised brand along with a licence enabling project editing – Development,
- The system must enable production process monitoring in terms of the current values of all line parameters, as well as the setting of work parameters for individual line devices, and access to current and historical alarms and charts,
- Power and control and network cabling including cable ducts, as well as junction enclosures and boxes,

The system must also have:

- Process visualization
- Remote production data tracking functionality
- ProfiNet, Ethernet
- Operator control of the line by means of a touch screen integrated with an industrial computer
- Transfer of production data to an independent database
- Connection of the computer to the company's computer network
- Creation and saving of technological processes
- Three access levels for entering settings, reading data and creating technological processes
- Saving all line operation data as files for archiving purposes
- Use of a connection providing diagnostics and service for all control elements such as the drive, controller and computer from anywhere in the world

19. Archiving of line parameter data

- Data collection system
- Archiving of production line operating parameters
- Possibility of displaying parameters on the process line in the form of line graphs

20. Finished product winder

The purpose of the finished product winder is to wind thermoplastic tubes into coils with defined parameters.

- The winding and strapping process must be fully automated,
- The process of winding the finished product must ensure the complete safety of anyone using the machine,
- To carry out the winding process in an emergency, the device must enable the winding process to be completed manually, i.e. in a forced manner that remains safe for the operator,
- Winder basic parameters:
- Permissible outer diameter of the coil up to 1200 [mm]
- Permissible inner diameter of the coil 400 – 600 [mm]
- Permissible coil height up to 600 [mm]
- Permissible coil weight up to 80 [kg]
- Winding speed: up to 50 [m/min]

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- Blade height: min. 200 [mm]
- Pipe diameter: 12-32 [mm]
- Drive: Servomotors
- Positioning: Servomotors
- Adjustment: Torque
- Emergency stop switches,
- Automatic pipe coil welding,
- Smooth and safe changeover during the production process,
- The winder must be designed in a way that prevents access to its inside during operation,
- Central core diameter adjustment,
- Central winding width adjustment,
- The winder must be equipped with a communication interface for visualising operating parameters in the Scada system.
- Coil pick-up by means of a roller table

21. Additional functions

- The defective product selection system

A system that checks if the quality of the manufactured pipes complies with the established technological parameters. The system must enable the setting of values to activate the pre-alarm, as well as values to activate the cutting out of the defective pipe. When a predetermined alarm threshold is exceeded, a siren must light up and a message must be displayed on the control panel. When the pipe defect threshold is exceeded, the pipe should be automatically cut into short sections (length to be set by the technologist) upon reaching the cutter. Once the defect has been removed and the pipe is once again in line with the preset tolerances along its entire length (head <-> cutter), the system is ready to confirm the start of winding of the finished product – the cutter stops when the proper quality of the pipe is confirmed by the operator. The system must include pipe geometry measurement and visual inspection.

- The defective pipe selection system should be based on the following:
 - QC device – XY LASER pipe geometry measurement
 - QC device – ultrasound pipe geometry measurement
 - QC device – visual quality control of the outer layer
 - Measurement of the pressure of the material being pumped
 - Display of the vacuum level in the vacuum tank
- Parameterization and visualization of measurement data and detected defects
 - Visualization of the defective production selection process includes the display of current measurements, as well as alarm and cut-out thresholds
 - Enables wall thickness measurement calibration
 - Enables the selection of active devices: disengaged devices, single axis, medium
 - Includes diagnostics of the measuring equipment used – OK/NO OK
 - Correlates existing product defects with the meter counter

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22. Technical documentation

- Complete Operation and Maintenance Documentation for the process line (paper version, 3 pcs., and electronic version) containing the following:
 - characteristics (technical parameters) and registration data
 - external drawing, flowcharts
 - list of normal and special equipment
 - diagrams, electrical and pneumatic
 - functioning flowcharts
 - instructions for use
 - user's manual
 - maintenance and lubrication instructions
 - OHS instructions
 - refurbishment standards
 - list of spare parts
 - list of optional equipment
 - list of enclosed figures
 - copies of line software (PLC, SCADA computer, drives, HMI)
- Documentation confirming compliance of the implementation with:
 - Directive 2006/42/EC of the European Parliament and the Council of 17 May 2006 on machinery, as amended,
 - Low Voltage Directive,
 - Electromagnetic Compatibility Directive,
 - Pressure Equipment Directive,
 - Declaration of the Office of Technical Inspection,
 - Report on protective measurement and protective bonding testing.

23. Transport and start-up

- Transport of the process line to the customer's premises
- Assembly and preparation of the process line for start-up
- Process line commissioning and acceptance testing
- Training the Tweetop Sp. z o.o. personnel on how to operate the process line

III. Finished product geometry

The production line under development is planned to produce Pert II/Evoh/Pert II pipes with the geometry set out in **Appendix TT 2 Final product – minimum requirements**.

IV. Technological process parameters

The required minimum process parameters are provided in **Appendix TT 2 Final product – minimum requirements**.

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V. Raw materials used

Pert II/Evoh/Pert II is a five-layer pipe. The Ordering Party plans to use the following raw materials in its production:

1. Inner layer – Pert II – Dowlex 2388, Hostalen 4731B, LG SP988, Total XRT70 or equivalent
2. Inner adhesion layer – Plexar PX3216, Plexar PX5335, Yparex 8903s, Yparex 8603s or equivalent
3. Oxygen barrier layer – Soarnol DC3208HB or equivalent
4. Outer adhesion layer – Plexar PX3216, Plexar PX5335, Yparex 8903s, Yparex 8603s or equivalent
5. Outer Pert II layer – (Dowlex 2388, Hostalen 4731B, LG SP988, Total XRT70) or equivalent

The above requirements regarding the type and supplier of raw material are dictated by the approval certificates held by Tweetop Sp. z o.o.

VI. Notes

The process line components described in the line specification and the required production process parameters constitute the minimum requirements. While components with other parameters may be used, their parameters must not be worse than those indicated in the specification.

B. Pert II/Evoh/Pert II pipe coating module – minimum requirements

I. General technological line parameters

Part of the process line for coating PERT II/EVOH/PERT II pipes with thermal insulation. Thanks to a system of reversible wheels and precise process synchronisation, it will enable the production of pre-insulated pipes in a single-stage process.

II. Production line components – minimum requirements

1. Deflecting device for insulation deflection
 - unreeling from reels with diameters of up to $\varnothing$ (2000) mm
 - reel width up to 900 mm
 - reel weight with product up to 50 kg
 - line speed up to 30 m/min.
 - contact-free sag measurement
2. Double deflecting device (with no drive) for base pipe
 - uncoiling $\varnothing$ 600 ÷ 1250 mm
 - friction brake
3. Straightener with drive for the lower horizontal wheel set
 - 5 pcs. of vertical rollers; a set of lower rollers driven synchronously with the extractor
 - 5 pcs. of passive horizontal rollers

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4. Reversible wheel system with synchronisation (for use with the EVOH line)

- Wheel system for stable base pipe feeding
- Min. reversible wheel diameter: 800 mm
- a system to synchronise the operation of the EVOH line with the insulation line

5. Base pipe feeding system

- max. diameter of the pulled pipe 40 mm
- min. diameter of the pulled pipe 14 mm
- line axis height 1000 mm
- direction left
- nominal pulling force 4000 N (at 34 m/min.)
- nominal speed up to 34 m/min.
- min. space after opening the chains up to 45 mm
- line-integrated safety switch

6. Device for cutting the heat insulation, placing it on the base pipe and jointing it

- cutting disc
- hot air jointing
- pipe coupling sensor
- set of guide rollers

7. Laminating extruder $\varnothing = 35$

The extruder is responsible for plasticising and feeding the pert material using a crosshead, i.e. extruding the insulation cover layer. The extruder must provide the constant mass output necessary to maintain a stable coating process for multilayer tubes with the geometry and linear velocity values compliant with those set out in **Appendix TT 2 Final product – minimum requirements**. It should ensure the required homogeneous quality of the plasticised material, without cavities or air bubbles.

- cylinder diameter min. $\varnothing = 35$ [mm]
- Minimalny stosunek L/D min. 30
- motor min. 30 kW, AC

8. Granulate feeders and dosing unit

- a vacuum device feeding the raw material from the container into the extruder hopper
- set of working hoses
- pulling in the material from a distance of min. 5 m, to a height of min. 3.5 m
- capacity of up to 150kg/h

9. Crosshead

- complete tooling set for the production of pipes with the geometry specified in **Appendix TT 2 Final product – minimum requirements**.
- 3 heating zones
- Supporting stand
- a set of tools needed to carry out the necessary servicing operations to be included

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10. Knurling device

- 8 rollers on the circumference
- pneumatic roller pressing
- 2 sets of knurling rollers
- water-cooled rollers

11. Drying tub

- integrated with metre counter
- length – min. 1,200 mm
- gravity discharge

12. Receiving extractor

- | | |
|---------------------------------------|----------------------------|
| • Max. diameter of the pulled pipe | up to 50 mm |
| • min. diameter of the pulled pipe | no less than 14 mm |
| • line axis height | min. 1000 mm |
| • nominal pulling force | min. 4000 N (at 34 m/min.) |
| • contact pressure length | min. 1200 mm |
| • Min. space after opening the chains | min. 60 mm |
| • Line-integrated safety switch | |

13. Cutter

- | | |
|---------------------------|---------------------------|
| • Max product diameter | Ø = 50 mm |
| • Number of knives | min. 1 |
| • power | min. 5300 kW (servomotor) |
| • minimum pipe cut length | 0.3 m |

14. Automated coil winder

- | | |
|-----------------------------------|---------------------------|
| • maximum speed | 30m/min. |
| • inner diameter | from 390 to 550 m |
| • outer diameter | up to 800 mm |
| • coil width | 390 mm |
| • automated coiled pipe detection | |
| • insertion chute | at least 10 linear meters |

15. Line control

- with process visualisation in a SCADA-class program, as well as current and historical charts and alarms
- remote production data tracking functionality
- ProfiNet, Ethernet
- operator control of the line by means of a touch screen integrated with an industrial computer (min. 21.5")
- possibility of collecting production data in an external database

Project title "Increasing the competitiveness of TWEETOP Sp. z o.o. through the implementation of an innovative technology for the production of Pert II/Evoh/Pert II multilayer pipes with increased mechanical strength" No. RPZP.01.05.00-32-W043/21 as part of the Regional Operational Programme of the Zachodniopomorskie Voivodeship 2014–2020 Priority Axis 1 Economy, Innovation, Modern Technologies". Measure 1.5 "Investments of enterprises supporting the development of regional specializations and smart specializations.

- possibility of connecting the computer with the plant computer network to view actual production data

16. Start-up and production testing

- Components and supporting structures required for assembly
- Assembly and start-up
- Ensuring stable coating process parameters

17. Technical documentation

- Complete Operation and Maintenance Documentation for the process line (paper version, 1 pc., and electronic version) containing the following:
 - characteristics (technical parameters) and registration data
 - external drawing, flowcharts
 - list of normal and special equipment
 - diagrams, electrical and pneumatic
 - functioning flowcharts
 - instructions for use
 - user's manual
 - maintenance and lubrication instructions
 - OHS instructions
 - refurbishment standards
 - list of replacement parts
 - list of enclosed figures
 - copies of line software (PLC, SCADA computer, drives, HMI)
- Documentation confirming compliance of the implementation with:
 - Directive 2006/42/EC of the European Parliament and the Council of 17 May 2006 on machinery, as amended,
 - Low Voltage Directive,
 - Electromagnetic Compatibility Directive,
 - Report on protective measurement and protective bonding testing.

18. Transport and packaging

- Transport of the process line to the customer's premises
- Assembly and preparation of the process line for start-up
- Process line commissioning and acceptance testing
- Instruction in operating the process line

III. Finished product geometry

The process line will be used to carry out thermal insulation coating of Pert II/Evoh/Pert II pipes of the geometry shown in **Appendix TT 2 Final product – minimum requirements**.

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IV. Technological process parameters

The required minimum process parameters (coating of Pert II/Evoh/Pert II pipes) are provided in Appendix **TT 2 Final product – minimum requirements**.

V. Raw materials used

The Ordering Party plans to use the following raw materials in its production:

Outer/insulation layer – Pert II – Dowlex 2388, Hostalen 4731B, LG SP988, Total XRT70 or equivalent.

VI. Notes

The process line components described in the line specification and the required production process parameters constitute the minimum requirements. While components with other parameters may be used, their parameters must not be worse than those indicated in the specification.