Extrusion lines for catheter tubing

High-precision lines for the production of medical tubing

Mono-layer and multi-layer tubes
Mono-lumen and multi-lumen tubes
Extrusion with supporting wire
Extrusion lines for medical catheters

**Areas of application**

Catheter tubing is used for a variety of medical applications. The tubes vary in diameter, wall thickness, polymer material or layer thickness. Most of these varieties require highly flexible production lines.

The lines have the following properties:
- very small diameters of 0.5 to 5 mm
- low wall thickness (0.07 to 0.5 mm)
- extremely narrow tolerances
- mono-layer, double-layer or three-layer structure
- take-off speed of up to 100 m/min.
- fast product change-over
- all line components comply with clean-room standards
- central control with acquisition, documentation and validation of all process data

**Main components of a catheter extrusion line**

**Extruder**

A finely-tuned range of extruders of 16, 20, 25, 30, 45 mm diameter covers the required wide throughput range from 0.05 up to 10 kg/h. High-precision screw speed control and a highly constant temperature control ensure reproducible quality and a continuous throughput. The processing of a wide range of polymers is optimized with the use of exchangeable feed bushings.

**Gravimetric feeding**

Gravimetric feeding is a proven tool for ensuring control, precise setting and documentation of the layer thickness ratios.

**Dies**

The die design is of crucial importance for the quality of both mono-layer and multi-layer tubings. Characteristics such as:
- bypass lines for fast purging,
- short flow length,
- prevention of dead spots,
- possibility to adjust the consistency of individual layers, even at a 2 or 3-layer coextrusion die,
- improved control for homogeneous temperature level
are the main features of a die designed for very narrow diameters and layer thickness tolerances.

**Vacuum calibration and cooling**

High-quality vacuum calibration promotes high-precision tube diameters.

**Areas of application**

- Gravimetric feeding
  - proven tool for ensuring control, precise setting and documentation of the layer thickness ratios.

**Typical properties**

- very small diameters of 0.5 to 5 mm
- low wall thickness (0.07 to 0.5 mm)
- extremely narrow tolerances
- mono-layer, double-layer or three-layer structure
- take-off speed of up to 100 m/min.
- fast product change-over
- all line components comply with clean-room standards
- central control with acquisition, documentation and validation of all process data
Constant and reproducible production conditions are possible through:

- Control of the water flow in the calibration and the cooling tank,
- Control of the temperature of the water in the calibration, even with heating,
- Air knife to blow off the water, prior to measuring the diameter,
- Closed loop control of the vacuum, by measuring the diameter,
- Closed loop control of take-off speed,
- Closed loop control of pressure and circulating volume of the supporting air.

In addition, the tanks have generous dimensions to allow for easy and safe feeding of the tube. The tanks are fitted with transparent lids to permit visual checks throughout the process.

**Diameter control**

A laser gauge measures the diameter of the tube in two places each offset at 90°.

The acquired diameter and ovality values are registered and logged. In addition to this, an ultrasonic wall thickness gauge can be used for efficient die gap adjustment and wall thickness optimization.

**Haul-offs**

Both belts of the double-belt haul-off are operated by synchronized AC-drives to ensure a highly consistent take-off speed and therefore consistency of tube diameter and wall thickness.

**Winders**

After haul-off, the tubes are either wound or cut off. Winding is best carried out by central winders with a balance roller system for fine adjustment of the tension. By a fine-adjustable traversing system, an exact positioned cross-winding of the tubes is guaranteed.
Cutting units
Alternatively, cutting systems provide the following:

a.) high cutting frequency to allow high-speed cutting of short tube length.
b.) selection between good parts and rejects (controlled by the thickness gauge) and assortment of quality classes.

Unwinder for supporting wire
For certain tubing, extrusion onto a wire is a well tried and tested method for ensuring a high-precision inner diameter. Suitable tension-controlled unwinding systems with straighteners are available.

Preheating systems
Extrusion coating to manufacture so-called braided tubing, i.e. cover wire supporting fabrics, require a preheating achievable with a hot air oven.

Process control with protocolling
Besides sophisticated mechanical equipment and controls, this type of line requires a state of the art data acquisition and evaluation system for controlling the whole process, generate the relevant protocols, facilitate and improve the reproducibility and offer the tools for a validation.

Clean-room conditions
All components of the catheter extrusion line are suitable for clean-room environment. Naturally, this requires the use of suitable materials, complete covering of all drives and heaters, smooth, homogeneous surfaces and easy cleaning of all surfaces.
3-layer Coextrusion Line

The line shown below consists of the following components:
- 3 extruders
- 3 gravimetric feeding units
- 3-layer die (see cover photo)
- Vacuum calibration and temperature control system
- Diameter gauge and control
- Haul-off unit
- Process-data acquisition and evaluation system
Control system

All control zones of a mono or coextrusion line are measured and supervised via the central control system. The system provides high precision control of the screw speed and temperature thanks to the set value signal. All modules of the line are coordinated and from only one VDU the whole line can be supervised. During the machine start-up, ramp programs bring all set point parameters up to the working point in a synchronous and continuous process. The diameter gauge controls the tube diameter by closed loop control of the take-off speed, vacuum or supporting air.

The documentation of all parameters is an integral part of the analysis software. Our experienced team of experts can carry out any required validation and re-calibration tasks.

### Technical specification

<table>
<thead>
<tr>
<th>Extruder</th>
<th>Diameter (mm)</th>
<th>16</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>45</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Output rate (kg/h)</td>
<td>0.05-1</td>
<td>0.1-3</td>
<td>0.3-6</td>
<td>0.5-10</td>
<td>2-40</td>
</tr>
<tr>
<td>Die</td>
<td>No. of layers</td>
<td>1,2,3; on mounting wire: 1 bis 5 lumen</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tube diameter</td>
<td>0.5 – 5 mm, thickness tolerance ± 0.003 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haul-off speed</td>
<td>5 bis 100 m/min.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>suitable for PE, PA, PP, PEBAX, PVC, TPU, TPE, PPS, PSU, FEP, PVDF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Technical modifications reserved

Dr. Collin GmbH
Sportparkstr. 2, D-85560 Ebersberg, Germany
Phone ++49 (0)8092/2096-0, Telefax ++49 (0)8092/20862

www.drcollin.de, eMail: collin@drcollin.de