New material gives PTFE tubings flexibility and strength

Material development | Design engineers are familiar with the unloved phenomenon of white fracture in fluoropolymer materials such as PTFE: strong bending stress can cause the material to kink and become irreversibly damaged. With development of the material ePTFE, ElringKlinger faces the technical challenges of endoscope tubing.

(Bild: ElringKlinger)

The material ePTFE enables flexible, kink-resistant and sterilizable endoscope tubes

In minimal invasive surgery, more and more powerful and efficient instruments and devices are being used, increasing the demand for mechanically more flexible systems. Manufacturers of endoscopes and endoscopic accessories for gastroenterology, urology and pneumology are investing an immense amount of time and effort in the development of new products with increased material requirements. Thereby a lot of energy is invested in the optimization of the control mechanism inside the endoscope insertion tube, as well as in the angulation unit at the distal end. This requires efficient performance of the internal channels, which makes the use of ePTFE tubing indispensable.

Using a special processing method called stretching, a porous structure of fibers and fibrils is created in the PTFE material, giving it significantly greater flexibility. In order to stabilize this structure, the material undergoes a tempering process after stretching, which results in improved strength and cold flow properties The characteristics of ePTFE (expanded PTFE) can be adjusted by the stretching process to suit the application.

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- Material for endoscope tubes
- PTFE becomes ePTFE by stretching
- Flexibility through porous structure
- Improved material properties
- Biocompatible and sterilizable

This opens up a wider range of applications for the material, for example in sensor and analysis technology.In flexible endoscopes, ePTFE is used today primarily as a material for internal biopsy and working channels of the device. Due to the high flexibility of the material, narrow bending radii of up to 270° are possible inside an endoscope. When the tube is bent, the material is stretched at the outer bending radius and compressed at the inner bending radius without material displacement. This material behaviour ensures protection against kinking.

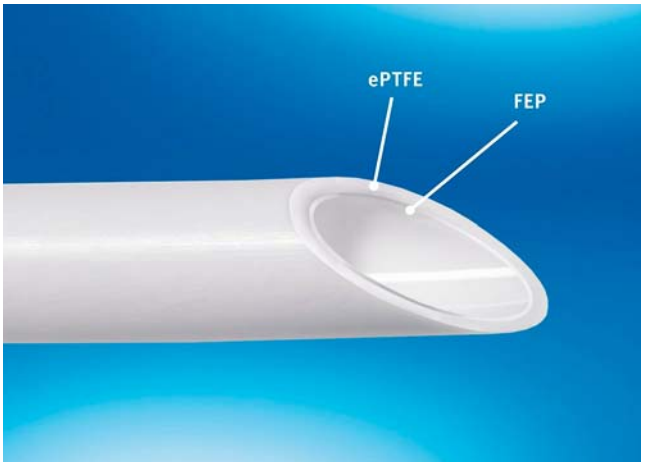
FEP layer protects the ePTFE tube from the inside

Depending on material density, porosity and flexibility, ePTFE channels with inner diameters of approximately 1.5 to 10 mm can be manufactured. For small inner diameters, thin walls can be produced in the range of 0.5 mm and slightly smaller. When refurbishing and cleaning an endoscope, the use of metallic cleaning devices may damage the inner tube surface.

For this reason, the ePTFE tubing is coated with a thin-walled inliner made of FEP which is homogeneously bonded to the ePTFE outer layer by a thermal process. The inner FEP layer has the additional advantage of stabilizing the outer ePTFE layer. The flexibility of the ePTFE layer provides kink protection for the small inner FEP layer even with large bending radii. ePTFE is also suitable for the sheathing of light guides and imager cables as the ePTFE surface reflects the light completely and without loss. The light

Molded structure of ePTFE (stretched PTFE) consisting of nodes and fibrils

(Bild: ElringKlinger)



Working channel made of ePTFE with FEP-Inliner. The layers are homogeneously bonded

(Bild: ElringKlinger)

yield at the exit of the light guide is not reduced by the sheathing which guarantees very high effectiveness of the light guide.

In addition, the ePTFE coating protects the light guide from external influences such as dust and mechanical damage from other components inside the endoscope insertion tube. Further applications of ePTFE in medical technology include:

- artificial arteries, lining of tracheal cannula
- movable cable sheathing in cleanrooms or covering of bone defects during surgical procedures in periodontology, oral and maxillofacial surgery and implantology
- Gas diffusion diaphragms in oxygen sensors to measure the oxygen content in the breathing air

In addition to its use in medical technology, ePTFE is also used in the textile industry, for example as breathable clothing material with defined water retentive properties. As a sealing material, ePTFE is also used in aerospace applications and, due to its high resistance to chemicals, in the chemical and pharmaceutical sectors.

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Advantages of ePTFE material

- Material characteristics like PTFE
- High flexibility
- Porosity, hardness and flexibility individually adjustable
- Kink resistance
- Very low sliding friction
- Unique 100% reflectance
- Biocompatible and sterilizable
- Production of various types of semi-finished products (tube, pipe, foil, plate)