The Tubing Solution Behind Minimally Invasive Surgery

Minimally invasive surgery has been a growing trend in healthcare for some time. As such, manufacturers who provide devices to the medical community for these procedures need to stay abreast of the technologies available to enhance their products. This article looks at fiber composite tubing and presents the advantages it offers for MIS devices. Additionally, the benefits of braided tubing are featured.

The medical device market has many characteristics and various different properties and strengths needed to make the revolutionary procedures possible. Doctors are always looking for materials that can be adapted to fit their applications.

By Jim Shobert

Smaller diameters, thinner walls, and more complex structures&#151that's a short description of the latest in medical tubing. New composites like these are driven by growing demand for minimally invasive surgery, tubing for wires to stimulate nerves and regulate heartbeats, tubes for vascular access and urology, and ever-smaller catheters including those for surgery on infants. Manufacturers offer more properties, more material options, and more precise process control than ever before. At the same time, there's a lot less to their products than there used to be. Holes are getting so tiny that they're literally invisible to the naked eye. Some new tubes feature diameters that measure in the thousandths of an inch, with walls thinner than a human hair.

Medical tubing has become a commodity item in the healthcare industry, available

in a daunting array of sizes and in a wide range of material types that have lengthy, unpronounceable names. Many products in the medical device market have varying characteristics; exhibiting different properties, different strengths, and various shortcomings along with various pricing structures. Tubing selection can be critical in controlling production costs, improving quality, and enhancing the capabilities of the final product&#151enabling physicians and surgeons to perform intricate procedures while increasing the patient health benefits.

Multi -tasking to the max; multi-lumen pultrusion tubing provides a port for one part of the procedure to take place and another port for an additional item such as a scope, suction, or a cauterization tool.

Usage in MIS Technology

Recommending a suitable tubing product for the performance of a minimally invasive (diagnostic or therapeutic) surgery procedure is paramount. A number of key factors should be considered when selecting components for use in medical equipment applications. Tubing selections can be critical in controlling production costs, improving quality, and enhancing the capabilities of the final product. Material properties such as the machining and finishing methods needed and the degree of precision necessary within the application is crucial in selection. The materials must offer precise levels of dimensional control and consistency. Material properties such as tensile strength, formability, and biocompatibility must match the desired environment and function.

Composite tubing can be

used for a variety of medical items due to composite's high stiffness characteristics, resistance to chemicals, and its stability across multiple autoclave cycles.

Some medical procedures require the use of composite tubing to provide characteristics that a metal product cannot. When compared to conventional metal and thermoplastic products, composite tubing advantages include a high strength to weight ratio, rigidity, and the ability to maintain precise tolerances. Because composites are nonmagnetic and nonconductive, composite surgical devices are well suited to perform minimally invasive, diagnostic procedures such as endoscopic or laparscopic procedures to destroy or extract tissue samples. The composite tubes are electromagnetically transparent, produce minimal distortion, and provide radiolucency while under imaging machines such as MRI or X-Ray systems. Composite medical tubing clearly has been an enabling technology for medical device innovation.
Minimally invasive surgery (MIS) is becoming the standard in surgical care. It is performed through small ports instead of one large incision and provides benefits such as shorter recovery, fewer complications, and reduced hospitalization costs. It provides the same medical benefit that a patient would receive from open surgery without the invasiveness and long recovery time. These complex procedures incorporate small composite tubing in the minimally invasive surgical procedures.

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Providers of fiber composite tubing produce a variety of single and multi-lumen cannulas, employing the pultrusion process and braiding methods. Composite tubing ranging in size from 3.0 mm up to 20 mm was designed to be safe for intra-body situations and to provide high dielectric strength, high stiffness characteristics, resistance to chemicals, and stability across multiple autoclave

cycles. Additionally, device manufacturers will want to select tubing that is USP Class VI approved and ISO 10993 compliant.

Enhancing Physical Capabilities

During the manufacturing process, a composite tube can be altered to fit a variety of performance requirements. This can include sizes, colors, and machining holes and cutouts to fit the variety of applications.

One of the most common methods for adding stiffness to a tube without adding size is to reinforce it with a braided structure. Braiding is a process that interweaves or interlocks the fibers into a circular shape, although this process can include other symmetrical, geometrical shapes. The interweaving provides a micro-structure similar to that of a bridge truss system. This process also uses an electrical grade continuous fiberglass material encapsulated within a thermoset resin matrix.
In some unique applications, secondary unidirectional fibers can be added to increase the tensile strength. Braiding also lets designers increase the tube's burst strength while thinning the wall at the same time. Braiding offers a unique solution for very thin wall applications.

Braided composite tubing performance and strength characteristics can be tailored to almost any engineering issue, making them the new material of choice. By changing several factors during the braiding process, adaptations within the characteristics of the tube can be altered to fit performance requirements. This gives the design engineer a material equal in strength to that of a metal without having to provide a secondary sheath for capacitance coupling issues. Advantages of braided over non-reinforced tubing include increased burst strength for higher injection pressures; increased push-ability, for the ability to pass through lesions;

and increased torquability, for better hub to tip response. Braiding also prevents kinking in a flexible tubing product.

Conclusion

With all the development and revolutionary procedures utilizing minimally invasive techniques such as laparoscopy, gynecology, mitral valve repair, revascularization, and gastric bypass surgery, the demand has never been greater for smaller and more complex composite tubing. Given the benefits this product provides as discussed in this article, it is easy to recognize why medical device manufacturers should become more familiar with this tubing technology.

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