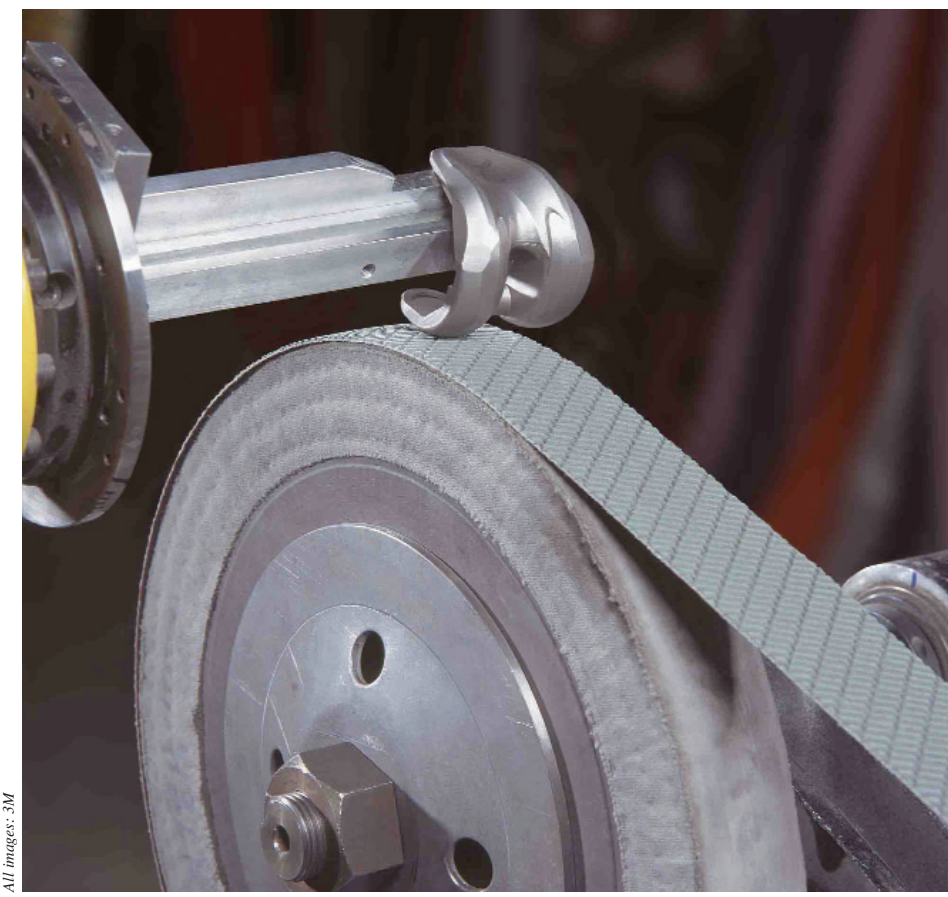
➤ BY JOHN L. BARRY, 3M ABRASIVE SYSTEMS

No-Defect Finishes

Abrasive selection and automation are keys to successful finishing of artificial implants.



All images: 3M

Manufacturers of medical implants can often take advantage of robots to streamline and improve their operations. Shown is a knee implant being finished in an automated finishing cell with a Trizact CF engineered-abrasive belt from 3M.

More than 400,000 artificial knees are implanted in the U.S. each year, and the figure for both knee and hip implants is rising steadily. Manufacturers of these implants continually strive to raise the quality of their products. At the same time, they seek ways to increase the efficiency of their manufacturing processes to meet the rising demand and to reduce production costs.

These efforts extend to finishing operations.

Key to successful finishing is meeting the tight tolerances required. Orthopedic implants must mimic the intricate movements of the human body parts they replace. Therefore, consistency and quality of finish cannot be over-emphasized.

Defects resulting from substandard finishing, including scratches and failure to achieve part tolerance during the grinding process, can go unnoticed until late in the manufacturing process—or even in the operating room. Once an implant is found to be defective, it is pitched in the scrap pile. It cannot be reworked.

This costs the manufacturer time and money. Of greater concern, though, is that defects can cause the medical community and public to lose confidence in the manufacturer's products.

Media Selection

Finishing cast implants is a labor-intensive task, one that typically requires four to six steps. Applying a high-quality abrasive media can eliminate some of these steps, regardless of whether the process is performed manually or robotically.

It's important for orthopedic implant manufacturers to have a variety of abrasive media available for finishing.

Selection should be based on what condition the part is in when the operator receives it, whether it is handled manually or robotically, its design and the material from which it's machined.

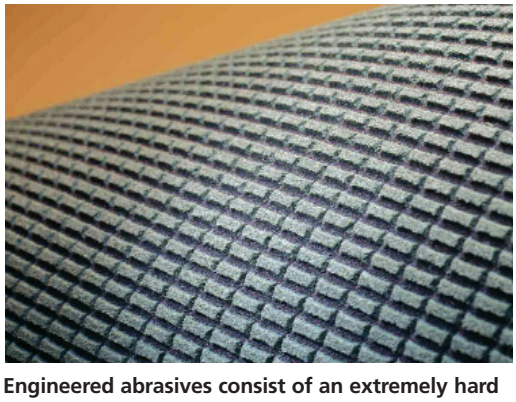
The average orthopedic implant lasts approximately 10 to 15 years. In response to the demand for longer-lasting implants, the industry is starting to use substrates made of harder, longer-wearing alloys.

Harder substrates, like cobalt chrome, make finishing more challenging. For gate-removal operations on these materials, manufacturers should use an aggressive ceramic-mineral abrasive. Ceramic minerals work well because they are man-made, meaning they can be formulated to stand up to these hard substrates.

Manual finishing of a knee implant. Inset: The use of cobalt chrome for artificial knees and other implants is growing because of the material's resistance to wear.

Zirconium and similar metals are also popular implant materials. They differ from other alloys and present their own finishing challenges. Before they are baked, or oxidized, they are relatively soft. Once baked, though, they become extremely hard and no additional finishing is possible. If the finish doesn't meet specifications after baking, the implant is scrapped.

Of the various ceramic-mineral formulations available, the more friable versions are recommended for operations involving unoxidized zirconium and other softer materials. Manufacturers of the abrasive belts used in these operations adjust the mineral formulation so that the belt cuts well and the grits break down consistently.



Engineered abrasives consist of an extremely hard mineral, such as aluminum oxide, arranged in a micro- or macro-replicated pattern. An engineered-abrasive belt exposes fresh minerals at a uniform rate, extending belt life while cutting consistently.

Driven to Automate

The move toward automation in the medical implant industry is driven by manufacturers' need to produce a more consistent product, increase throughput, reduce labor costs and decrease repetitive-motion injuries. Material suppliers and system integrators often work together to determine the best tooling sequence for implant manufacturers.

When finishing robotically, the longer a belt lasts the less need there is to shut down the cell to change the abrasive media, thereby reducing downtime and increasing throughput. Therefore, it's best to select an abrasive that provides a consistent cut and finish and has a long wear life.

For initial material-removal operations, including gate, part line and "skin" removal, the best choice is a belt with an aggressive grain that will cut quickly, stay sharp and not transmit the heat generated during grinding to the part. Typically, a ceramic-mineral belt is the best choice for these tasks. Most have X- or Y-weight backings, which are stiff enough to properly support the minerals. These backings help increase the cut rate, reduce dulling of the abrasive and ensure consistent performance.

Because final-finish consistency and quality are critical when manufacturing implants, it's best to use engineered, or structured, abrasives, which consist of an extremely hard mineral, such as aluminum oxide, arranged in a micro- or macro-replicated pattern.

A structured-abrasive belt is designed to expose fresh minerals at a uniform rate, extending the belt life while maintaining a consistent level of cut. This predictability makes the belt easier to work with and reduces rework due to out-of-spec finishes. The lengthier belt life also means lower overall abrasive costs and reduced belt inventory. Additionally, structured-abrasive belts are usually manufactured with a flexible backing. This facilitates the blending of contours, which enhances finish.

Another important benefit of eliminating finishing-process steps is that a facility generates less debris. That, in turn, reduces the amount of time and money spent cleaning and prepping implants for delivery.

Some abrasive manufacturers work directly with orthopedic implant manufacturers to implement methodologies such as Six Sigma, which helps improve and streamline processes. Top abrasives companies can also evaluate customers' finishing operations, provide hands-on training, and suggest ways to decrease costs and maximize abrasive performance.

In short, they help medical manufacturers deliver orthopedic implants of the highest quality that perform consistently and enhance the lives of a growing number of people. △

About the Author

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