



**NEW MATERIALS AND TECHNOLOGIES ARE CHANGING THE
PROCESS OF SURFACE FINISHING, LEADING TO IMPROVED
PERFORMANCE, LESS GEAR NOISE, AND ENHANCED PART LIFE.**

it's **ALL** on the **SURFACE**

By Brett Watkins

As manufacturers look to reduce cycle times, costs, and to improve the life of their products, many variables are considered in accomplishing this never-ending goal. In this article we will examine finishes applied after the manufacturing process to enhance part life, improve performance, reduce drag, improve corrosion resistance, and lessen the noise related to gears.

Due to the many different plating processes and surface treatments, we must limit the review to several popular and well-known processes. We will briefly touch on future coatings, and then leave the reader with a list of resources where they can gather more information on the processes.

For the purpose of this article, I will assume that most gears are made of high carbon steel, low carbon steel, and powdered metal. First, let's take a look at one process in particular, as well as its attributes.

Electroless Nickel Plating

Electroless nickel plating processes come in three major categories: low phosphorous 3 percent; mid phosphorous 5-7 percent; and high phosphorous 10-percent content. The increased amount of phosphorous has a direct impact on corrosion resistance.

Typically, the higher the phosphorous content, the better the corrosion resistance. There are many white papers and detailed documentation on this subject. The process is an auto-catalytic process in depositing nickel ions. This simply means that no rectifier is used to apply the nickel deposit. There is a reducing agent in the electrolyte that acts as a "chemical rectifier" and deposits the nickel ions. This process is great in the sense that it has excellent uniform coverage and doesn't need any conforming anodes to deposit in recessed areas (unlike chrome). This process gives a bright metallic finish, excellent corrosion resistance, lubricity, hardness and, ultimately, longer gear life. The parts can also be baked after processing to relieve hydrogen and achieve greater hardness in the range of 58-60 Rockwell. No final machining is needed due to the excellent uniformity of the process. Other processes need a final grind to remove buildup in the high current density areas, thus adding time and raising costs.

There are many electroless nickel-plating shops utilizing different EN chemistries. Some are very good shops, and some not so good—as it is with any industry. If you are interested in any of these processes, I suggest that you ask for a tour of the facility and meet the employees who are personally handling the operations, and you could always hire a metal finishing consultant to accompany you during your visit. They will know what questions to ask, what to look for in the process, process control parameters, and other matters that are second nature to them. It is much better to spend a thousand dollars up front with a consultant who will evaluate a vendor and their capabilities before risking your company's product and reputation with your customer.

Duplex Coatings

The nickel-cobalt, nickel-TEFLON, and other duplex coatings applied as an electroplated process can also have significant performance impact on your gears. Depending on your goals for your product line, all of these processes are worth taking a look at.

The duplex coatings are applied by electroless application and electroplating techniques. They all have individual attributes and downsides. The best thing about the advancement of duplex coatings is that it provides engineers with the flexibility to choose from several

different composites to deposit on their gear. This technology has opened the door to many more options to customize specific surface and performance characteristics for your gears.

Nano Coatings

This is an extremely exciting and interesting technological development that will impact almost every imaginable product in the future. Nano coatings can be applied via electroplating techniques, powder coating, fluidized bed, HVOF, and many other applications.

This coating is unique in the sense of the molecular size of the ions implanted. They are much smaller than an atom, and also much more dense. The coatings can be manipulated to co-deposit specific ions, and thus create a customized coating for your product. This process will be a major force in the near future in regard to modern-day coatings. Some nano composites also include diamond particles. The possibilities of this process are endless, and it can be very specific or quite broad, according to the applicable standards.

Raw material will also be impacted by this tremendous development. Materials are being created with the metallurgical properties of nano composites. They will be stronger, denser, and more corrosion-resistant, among many other attributes. A word to the wise is to keep an eye on this particular technology.

Pondering Electropolishing

I would like to pose a question to engineers, company owners, sales managers, and business-development managers alike—and please feel free to respond to the e-mail address listed below. I realize that the gear industry utilizes carbon steels and powdered metals due to their hardness, machinability, and other characteristics. But there's another option:

If gears were manufactured out of stainless steel, they could be electropolished to achieve a very bright cosmetic finish, improved corrosion resistance, hydrogen relieved parts, burr removal, and Ra surface finish improvements all in one process. This is not a plating process, so no delaminating can occur. This process improves the chrome oxide ratio on the surface of the part to improve corrosion resistance and life cycle. It would look like a chrome finish, but it would be the part itself—not a coating.

Specific electropolishing solutions can be formulated to process low carbon, and high carbon steel as well. They will not achieve the same brightness as a stainless part, but it will remove burrs and improve surface finish. ☐

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ABOUT THE AUTHOR:

Brett Watkins is president of Infinity Metal Finishing, LLC, which is based in Cleveland, Ohio. Infinity Metal Finishing is an electropolishing, passivation, de-burring job shop that also designs and sells customized electropolishing machines and deburring machines. It also offers consulting in all metal finishing processes. To learn more call (216) 251-5102, or send e-mail to bwatkins@infinitymetalfinishing.com. Visit the company's Web site at [www.infinitymetalfinishing.com].