Why Selective Plating Stops Your Gears from Grinding to a Halt

Mark Meyer, Sales Manager, SIFCO ASC

Gears are a crucial part of many machines, and if they wear and corrode beyond repair it can then be a costly expense to replace them. Mark Meyer, Sales Manager, North America at SIFCO ASC, explains how brush plating can help prevent gears from being damaged and how the process can be used to restore worn or corroded gear components.

When problems occur with gears, maintenance engineers know how much of a headache they can be to fix.

During the manufacturing stage, despite all the modern machining centers, parts can end up undersized — whether that's in the bore, the teeth or the shaft. The extent of these dimensional defects is usually small, but the cost of remanufacturing the entire part would be prohibitive.

When in operation, gears are often subjected to harsh environments, with wear and tear from corrosion or day-to-day running in dusty conditions being common problems.

With small gears, the capital cost of replacing these components in many cases will be tolerable. However, in larger equipment, such as in earth moving, industrial, or marine machinery, it is not just the capital outlay that maintenance engineers must factor in. Not only is the capital cost of larger gears much higher, but there is also the downtime from taking machines out of service that can make the true cost of replacing these components extraordinarily high.

Indeed, downtime is one of the biggest costs that any business can face. In Britain, the impact of machine downtime is costing manufacturers more than £180bn every year (Source: *The Manufacturer*). The study, conducted by Oneserve, found that 3% of all working days are lost annually in manufacturing due to faulty machinery. Eighty-three % of those surveyed also said that they replace machines at least once a year, no doubt carrying huge financial implications and operational costs to do so.

With that said, it is crucial that maintenance costs are kept down, machinery components like gears can be kept in service as long as possible, and, if needed, they can be repaired quickly and effectively.

Brush plating, or selective electroplating, is one proven cost-effective way to build gears back to their original specification and help extend their life.

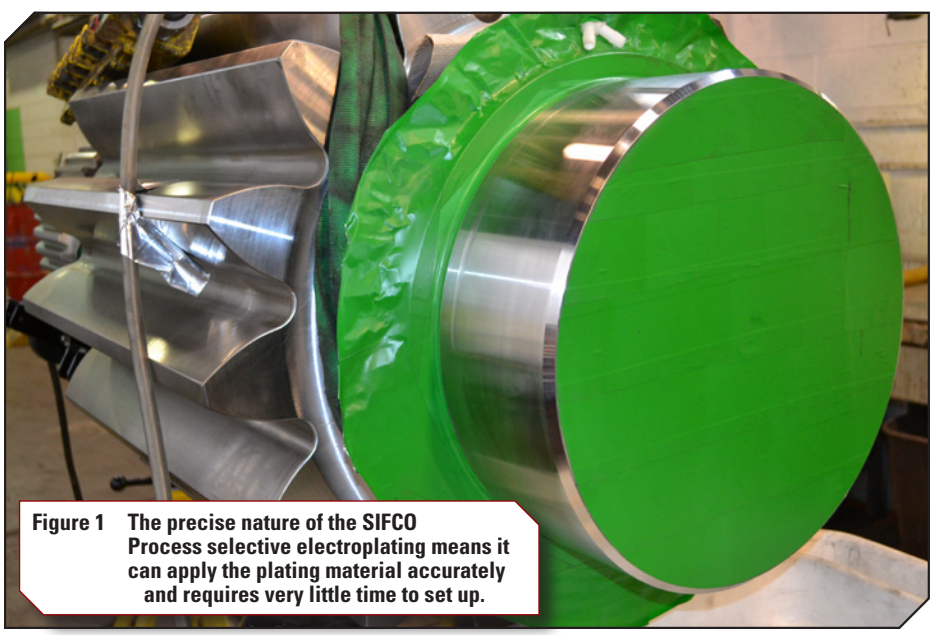

Figure 1 The precise nature of the SIFCO Process selective electroplating means it can apply the plating material accurately and requires very little time to set up.

The Selective Electroplating Process

Selective electroplating, such as the industry-leading SIFCO Process, is a proven, efficient, and economical way of performing surface treatment repairs. The SIFCO Process is a portable plating method used to enhance, repair, and refurbish localized areas on manufactured components.

The process uses fundamental electrochemical principles. An electrolyte solution, which contains ions of the metal to be deposited, is introduced between the negatively charged part to be plated and the positively charged plating tool, or anode. A portable powerpack provides the required direct current and allows precise control of amperage, voltage and plating time for high quality and accurate plating results (Fig. 1).

The circuit is completed when the anode touches the surface of the part to be plated. A suitable wrapping around the tool provides a reservoir to evenly distribute the electrolyte. The current causes the metal ions in the electrolyte to bond with the surface of the part and build up the plating layer. The result is a highly adherent and dense metal plating. The metal or alloy to be deposited can be chosen from over 50 different solutions, which allows the plating material to be tailored to the desired properties of the plating.

Plating can serve a variety of purposes, such as a localized defect repair or bringing an inside diameter (ID) or outside diameter (OD) back to size. Plating can also enhance wear or corrosion resistance exactly where it is needed — even on new parts where it would be prohibitive to make the entire part from a more resistant material.

When assessing parts for repair, it is always important to consider the size

and location of repair required, as well as how much material needs to be plated, as this will determine whether selective plating is appropriate or not.

One example that illustrates two types of repair on the same part was the repair of a pinion gear of a dragline excavator used in surface mining.

Repairing a Damaged Pinion Gear with Selective Electroplating

Working with large gear manufacture and repair specialists Horsburgh & Scott Co., SIFCO ASC's brush plating solutions were used to repair two defects on the 16"-diameter-by-5"-long bearing journal of this gear. They were caused by a seized bearing which damaged the seat and also created a gouge during the removal of the bearing.

The first defect was a 0.030" deep gouge measuring 0.75" wide and 12" long, while the bearing seat was 0.012" undersize after clean-up.

This was considered a good selective plating application because the groove was relatively shallow and could be quickly filled with copper using a 100% tool contact. The undersize condition required only 0.006" thickness of nickel.

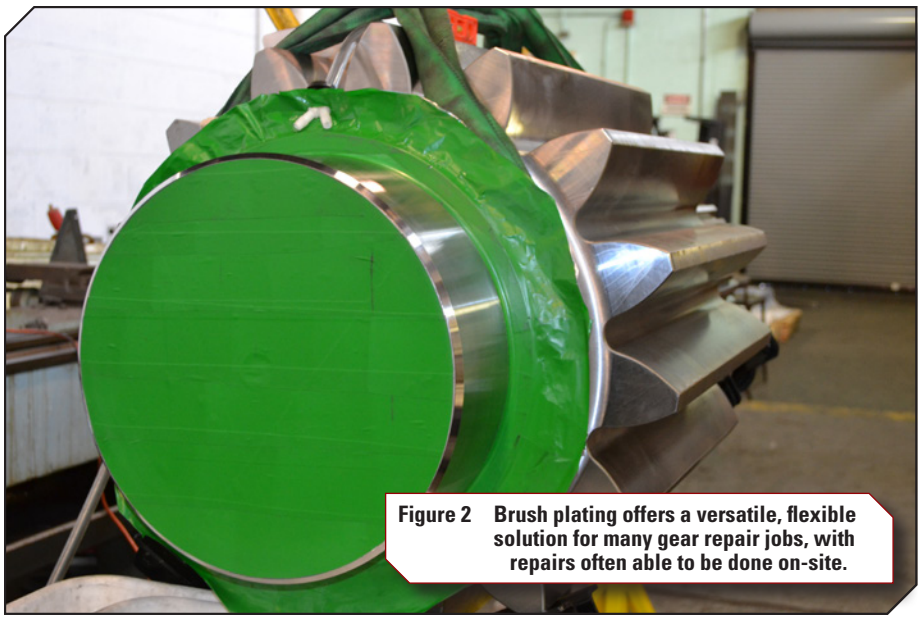

Figure 2 Brush plating offers a versatile, flexible solution for many gear repair jobs, with repairs often able to be done on-site.

Welding to fill the defect was rejected as an option due to the heat and associated structural changes in the metal inherent in the welding process. Meanwhile, machining the entire diameter to remove the defect would have made the diameter 0.060" undersize, and so this was ruled out as well, as it would

have made the journal too impractical for plating at such a high thickness.

For the re-size deposit, the part required a deposit of approximately 30 Rockwell hardness; nickel was chosen to meet that requirement.

First, the gouge was selectively filled with copper to bring it back to the overall OD. The bearing journal was first plated with 0.001" thickness of copper and then masked for the defect repair. A plating anode was used to cover the full length of the gouge, which shortened the plating time. The defect was filled with three layers of copper and hand-finished between layers; the final layer was dressed flush with the OD.

Once the gouge defect was repaired, the entire OD was brought back to size by plating with 0.006" thickness of nickel. After the repair of the two defects, the journal was as good as new and ready to receive a new bearing, making the excavator ready for action once again.

Figure 3 Example of a pinion gear's bearing journal on a dragline excavator being repaired with brush plating.

Building Layers without Compromising Gear Strength, Durability and Specification

As stated, gears used in large applications are expensive to replace if damaged or worn. In many cases, brush plating can return the gear components back to their nominal specification, and in some cases, even exceed the performance of the original material.

With brush plating, a frequently used plating material for repairs is nickel. Other materials such as cobalt are also popular, while certain alloys like nickel tungsten alloys or nickel cobalt alloys can provide their own unique properties. With proper selection of deposition parameters, the grain structure of the nickel can be influenced to yield the desired properties such as hardness and corrosion resistance — thus enabling it to withstand the day-to-day operation that gears are subjected to.

For gears, the most common repairs are shafts, bearing journals, and bores. In certain circumstances, localized damage to teeth may also be considered. For gears that will see corrosive environment, the bores and outside machined surfaces that cannot be painted are also plated when new to provide corrosion resistance.

Figure 4 Often, industrial machinery gears are too large to easily disassemble and too impractical and costly to ship to off-site job shops for repair.

On-Site Selective Plating Brings Down Costs

Another consideration that engineers face with repairing gears is how the maintenance can be achieved while incurring the least cost. Costs can start rising through directly associated expenses like shipping the gear to a job shop, disassembly and reassembly of the gear, and the repair itself. Then there are indirect costs to factor in, such as disruption, downtime and loss of productivity.

Often, the gears that are too large to simply replace are also too large to easily disassemble and too impractical and costly to ship to off-site job shops for repair. Downtime is also prolonged, due to the need to take the gear and machinery apart, wait for it to be repaired, and then sent back and re-assembled.

Brush plating overcomes these obstacles. In many cases, technicians can assess the damage to the gears and make the repairs on-site (Fig. 2).

This was the case for the pinion gear repair on the dragline excavator (Figs. 3 and 5). Of the repair, Dave Niederhelman, Chief Metallurgist, Horsburgh & Scott Co. said: "SIFCO ASC is a well-established partner of Horsburgh & Scott and their ability to work on-site is highly attractive. Over the years they have helped us to find the most efficient ways to repair and maintain our customers' equipment and this has added up to thousands of dollars, hours of downtime, and manpower time saved.

"In this application the SIFCO Process has extended the working life of the gear and improved the failure rate due to the nature of the nickel coating on the journal. The cost of manufacturing and material to replace the gear would have been exorbitant in comparison — as well as causing weeks of downtime."

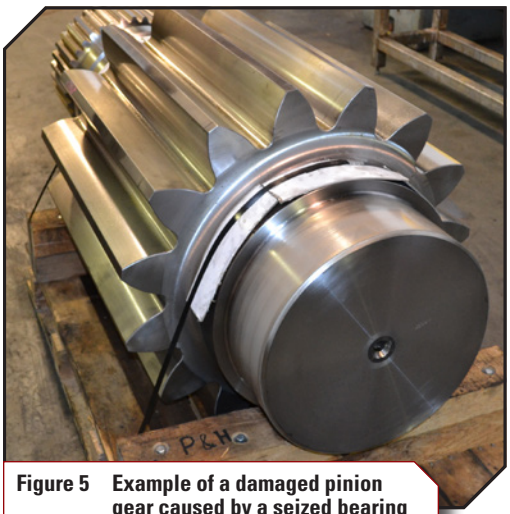

Figure 5 Example of a damaged pinion gear caused by a seized bearing which damaged the seat and also created a gouge during the removal of the bearing.

Brushing Aside Gear Repair Issues

While simple on the surface, gears are complex components, and once they start to wear and tear while in service, it can be an even more complex job to repair them.

Repairs must be well-considered and executed correctly, and the gear must remain strong enough to handle the day-to-day operation or setting that it exists in. Otherwise, it can cost even more than the initial cost of refurbishment, after factoring in downtime and lost productivity costs.

This is where brush plating offers a versatile, flexible solution for many gear repair jobs. Along with being able to make repairs on-site (Fig. 4), the SIFCO Process of selective electroplating is highly effective. The precise nature of selective electroplating means it can apply the plating material accurately and requires very little time to set up. Unlike with alternative repair methods, post-machining or treatment of the gears frequently is not required because plating can be done to size. Due to the low temperature of the process, there is no risk of changing the structure of the base material and with that its properties.

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