in the details

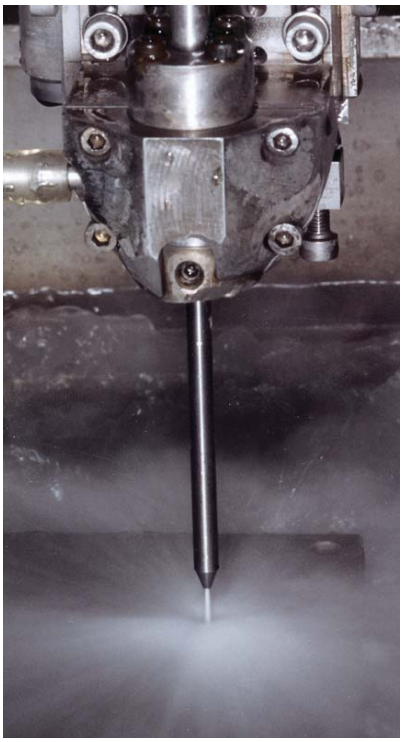
A patented technique for chrome coating removal offers to avoid toxic byproducts.

Avoiding the Environmental Impact of Chrome Coating Removal

The 2000 movie "Erin Brockovich" exposed the dangers of chrome as part of a production or manufacturing process. In the movie, a form of chromium used in one company's process created a toxic by-product that was stored in tanks around the facility and was later found to have leached into the groundwater. The company paid out an historic $333 million settlement for the environmental and human harm that had been caused to the surrounding community. Although today third-party waste management companies ensure the responsible disposal of waste products, in the gas turbine industry, chrome coatings and repair processes still use acids that turn the chrome into that same toxic waste referenced in the movie.

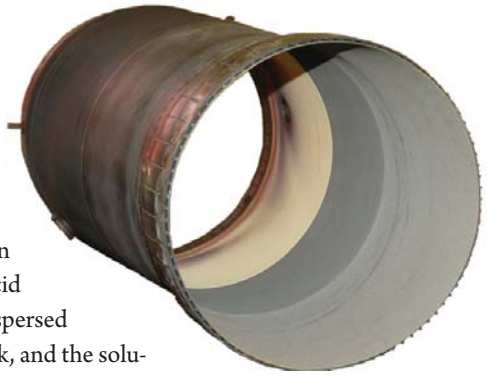
In a positive development for the gas turbine industry, Huffman LLC and Springfield Manufacturing LLC, both located just outside of Charlotte, NC, have developed a way to safely remove chrome coatings without creating the toxic waste generated in the acid removal process. This highly controlled abrasive waterjet (AWJ) process removes the coating but leaves the chrome metal in its inert solid form. The company says the process is faster, cheaper and safer than the existing acid stripping and hand grinding removal process. With the process targeted specifically to companies involved in the industrial gas turbine repair market, Springfield Manufacturing has opened a facility in Houston, TX, a region where much of this kind of work takes place.

The company says the benefits of the waterjet process extend beyond avoiding the creation of toxic waste. While the acid process entails human health threats to workers, such as fumes, burns, fires and even explosions, the AWJ process has none of these drawbacks.



The Clean and Green Solution

The company's waterjet process aims to overcome a few of the common limitations of working with an acid bath process. In the bath process, acid is inconsistently dispersed throughout the tank, and the solution weakens with use, so for one or both reasons, sometimes the coating is not removed from the entire part surface. This creates a problem, because the spotty residual chrome bond coating is not as good as a new coating to enable adherence of a final thermal barrier coating (TBC). Often, the entire residual coating must be completely removed to ensure good-as-new adherence for the new coatings on the part being refurbished. But making sure the entire coating is removed requires additional post-acid bath hand blending.



Parts such as this industrial gas turbine liner are good candidates for the AWJ process because of their need for uniform coating removal during refurbishing.

A typical process for discovering a residual coating is to bake the part at a high temperature until the base metal turns blue. After baking, the residual coating has an orange color, and hand belt grinders are used to sand away the now-visible residual coating. This is a costly task that can thin the part walls, reducing subsequent part life and distorting the important airfoil shape that is critical to turbine operating efficiency. And for workers, the repetitive task can result in carpal tunnel syndrome.

Alternatively, the computer-controlled AWJ process can maintain tolerances within a fraction of a human hair as it surface mills the coating across the entire airfoil contour. Compared to the acid bath process, the waterjet process removes the coating gently and without compromising the base metal's structural integrity. There is no inter-granular attack with the AWJ process, and it is a clean, efficient, repeatable process for removing MCrAlY coatings from hot gas path components. A precision five-axis CNC waterjet removes the coat-

ing in iterative steps. Much like a machine tool, the material removal rates are controlled by speeds, feeds, pressures and material flow. Having increased control over the surface conditions offers a better TBC bond strength, which can result in a longer, more effective service life for each refurbished part.

In the acid bath process, once the coating has been ground off, the next step is typically a grit blast process to rough the surface in preparation for recoating. Besides being yet another repetitive hand operation risking worker injury, grit blasting re-contaminates the surface before the subsequent coating, weakening or even destroying the bond interface and ultimately, shortening the life span of the refurbished part.

But with the AWJ process, the remaining part surface is cleaned of all surface contamination and, in some cases, shows directionally solidified (DS) grain structure and DS etching. Most compa-nies using this method can bag the part and send it directly to coating without a need for further cleaning. Process controls are in place to measure before and after conditions to verify removal over the surfaces where it is desired.

The acid bath process is a batch process, so if a mistake is made anywhere along the line, such as forgetting to remove parts and over-baking them, the entire lot might be scrapped. The process also requires masking of hollow parts to prevent the acid from destroying internal coatings. It takes labor time to add the masking and to remove it after the bath. Beyond that, parts often need to soak for many hours, shifts or days before being ready to move to the next step in the process. And there is the ongoing problem of having to properly process, store, and dispose of the waste byproducts mentioned at the beginning of this article.

The AWJ process, on the other hand, requires virtually no preparation time, and eliminates several steps both before and after stripping. The acid bath toxic waste disposal cost, often the highest expense of the entire repair factory, is also eliminated.

Overall, the AWJ process offers to overcome many limitations. It doesn't put chrome into solution as the acid bath can. It is a highly controlled mechanical removal process—sort of a surface milling process with tight tolerance control—up to less than 0.0005 inch. Coating thickness is measured before and after the process to ensure entire removal of the bond coating and diffusion layer, as well as any contamination, corrosion, and so on, under the bond coat. The process can even remove craze cracking and clean deep cracks.

So the process offers a less destructive solution for removing chrome coatings while eliminating the safety issues caused by worker exposure to acid, all while addressing environmental concerns by eliminating the need for toxic waste disposal.

WJ-155

Huffman waterjet machinery has five-axis capability, providing ±0.0005 tolerances in a fully enclosed chamber to contain both water and noise levels.

DEBURRING BY WATER JET

See how this process can add value through reduced rework and increased component longevity.

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