Micro Abrasion for Reconditioning Turbine Parts

Comco MicroBlaster designed to remove coatings, contaminants from components for better recoating

by Randy Woodall and Neil Weightman

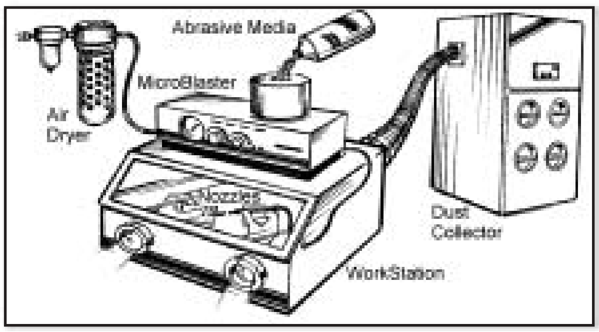
It is well-known that the gas turbine industry is currently experiencing some major changes. Tight economic times have made many power facilities decide to postpone buying new power turbines, even to the point of forfeiting hefty deposits. The spotlight has turned to maintaining existing turbines for the longest and most reliable life spans possible.

Because of this, more large turbine manufacturers have created divisions dedicated exclusively to engine overhaul, and there are more independent maintenance shops than ever before. At the same time, the quality levels required of this new maintenance have led to extensive research into precision methods to restore turbine parts to “like new” condition. One method that is steadily gaining converts is microabrasive blasting technology.

Comco Inc. of Burbank, California, U.S.A., has been at the forefront of advancements in microabrasive blasting technology since the 1960s. On the turbine level, the company first became involved with Howmet at Howmet's division in Whitehall, Michigan, U.S.A., in the early 1970s. Howmet is well-known for building turbine blades and parts. In the manufacture of turbine parts, (investment casting process) residue must be cleaned out of small air holes, and Comco MicroBlasters were, and still are, an effective way to do this.

Another application for microabrasive blasting arose as companies such as Engelhard and other turbine manufacturers searched for a reliable tool to remove heat coatings. These coatings were applied to new turbine blades and would often migrate to unwanted areas. The manufacturers found that microabrasive blasting technology was a fast, reliable method to clean up overcoatings.

A Comco MicroBlasting system requires a dust collector and air dryer. New high power blaster shown in photo has a high-volume abrasive tank for longer working cycles.



These applications are, of course, on the manufacturing side of the turbine industry. The turbine components and coatings have not yet been exposed to any of the complications that heat and wear bring over time.

MicroBlasting is a cousin to the larger, and better known cabinet or grit blasting. It is typically used to clean, deburr, finish, texture, drill and mark small parts or small, hard to reach areas within larger parts and tooling. Without masking or shielding, blast areas restricted to 1.27 mm to 0.46 mm can be achieved.

Whether a manual or multiple-fixtured semi-automated system is used, the process is basically the same. MicroBlasting works by mixing an abrasive media in granular form with a jet of clean, dry air. It is propelled through a pencil-like stylus, tipped with a small nozzle. Whether the blast cuts, textures or peens the surface to a satin finish depends on the type of abrasive used, the pressure of the blast and the period of time that the blast is held on the surface.

MicroBlasting requires a work chamber to contain the particles, a dryer system to ensure that both the air and abra-

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New high-power Comco MicroBlasters are capable of running nozzle array configurations for semi-automated applications. Fixturing shown is designed to present product to the nozzles.

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sive are always free of moisture and oil to avoid clumping and clogging nozzles, and an industrial dust collection system.

When the turbine is split in two for maintenance, hot path components and combustion components are pulled out for repair. These parts take in and distribute cooling air within a turbine through multiple small holes, which can number more than 140 per component and be as small as 0.08 mm in diameter. The holes are often present in airfoils and shrouds of many first- and second-stage components.

Manufacturers diffusion-coat internal hot gas path components with an aluminide to protect them from the high temperatures to which they are subjected. The manufacturers often use various processes to apply a thin diffused metallic and/or sprayed ceramic coating to the external surfaces of the components. Many coatings are a powder mix consisting of aluminum oxide, halogenated salts and free aluminum flake with some catalysts. The part is dipped into the mixture and placed in a furnace at temperatures of up to 1093°C for various lengths of time, depending upon coating requirements. The process creates a metal gas that alloys with the base material.

This coating allows higher operating temperatures and efficiencies in modern turbines, but also creates a definite challenge during refurbishing. The worn existing coating must be removed to a sufficient degree to allow a new coating to bond properly. However, through cycle after cycle, the old coating has been literally baked into the surface along with oxidation and contaminants. It is not easily removed.

Because of the rugged nature of hot path parts coatings and byproducts produced during engine operation, high-powered cabinet-type abrasive sand or "grit" blasting equipment was initially used to "blast texture" the overall parts surfaces. This process was then combined with chemical stripping procedures. While this worked to some degree, it did not really get into the critical areas such as the small air duct holes. Also, cabinet blasters were prone to "surging," where unbalanced mixtures of abrasive and air caused uneven abrading, even on the outside surfaces of parts, and often plugged up holes with grit instead of cleaning them.

This is not a problem with MicroBlasting because of the technique that blends the abrasive media into the air stream. The modulation mixing process is specifically designed to handle the 25 to 50 micron particles in very small quantities, traveling through miniature nozzles.

For most coating/oxidation removal, the blaster uses a 200 to 400 grit (25 to 50 micron) aluminum oxide powder, which is a sharp, cutting abrasive. For extremely difficult coatings, silicon carbide, the most aggressive abrasive, may also be used. In manual operation, an operator points a nozzle into the cooling hole and activates the blasting cycle, typically via foot pedal.

An application such as this, where the depth of the apertures and/or level of coating to be removed varies, requires the decision process of a knowledgeable operator regarding placement of the nozzle, variation of the timing and blast pressure. Other, more uniform removals, particularly where a quantity of "same part" types are to be processed, can benefit from special fixturing and automated programming.

Comco high-performance MicroBlasters allow turbine maintenance facilities to effectively process coating and contaminant removal in small areas that were previously impossible to strip. For some types of coatings, MicroBlasting efficiently replaces the harsher acid/chemical bath process. This, of course, makes the entire application safer and less expensive, because MicroBlasting is a clean technology. All abrasive powders are nonhazardous and do not require special disposal. This is very desirable, because the chemical processes are being greatly restricted and typically require special and costly hazardous material disposal handling.

For extremely difficult or thick coatings that still require a chemical treatment, microblasting assists in getting the chemical action to the base material more quickly, which means fewer dip cycles are needed. The abrasive will cut into the coatings in areas that cabinet blasting cannot reach. This allows

New materials have allowed the development of a wide range of standard and custom blasting nozzles in many configurations and designs.

the chemical bath to "eat into" the material more efficiently, particularly in areas where, without abrading, the chemical would not even activate.

Some parts may need only an abrasive blasting to strip away all contaminants. Others may need one or two cycles (blast/acid bath) to remove coatings, usually reduced from four to five cycles. Very resistant coatings may still need up to four to five cycles, but these are ones that likely could not be processed completely using older methods. After final cleaning, the internal surface is receptive to accepting a completely new coating, giving the part a new life.

Every reconditioned turbine component must pass a fluorescent penetrative inspection (FPI) that looks for cracks and other negative conditions. Once the component has passed that inspection, it is checked to see if any welding or alloy brazing is required. After all inspections are completed, and the parts are confirmed ready for use, they are recoated.

The addition of Comco MicroBlasting technology to the tools already used offers a definite advantage for companies involved in turbine maintenance. MicroBlasting can be a process that saves both time and money, eliminating or greatly reducing, the cost of chemicals and disposal. Removal of degraded coatings from air-cooled thin-wall sections that are exposed to higher temperatures allows a more effective and thorough recoating cycle. Better recoating of these components provides consistent protection to internal parts.