

Zero-Temper Pure Zinc Cut-Wire Blasting

The NDCEE has been working with the maintenance department at OO-ALC to identify, demonstrate, and validate environmentally sound, alternative technologies for coatings removal from aircraft landing gear wheels. As part of this effort, the NDCEE demonstrated two types of zero-temper pure zinc cut-wire (ZCW) blasting as potential alternatives to chemical stripping and ultrahigh-pressure waterjet removal system. OO-ALC is currently using methylene chloride chemical stripping, which involves both carcinogenic materials and a volatile organic hazardous air pollutant. However, OO-ALC has installed a UHPWJ based upon familiarity with the technology and its suitability for use on landing gear strut assemblies. Because of positive demonstration and economic findings, OO-ALC is considering using a ZCW process.

Technology Description

Zero-temper pure ZCW blasting is a dry blasting process by which the ZCW media, comprised of zero-temper (very soft) pure zinc alloy, can be applied to a work surface by either of two delivery methods—by conventional air pressure and nozzle (air-blown) or thrown by constant rpm motorized wheel (airless). ZCW blasting is used to remove casting flash and heavy coating residues from coating line jigs and hooks.

Both the airless and air-blown blasting methods use a zinc shot material that is made from high-grade zinc wire that has been cut into segments approximately 1–2 times in length as its diameter. The cut edge of the zinc produces the abrasion that is necessary to remove the coating. The ZCW shot has a density of 240 pounds per cubic foot and a hardness of 20–30 Rockwell B. It is much softer than other metallic media, such as steel shot, which have a hardness of 200–300 Rockwell B. In addition, the ZCW shot has a very low breakdown rate and fairly constant mass size.

With the airless ZCW blasting method, a spinning wheel is used to mechanically project the blast media while the part is moved within the blast stream. The blast pressure is dependent on the speed of the rotating wheel. The blast pressure and media feed rate can be varied to increase or decrease the aggressiveness of the blast stream. The air-blown ZCW blasting method uses compressed air instead of a spinning wheel to project the blast media at the part.

The media can be recycled by separation of the media from the blast residue and spent media particles. Media life depends on the blast pressure and the part substrate type.

As the cut edge of the zinc shot dulls, the effectiveness is reduced. The disposal method of the blast waste is dependent upon the removed coating. Generally, if the coating that is being removed is classified as nonhazardous waste, then the spent media and the coating particles can be separated and the media recycled. If the coating is classified as a hazardous waste, then the facility must determine the proper disposal method. With ZCW, the spent media can be sold to metal recyclers.

Technology Benefits and Advantages

- Can be specified for specific diameters and lengths, allowing for control of applied kinetic energy of the media to the work surface
- Offers chisel points that provide good cut edges for removing high-performance polyurethane aerospace coatings

ESOH Need

Cleaning and coatings removal techniques



Landing gear wheel mounted in a motorized ZCW airless test machine

- Allows continuous use without having to anneal metallic media in order to return it to a desired hardness range because of the zero work-hardening characteristics of the used media
- Reduces dust generation that is associated with most dry media blasting because of the malleability of the pure zinc
- Allows for 50% higher coatings removal rates than PMB or 30% higher than UHPWJ removal rates with motorized airless method: these two methods were determined to meet the production needs of the Air Force wheel maintenance program (14,000 wheels per year) and were analyzed further to develop a full cost analysis review
- Permits recycling of zinc directly to metal recyclers at a positive cost per pound (e.g., typical recycling for zinc nets \$0.60 per pound versus a hazardous waste disposal charge for other solid blast media of \$0.40 per pound)

Technology Limitations

- May not be suitable for soft substrate materials such as composites
- Requires precleaning of parts to remove grease and dirt before blasting because any grease or dirt on the part will attach to the media, resulting in clumping and reduced effectiveness
- Requires postcleaning because of a zinc residue that is left on some substrates
- Requires a dedicated air compressor or compressed air source for the air-blown method, which can result in a greater equipment cost and process footprint size than the airless system

NDCEE FY04 Accomplishments

- Demonstrated both methods, conventional air-blown and motorized airless, of media application for the Air Force at two vendor locations
- Validated that coatings removal rates for conventional air pressure blasting process were approximately 150 in²/min per nozzle and 350 in²/min. per motorized throw wheel respectively
- Validated that both methods preserved the underlying anodized pretreatment layer while removing 99+% of the coating

Economic Analysis

The NDCEE performed an economic analysis on the mechanical airless process because it met the stated Air Force coatings removal production rate of 4 minutes per wheel half. Each wheel separates into two unique halves and is thus treated as an individual piece for production calculation purposes. Using baseline data from OO-ALC, the NDCEE calculated an annual savings of more than \$850,000 and a payback period of less than 2 years. This savings is primarily the result of reducing annual material cost by nearly \$175,000 and reducing annual disposal costs by more than \$108,000. The technology is expected to reduce Hill's solid waste by approximately 90%.

Because the conventional air-blown method did not meet the Air Force-required production rate, no economic analysis was performed on this process.

Suggested Implementation Applications

ZCW blasting technology may be used by the Air Force for coatings removal from aircraft landing gear wheels and for other coatings removal needs such as ground equipment and vehicles. Parts, such as vehicle wheels, fenders, doors, engine components, mounts, and racks, can be removed and transported into the stripping booth. Surface profiling (roughening) pretreatment may be eliminated by use of this technology.

Points of Contact

- Richard (Guy) Whalen, OO-ALC, (801) 775-6866, richard.whelen@hill.af.mil
- Doug Atterbury, NDCEE/CTC, (814) 269-2849, atterbud@ctc.com

Applicable NDCEE Task

Automated Plastic Media Blast for Depainting Landing Gear Wheels for Commodities
Directorate Ogden Air Logistics Center (Task N.258)