Mobile Manipulation of a Carbon Dioxide Pellet Turbine Wheel (Task N.045)

Statement of Need

Waste from media blasting has been the primary hazardous waste stream leaving the Department of Defense (DoD) maintenance depots. Legislative action banning ozone depleting chemical (ODC) production (1995), such as methylene chloride and phenolic wet stripping, has resulted in increased use of abrasive blasting technologies. Therefore, although progress has been made in reducing other hazardous waste streams, waste from media blasting has been increasing in volume.

Continued pursuit of an environmentally friendly coatings removal technology is necessary for engine components. Naval Aviation Depot, Jacksonville (NADEP-JAX) supports the J-52, F-404, TF-34, and T-56 engine programs. As a result, NADEP-JAX tasked the National Defense Center for Environmental Excellence (NDCEE) to prototype and test an automated advanced turbine-carbon dioxide (T-CO_2) coatings removal system for engine canisters, aircraft (fuel) drop tanks, and corrosion protective paint and primer systems from steel structures. The proposed system must meet all National Emission Standards for Hazardous Air Pollutants and Control Techniques Guidelines (NESHAP/CTG).

Identified Alternatives

To support this contract, the NDCEE received an Alpheus CO_2 pelletizer and blasting unit, a portable Alpheus CO_2 pellet cleaning unit, Cold Jet pelletizer and blasting unit, Pneumatech aftercooler, CO_2 liquid storage tank, air compressor, hoses, and accessories from NADEP-JAX. The NDCEE procured a Turbine-CO_2 stripping assembly with Allen-Bradley controls from Cryogenics Applications F. An advanced pellitizer was also incorporated. This equipment was maintained and used by the NDCEE to complete the requirements of this task.

The first objective of this task was to demonstrate and test a T-CO_2 coatings removal system on organically coated surface substrates. After this objective was successfully completed, an addedum to the task required the NDCEE to expand the use of the T-CO_2 coatings removal system. This included incorporating a flexible workcell design for use on a variety of parts and testing the capability of electrocoat and powdercoat removal.

Demonstration and Justification

The advanced T-CO_2 coatings removal system for removing Chemical Agent Resistant Coatings (CARC), MIL-P-23377F primer, MIL-C-83286B Type I polyurethane, and two non-skid coatings from steel substrates was demonstrated at the NDCEE Demonstration Factory in Johnstown, PA.

The T-CO_2 system proved successful for removing these coatings at a rate of 36–56 square feet per hour (ft2/hr) and a CO_2 feed rate of 300–500 pounds per hour (lbs/hr), depending on the type of coating and transverse rate.

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Status
Completed

It was determined that the optimum test parameters for engine cans occurred with one pass at a CO_2 feed rate of 407 lbs/hr, a transverse rate of 0.96 in/sec, and a standoff distance between 4–6 inches at an angle of 90 degrees.

A cost payback analysis on using a T-CO_2 coatings removal system as an environmentally friendly alternative for removing coatings from engine cans using the optimized parameters noted above was completed. The analysis showed an estimated payback period of 4.41 years. Based on an initial capital investment of $365,340, the total annual savings was estimated at $87,911.

Implementation

T-CO_2 was not selected for implementation at NADEP-JAX due to some of the access constraints of the technology.

Follow-Up

Another potential environmentally friendly coatings removal technology that should be investigated as an alternative method for removing coatings from engine cans and aircraft (fuel) drop tanks at facilities such as NADEP-JAX is high-pressure waterjet technology. This technology has been implemented and is currently being used at Corpus Christi Army Depot (CCAD) for engine can stripping.