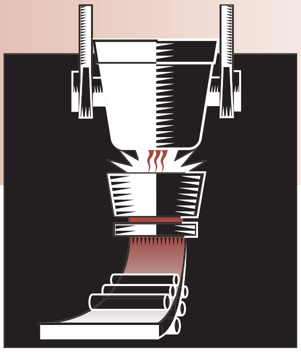


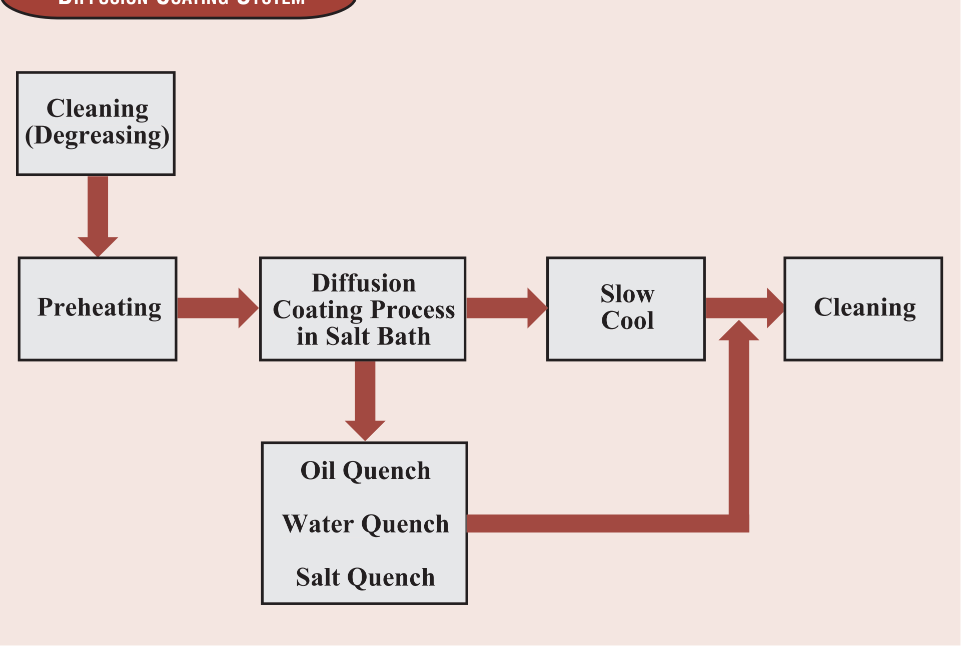
Vanadium Carbide Coating Process

Innovative Process Enhances Wear Resistance of Metals, Saving Energy, Waste, and Costs

Traditional methods of coating steel surfaces with a layer of hard metal carbide require large capital investment, produce toxic and hazardous gases, are costly to operate, and require multiple heat treatment steps during processing. Tools and dies manufactured with currently available coatings have limited wear resistance leading to premature failure, frequent downtime, and high replacement costs.

Vanadium carbide (VC) coating technology provides a superior protective coating for steel surfaces and eliminates the need for multiple heat treatment processing, thereby eliminating harmful gas emissions. The VC coating technology is expected to reduce energy use by 35% to 50% and costs by 5% to 15% and to increase productivity by 10% to 30%.

Diffusion Coating System



The unique coating process is based on thermal diffusion technology which forms a VC layer on the surface of steel and stainless steel base materials. Tool and die manufacturers could reduce energy use by 35% to 50%.

Benefits

- Offers potential annual savings of 137 million Btu per 3000 pound capacity unit
- Offers potential total annual savings of 2.6 trillion Btu by 2010
- Offers energy savings of 35% to 50% compared with current technology
- Reduces carbon dioxide and other greenhouse gas emissions by 20% to 40%
- Reduces water usage by 20% to 50%
- Reduces process cost by 5% to 15%
- Offers productivity gains of 10% to 30%
- Increases tool life 5 to 30 fold over conventional wear-resistance methods
- Increases dimensional accuracy by eliminating multiple heat-treatment steps
- Applies to parts with complex shapes and contours

Applications

The metal forming industry, including steel rolling (hot and cold), shaping, and their manufacturing tools and dies will greatly benefit from this innovation, including metal forming tools used in the aluminum, glass, plastics, and rubber industries.

Project Partners

NICE³ Program
Washington, DC

Pennsylvania Department of Environmental Protection
Harrisburg, PA

Metlab-Potero
Wyndmoor, PA

Norman H. Brown Ltd.
United Kingdom

Project Description

Goal: Metlab-Potero, the host company, will construct a commercial-scale VC coating system and will receive technology support from Norman H. Brown (NHB). VC will be metallurgically bonded onto the surfaces of production-size parts and tools such as rolls, dies, molds, and shears.

The system is based on thermal diffusion technology, which forms a VC surface layer, that can be made up to 15 microns thick in 12 hours. Process steps include cleaning, preheating, coating, cooling, or quenching, and subsequent tempering as required. Cleaned parts are preheated and then immersed in an environmentally benign fused salt bath in an 800 to 1200°C furnace at ambient pressure until the required coating thickness is achieved. The work piece is then removed from the furnace for quenching, slow cooling, or additional hardening and tempering. This process protects steel surfaces with a thick, well-controlled layer of VC while eliminating the need for multiple heat treatment steps that increase energy use and the chance of production defects. Reducing the number of processing steps eliminates emissions, vacuum vessels, and the associated electrical heating system components.

NHB, together with Metlab-Potero and the Pennsylvania Department of Environmental Protection, is demonstrating the VC coating technology with funding from the NICE^3 Program of the U.S. Department of Energy's Office of Industrial Technologies.

Progress and Milestones

- Design the equipment and fabricate and install the system.
- Perform shakedown and preliminary tests.
- Test and operate the system and analyze the performance data.

Economics and Commercial Potential

This technology will have wide applicability in the steel, metal casting, aluminum, glass, plastics, and rubber industries. Major markets include wear-resistant coatings for hot and cold rolling mills; oilfield drilling tubes and tools; hot and cold forging dies for steel mills and other forging operations; dies and molds for zinc, magnesium, and aluminum castings; and shafts for rotary equipment used in industry. One unit is assumed to operate at a 3000-pound load capacity, 10-hour cycle, 220 days per year. An ultimate market share of 50% is assumed, with commercial introduction in 2004. One unit could save 137 million Btu per year. Based on 7% of potential market penetration by 2010, annual savings could be 2.6 trillion Btu with 19 units installed. Market penetration of 23% by 2020 could save 7.89 trillion Btu annually from 62 units installed. Reduced fuel consumption resulting from this higher efficiency could translate directly into a reduction of 62,300 tons of carbon dioxide emissions in 2010 and 204,000 tons in 2020.

NICE^3 – National Industrial Competitiveness through Energy, Environment, and Economics:
An innovative, cost-sharing program to promote energy efficiency, clean production, and economic competitiveness in industry.
This grant program provides funding to state and industry partnerships for projects that demonstrate advances in energy efficiency and clean production technologies. Awardees receive a one-time grant of up to $525,000. Grants fund up to 50% of total project cost for up to 3 years.

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Order # NICE^3 ST-9
March 2002