



ENERGY-EFFICIENT PROCESS FOR HOT-DIP BATCH GALVANIZING

LEAD-FREE ZINC COATINGS SAVE ENERGY AND WASTE

BENEFITS

- The ability to produce defect-free and lead-free zinc coatings
- Allows productivity increase of 20-30%
- Significantly reduced energy costs
- Reductions in dross, top ash, and smoke
- Products meet specifications with 10% to 50% thinner coatings
- Top-flux use on the kettle eliminated
- Increased expected kettle life span

APPLICATIONS

Steel is a component of a wide range of products and makes up the building blocks of the construction, automotive, and machinery industries, among many others. Coating steel products to protect them is a popular practice which stands to grow even more with the development of high-quality lead-free coating processes

Hot-dip galvanizing of steel sheets, pipes, and other fabrication items is a popular method of corrosion protection. Currently, steel articles are immersed in molten zinc at 860°F, thereby forming a “frozen” metal (interfacial zinc iron intermetallic layer) on the surface. Drawbacks to the current technology include the expense of heating parts at such a high temperature and the generation of by-products such as zinc alloys, zinc oxides, and smoke.

Furthermore, new federal regulations have significantly reduced acceptable lead levels in coatings, because lead from galvanized, coated steel will dissolve in water. Such dissolved lead may accumulate in human bodies with deleterious results. Additionally, the use of a molten salt layer on top of zinc (top-flux) causes kettle smoke and ash evolution.

Ferro Technologies, Inc. has proposed a lead-free batch technology that will significantly improve the galvanizing process. The new Thermo Prep™ process protects steel surfaces with a thermally stable flux by preheating parts to 400° to 450°F in a separate furnace, and then immersing them in molten, lead-free zinc for a short period of time. The use of a thermally stable pre-flux would eliminate the need for top-flux, thereby reducing associated wastes.

HOT-DIP BATCH GALVANIZING IS CLEAN, EFFICIENT

The Thermo Prep™ process demonstrated by Ferro Technologies, Inc. preheats steel parts, and then immerses them in molten, lead-free zinc in a separate furnace to save energy and reduce defects.



Technology Advantages

The new technology provides hot-dip batch galvanizers with the following advantages: (1) a 20%-30% productivity increase; (2) significant energy cost reduction; (3) dross, top ash, and smoke reduction; (4) 10%-50% coating thickness reduction to meet specification requirement; (5) elimination of top-flux use on the kettle; (6) the ability to produce defect-free and lead-free zinc coatings; and (7) increased kettle life.

Current Status

The equipment is in place at the LaCledde steel plant in Alton, IL, and Ferro Technologies is currently optimizing the system. The kettle handling system is being redesigned to reduce pipe immersion time. Ferro Technologies demonstrated the system to DOE personnel in March, 1998.

ENERGY SAVINGS PER UNIT* (PROJECTED)

Current Energy Use (Btu)	1 billion
With Proposed Technology	486 million
Energy Savings	514 million

WASTE SAVINGS PER UNIT* (PROJECTED)

Current Waste (tons)	3,800
With Proposed Technology	2,500
Waste Savings	1,300

ECONOMIC SAVINGS PER UNIT* (PROJECTED)

Current Costs	\$1.194 million
With Proposed Technology	\$807,600
Cost Savings	\$386,400

*for a facility galvanizing 6,960 tons of steel per year

INDUSTRIES OF THE FUTURE—STEEL

Through OIT's Industries of the Future initiative, the Steel Association, on behalf of the steel industry, has partnered with the U.S. Department of Energy (DOE) to spur technological innovations that will reduce energy consumption, pollution, and production costs. In March 1996, the industry outlined its vision for maintaining and building its competitive position in the world market in the document, *The Re-emergent Steel Industry: Industry/Government Partnerships for the Future*.

OIT Steel Industry Team Leader: Scott Richlen (202) 586-2078



NICE³—National Industrial Competitiveness through Energy, Environment, 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 \$400,000. Grants fund up to 50% of total project cost for up to 3 years.

PARTNERS

Ferro Technologies Inc.,
Pittsburgh, PA

LaCledde Steel Company,
Alton, IL

Pennsylvania Department of
Environmental Protection

Advanced Thermal Dynamics, Inc.,
Liberty, OH

FOR MORE INFORMATION

NICE³ Web site:
<http://www.oit.doe.gov/Access/nice3/>

NICE³ program contact:
Steve Blazek
Golden Field Office, DOE
1617 Cole Boulevard
Golden, CO 80401
(303) 275-4723
(303) 275-4288 (fax)
steve_blazek@nrel.gov

Ferro Technologies, Inc.:
Thomas L. Ranck
University of Pittsburgh
Applied Research Center
1125 William Pitt Way
Pittsburgh, PA 15238
(412) 826-3239
(412) 826-3247 (fax)

Office of Industrial Technologies
Energy Efficiency and Renewable
Energy
U.S. Department of Energy
Washington, D.C. 20585



DOE/GO-10098-561
April 1998