Industrial Technologies Program

Development of High-Density Infrared Based Surface Enhancement Technology for Mineral Processing Equipment

New Surface Enhancement Technology Will Help Diminish Wear and Corrosion of Mineral Processing Equipment and Save Energy

Major efforts have been made to reduce the wear of cyclones, pumps, heavy medium vessel plates, and other components used in mineral processing over the past two decades. Significant progress has been achieved through the use of ceramic linings, which have considerably increased the lifetime of equipment such as hydrocyclones. However, little has been done to reduce the wear of screens, chains for conveyors, pipings, and other devices where ceramic lining is impractical. For instance, the screen aperture increases as material wears, resulting in inconsistent aperture sizes that decrease screening efficiency by creating non-ideal feed to downstream operations. Frequent replacement of screens, conveyors, and pipes increase equipment downtime and maintenance cost, reducing process efficiency.

Researchers at the University of Kentucky and Oak Ridge National Laboratory are developing advanced High-Density Infrared (HDI) and laser- based surface enhancement technologies for decreasing the wear and corrosion rate of mineral processing equipment by an order of magnitude. The process is easily adaptable to automation and less expensive than current methods.

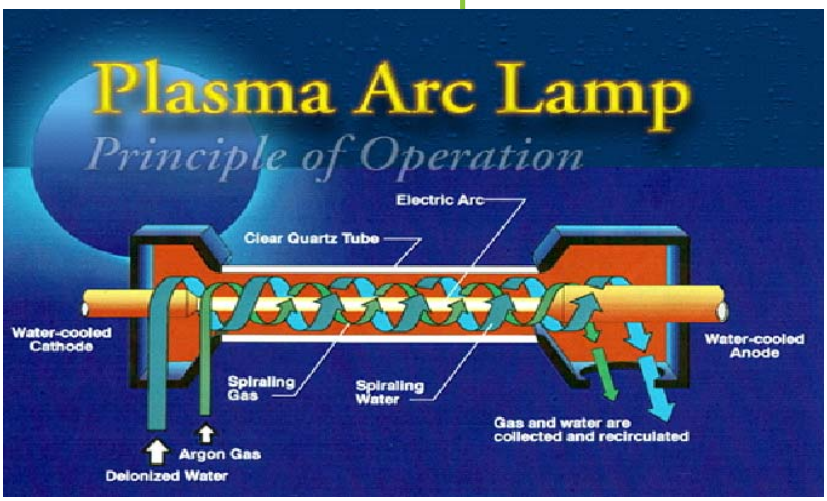
Enhanced component surfaces will be achieved through three concepts. First, through controlled thermal treatment of surfaces to convert them to higher hardness for a known level of depth, without affecting the core properties. Second, through controlled thermal treatment of surfaces to enrich them with certain elements for a known level of depth, without affecting the core properties. Finally, through controlled thermal treatment of surfaces to fuse and diffusion-bond externally applied coatings of select hard materials. The component surfaces treated by these concepts will be characterized by the following methods: metallography, micro-hardness profiles, and microprobe analysis. The enhanced surfaces will also be characterized for their bend resistance, debonding in case of coatings, and wear resistance under simulated mineral processing conditions.

Benefits for Our Industry and Our Nation

- *Decrease plant maintenance time by 20%.*
- *Increase energy efficiency by reducing downtime and increasing productivity.*
- *Extend the lifetime of screens and piping 10-fold.*
- *Improve worker health and safety by less frequent exposure to noise and risks involved in maintenance and replacement activities.*

Applications in Our Nation's Industry

This technology has many potential applications in the mineral processing and coal preparation industries including, but not limited to, crushers, grinding mills, pumps, pipes, conveyors, and compressors.



HDI Surface Enhancement Technology

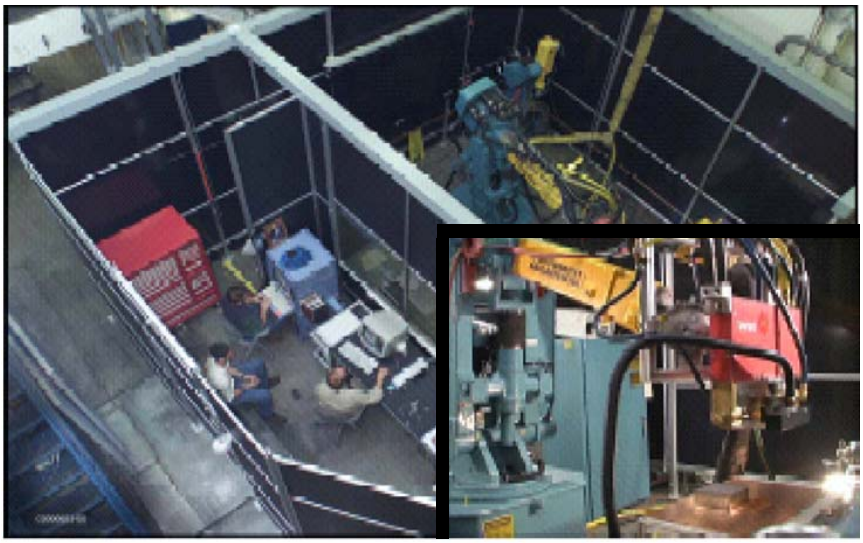
Project Description

Goal: To develop a cost-effective advanced surface enhancement technology for decreasing, by an order of magnitude, the wear and corrosion of equipment that is used widely in mineral processing and coal preparation plants.

The project addresses compelling issues facing the mining industry. This technology can be made readily available for the entire mining industry. In order to rapidly commercialize the technology, the proposed program consists of both laboratory development and testing, and on-site demonstration. To facilitate the development and commercialization process, the University of Kentucky Research Foundation has established partnerships with coal, mineral, and aggregate mining companies, as well as screen and chain manufacturers. After successful technical and feasible evaluation, the screen and chain manufacturers will eventually license and commercialize the technology, first at the participating mining companies, and then to the entire mining industry.

Milestones

- The partnering mining companies and screen and chain manufacturers will provide representative wear-susceptible screens, chains, and piping (a pipe or joint elbow), together with coal or aggregate samples to be used in the testing program. A representative sample will be collected for the characterization of particle size distribution, abrasion properties, hardness, and other measures.
- Full assessment of three different surface enhancement methods.
- Optimization of process parameters for surface enhancement.
- Screening and slurry transporting tests, using screens, chain components, and piping treated by the optimum process identified in the prior step, will be performed in the laboratory to yield wear and corrosion resistance data.
- On-site demonstration will be performed at the processing plants of the industrial partners.
- An economic and technical analysis of the HDI process for screens, chain components, and piping will be conducted using the laboratory and on-site evaluation results.



ORNL HDI Facility

Project Partners

The University of Kentucky Research Foundation
Lexington, KY

Oak Ridge National Laboratory
Oak Ridge, TN

Carbontronics Fuel Management, LLC.
Lexington, KY

CONSOL Energy
Oakwood, VA

James River Coal Service Company
London, KY

Florida Rock Industries, Inc.
Tyrone, GA

AMVEST Mineral Services, Inc.
Charleston, WV

Kurtz Bros., Inc.
Groveport, OH

Phelps Dodge Mining Co.
Phoenix, AZ

Innovative Screen Technology
Chapmanville, WV

Jeffrey Chain Corporation
Morristown, TN

Energy Industries of Ohio
Independence, OH

Kentucky Coal Association
Lexington, KY

Ohio Coal Development Office
Columbus, OH

Massey Energy Co.
Charleston, WV

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

U.S. Department of Energy
Energy Efficiency and Renewable Energy

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