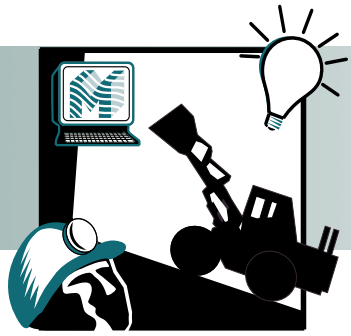
# MINING

Project Fact Sheet



## Metal-Matrix Composites and Thermal Spray Coatings for Mining Machines

### Benefits

- Reduces energy needed to make replacement parts by doubling life of existing parts
- Decreases frictional losses by maintaining optimal shape and through proper placement of coating or hard reinforcement
- Reduces equipment downtime as a result of doubling lifetime of wear components

### Application

Advanced materials apply to research priorities defined by the mining industry such as new materials for wear, construction, and process application.

## Abrasion-Resistant Materials will reduce scheduled downtime by 50%

Advanced abrasion-resistant materials will reduce scheduled downtime by 50% by doubling the life of wear components. This project involves the development and testing of abrasion-resistant materials for mining equipment. These materials include thermal sprayed hardfacing coatings and steel metal matrix composites (MMCs).

Thermal spray coatings are favored over weld hardfacing because they permit greater flexibility of composition. In addition, the sprayed parts are subject to lower and more uniform heat input during processing resulting in less distortion and a shallower heat affected zone. This project will explore the benefits of sprayed hardfacing coatings. These coatings are fused to the substrate and densified using a high-flux infrared-based heating source. This post infrared processing is referred to as high-density infrared (HDI) transient-liquid coating (TLC).

A few steel metal matrix composites currently exist in the marketplace. Some of the best quality composite materials are produced using powder processes. However, such processes are not economically feasible for the large wear components used in mining. Caterpillar has proven the feasibility of a hybrid pressure infiltration casting process that uses low cost ceramic die liners and steel tooling to fabricate low porosity steel MMCs. This project will develop the hybrid pressure casting process with particular focus on process optimization, selective reinforcement, and optimization of the composite systems' wear-resistance and toughness.

Bucket

**Improved mining productivity though material innovation.**

## Project Description

**Objective:** To develop and test advanced abrasion-resistant materials for mining equipment using two methods: (1) a hybrid pressure casting process for parts comprised of steel metal matrix composites, and (2) a novel thermal treatment of parts that have been spray coated. These abrasion-resistant materials will reduce operating costs and increase production by reducing machinery downtime.

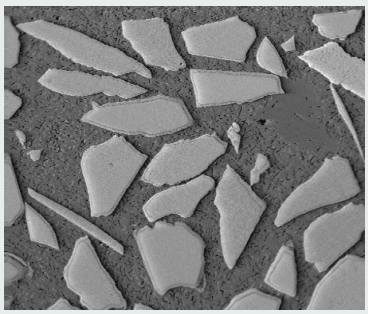
For the first year of research Caterpillar Inc. will work closely with the Oak Ridge National Laboratory to apply the HDI/TLC process to Caterpillar components. In parallel, Caterpillar will work with St. Louis Metallizing to develop them as a supplier of this technology. Also, during the first year, efforts will be made to begin identifying industrial partners willing and capable of pursuing the hybrid pressure infiltration process. Caterpillar's current partnering with leading steel foundries may aid this effort. Once developed, industry partners would be involved in further enhancement and optimization of the material systems and process, ensuring that manufacturability issues are addressed and offering a potential to further accelerate development of these products.

## Progress and Milestones

Activities to be completed in this project include:

- Evaluate processing and material costs, as well as the economic competitiveness of the processes.
- Identify the material constituents and, for components, the hard materials placement to provide the optimal combination of abrasion resistance and structural properties.
- Develop the hybrid pressure infiltration casting process with emphasis placed on ceramic die liners, hard particle preforms, and casting process development and optimization.
- Further enhance the coating performance by addressing two factors that have limited their application in mining: interfacial bond strength and low coating density.
- Examine the abrasion-resistance and integrity of the material systems.
- Fabricate and field test the components.

**Composites and Coatings**



(Left) Steel matrix composites. (Right) Thermal spray coating process.

Project Partners

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Albany, OR

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Oak Ridge, TN

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