Metal-Matrix Composites and Thermal Spray Coatings for Earth Moving Machines
Quarter 10 Report

Reporting Period Start Date: 04/01/03
Reporting Period End Date: 06/30/03

Authors:
D. Trent Weaver (Caterpillar)
Matthew T. Kiser (Caterpillar)

July 2003

DOE Award: DE-FC26-01NT41054

Caterpillar Inc.
Technical Center – E – 854
PO Box 1875
Peoria, IL 61656-1875

Metal-Matrix Composites and Thermal Spray Coatings for Earth Moving Machines
Quarter 10 Report

Table of Contents

Metal-Matrix Composites and Thermal Spray Coatings for Earth Moving Machines
Quarter 10 Report

Abstract:

In the 10th quarter no further work was conducted on the steel matrix composite element of this project. For this element work is effectively complete and all that remains is the composition of the final report. For the thermal spray coating effort, components coated and fused in the previous quarter were subject to high stress abrasive wear testing. Some complications were encountered with the wear testing, but the tests which were completed successfully showed that the coatings provided wear resistance 5x that of the baseline material. Further wear testing is planned for the 11th and final quarter.

An overview of the progress during the 10th quarter of this project is given below. Additional research details are provided in the limited rights appendix to this report.

Thermal Spray Coatings

Experimental

Full-scale laboratory wear testing of three coated (and fused) components was completed. Details on the coating designs are given in Table I (see Appendix: Limited Rights Proprietary Information). The testing consisted of sliding motion between the as-fused coating surface and a hardened steel. Both water and sand were injected between the sliding surfaces after each cycle. Baseline tests were run with current production materials for comparison.

Results and Discussion

Wear testing equipment maintenance prevented the testing of more coatings this quarter. Also, misalignment of the coated component and the mating steel component resulted in point loading (invalid testing) of two of the three coatings. The coatings that were point loaded cracked and partially flaked off of the substrate. A digital image of the successfully tested component is shown in Fig. A1. As observed previously, a traditional wear scar in the coating was not evident. Instead, the coating surface merely "polished" during testing.

The flaking of coatings is thought to be a result of imperfect metallurgical bonding between the coating and base material after arc lamp fusing. Further optimization of the arc lamp fusing process is needed to achieve the desired degree of bonding.

The coating that survived wear testing showed outstanding abrasion resistance, increasing the wear life of coated component by a factor of five. The as-fused coating surface proved to be smooth enough to prevent gouging of the softer mating surface, thus eliminating the need for any costly finishing processes.

Conclusions and Future Work

Laboratory wear testing will continue with these fused coatings during the upcoming quarter. Wear rates for both the coatings and mating steel components will be determined. Destructive

analyses of the fused coatings will be performed in order to determine the soundness of the metallurgical bond between the coating and substrate after wear testing.

References:

No publications or documents were used or cited in the preparation of this particular quarterly report.