Quarterly Management Report

FY 2003

WBS Element	Project Title	Contract Number	Contract Start	Contract End
LU-2	Effect of Chromium on Fe/Al Weld Overlay Coatings for Corrosion Protection...	19X-SU604V	12/15/95	06/27/04

Performer Name and Address	Principal Investigator(s)
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BUDGET AND COST REPORT

Prior Year Funds [$K]	361
Total Current Year Commitment $K]	49
Projected Current Year Costs [$K]	108

	O	N	D	J	F	M	A	M	J	J	A	S
Planned Costs	8	8	8	12	8	8	8	8	12	12	8	8
Actual Costs	1	5	2	8	23	8	0	0	0	0	0	0
Variance	7	3	6	4	(15)	0	8	8	12	12	8	8

MILESTONE REPORT

Milestone Designation	Milestone Description	Due Date	Revised Due Date	Completion Date
Task 1	Weldability Study of Fe-Al-Cr Alloys	07/15/03		
Task 2	Gaseous and Solid State Laboratory Corrosion Studies	03/15/04		
Task 3	Characterization of Fe-Al-Cr Welds (TEM) - beginning August, 2002	01/31/04		
Task 4	Final Report Preparation - beginning June, 2003	06/15/04		

TECHNICAL HIGHLIGHTS

Since the last report, several cast alloys representative of weldable Fe-Al-Cr weld overlay coating compositions were exposed to a Mixed Oxidizing/Sulfidizing Gaseous Environment (10%CO- 5%CO2- 2%H2O- 0.12%H2S- N2). The FeAlCr alloys (Fe-12.5Al, Fe-10Al-5Cr, and Fe-7.5Al-10Cr) were compared to a currently used Ni-based weld overlay coupon of Alloy 622. Samples were held at 500C for 100 - 2000 hours. It was found that the corrosion kinetics for all three of the Fe-Al-Cr alloys were significantly lower than the corrosion kinetics of Alloy 622. For example, during 2000 hours of exposure to the corrosive environment, Alloy 622 gained approximately 20 mg/cm2 and all three of the FeAlCr alloys gained less than 0.5 mg/cm2 during 2000 hour exposure. Corrosion scale morphology was also considered and it was found that Alloy 622 formed a thick porous scale rich in nickel and sulfur, whereas the FeAlCr alloys formed small block-like nodules that were rich in iron and sulfur. It was concluded that several of the weldable FeAlCr overlay coating compositions could be deposited crack-free and can provide superior high-temperature corrosion protection to Alloy 622.

Weld overlay coatings were also characterized to determine if the weld microstructure had any effect on the cracking behavior of the welds. X-ray Diffraction (XRD) was used to identify the phases present within the weld overlay coatings. It was found that welds containing <6wt%Cr formed intermetallic phases (Fe3Al and/or FeAl) above approximately 11wt%Al. All alloys containing less than approximately 4wt%Cr formed (Fe,Al)3C carbides, which were identified using XRD. Alloys containing chromium additions greater than approximately 6wt%Cr showed only ferrite to be present, although weak Cr-rich carbide peaks were observed in these samples as well. Light Optical Microscopy (LOM) was also used to make observations about the weld microstructure. LOM observations of weld samples confirmed the existence of highly acicular carbides in welds containing lower chromium concentrations [(Fe,Al)3C] and small spherical carbides in samples containing high chromium concentrations [Cr-rich carbides]. The intermetallic phases cannot be observed using the LOM so the presence of this phase was not considered in the LOM observations.

The role of the formation of carbides on the cracking susceptibility of the FeAlCr weld overlay coatings is currently being considered. The carbide distribution will be measured using a quantitative image analysis program interfaced with an light optical microscope. Also the effect of carbides on the corrosion behavior of these coatings will also be evaluated by exposing actual weld overlay samples to the corrosive environment for 1000 hours and compare to the corrosion behavior of the cast alloys of equivalent composition.

ISSUES

None.

Report Prepared By	Date
Dr. John N. DuPont and Jonathan Regina	05/28/04