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Contract Number: DTRS56-04-T-0010

Project Title: Evaluation of Hydrogen Cracking in Weld Metal Deposited using Cellulosic Electrodes

Prepared by: Edison Welding Institute, Inc., Columbus, OH 43221

Quarterly period ending: January 4, 2005 {effective date: October 4, 2005}

Objectives: The objectives of the proposed project can be summarized as follows: (1) To determine the effect of electrode drying and arc length on weld metal chemistry, mechanical properties and hydrogen cracking susceptibility. (2) To determine the effect of electrode re-hydration on weld metal chemistry, mechanical properties and hydrogen cracking susceptibility. (3) To develop practical guidelines on how to prevent hydrogen cracking in welds deposited using cellulosic covered electrodes.

**Results and Conclusions:**

- Task 1: Selection/Procurement of Welding Electrodes
  - EXX10 Electrodes were procured from Lincoln, Hobart and ESAB. Table 2 lists the electrodes that were initially procured for this program.
- Task 2: Preliminary Welding and Testing of Dried Electrodes
  - The electrodes were tested in the as-received condition for coating moisture and weld metal chemical analysis. The electrodes were then dried for 7 days at 86 °C.
  - Following the drying operation, they were again tested for coating moisture and weld metal chemical analysis
  - Results of the moisture/chemistry testing are shown in Table 3.
  - Based on the results of the analyses, two electrodes from each class were selected for further testing. The selection was based on which electrodes showed the greatest change in chemical analysis following drying, and the electrodes which were selected are highlighted in Table 3. The Hobart Pipemaster 90 was never received, so only one 9010-class electrode has been included in the program.
  - Groove welds have been made with each of the electrodes selected, both in the as-received and dried conditions, and both using a “medium” (3-4 mm) arc length and with a “short” (1-2 mm) arc length. The welds were inspected visually and radiographically for porosity and cracks, and then machined to remove mechanical test samples. Testing, including bend and tensile testing, is scheduled to begin shortly.
- Task 3: Re-hydration Study
  - Concurrent with the production of the groove welds, electrodes from each of the seven batches of dried electrodes were placed in a humidity cabinet set at 27°C (80°F) and 80% relative humidity for a period of one week.
  - Coating moisture analyses were performed on each of the re-hydrated electrodes. Results are shown in Table 4.
  - Chemical analysis pads have also been produced with each of the re-hydrated electrodes, although those results are not yet available.
  - Welding of test plates using the re-hydrated electrodes has also begun, but no results are yet available