PROJECT facts

PLASMA ARC SMELTING
SCIES

DEMONSTRATION OF PLASMA ARC FERROCHROMIUM SMELTING - A SIGNIFICANT DEVELOPMENT

PROJECT PARTNERS

South Carolina Research Authority
Charleston, SC
South Carolina Institute for Energy Studies
Clemson, SC
MacAlloy Corporation
North Charleston, SC
Massachusetts Institute of Technology
Cambridge, MA

PROJECT SPONSOR

Defense Logistics Agency
Washington, DC

PROJECT SITE

MacAlloy Corporation
North Charleston, SC

Project Background

Ferrochromium is of vital importance to the United States. It is essential to stainless steel and super alloy production and, therefore vital to the defense, aerospace, chemical power generation and transportation industry.

Approximately 90% of the ferrochromium consumed in the United States is imported -- with 62% imported from South Africa. Only one commercial producer of ferrochromium remains in the U.S. and this plant (MacAlloy) is threatened by the more advanced technology used in other countries. The smelting technology currently used in the U.S. is the submerged arc process. This process requires large electrical currents to pass through carbon electrodes into the materials within the smelting furnace. Domestic plants using this technology have been forced to shut down due to the high cost of energy and labor along with obsolescence and inefficiencies of production facilities. U.S. production capacity has declined, demand for the product is growing, and other countries are supplying our need.

Plasma Arc

The advantages of the new plasma arc furnace smelting technology are significant. Plasma arc technology offers opportunities to reduce overall cost of smelting, improved recovery efficiency of chromium, and use of fine-grained domestic ores. Technical advantages of the plasma arc process include less critical requirements for ore and carbon reductions, a relatively large range of suitable slag compositions, continuous feeding of the smelting furnace materials, reduced environment problems, and high recovery of chromium.

DC Open Arc Process Chosen for Demonstration

Of the three technologies considered -- Processing Arc, DC Open Arc, and Plasma Chrome -- the DC Open Arc process was chosen for demonstration. The DC Open Arc process comprises an electric furnace with a simple graphite consumable electrode. The metal heel in the furnace is the anode. The electrode may be hollow with solids charged down the center. A 1.5 MW plant and 12 MW demonstration facility were designed and operated at the MacAlloy site.

PLASMA ARC SMELTING

Project Reports

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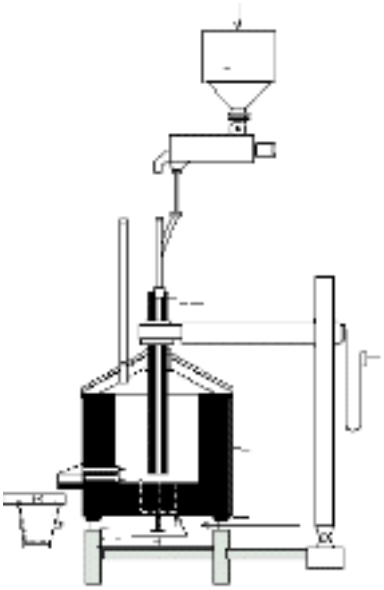

Report No.	Title	Author
PAG-012	Data Analysis-Phase I	Dr. R.S. Figliola
PAG-011	An Analytical Model for the Thermal Analysis of a Plasma Arc Furnace	Dr. J.B. Riester
PAG-009	A Preliminary Study of Thermo-dynamics and Physical Chemistry of Metal Melt and Slag Encountered in Production of Ferrochromium	Dr. Mica Grujicic
PAG-006	Exposed Arc Length Impact on Furnace Heat Transfer	Dr. R.S. Figliola
PAG-005	Results of the Transient Heat Transfer Study (Part I: cold start up)	Dr. R.S. Figliola
PAG-004	Plasma Arc - Results of the Steady State Heat Transfer Study	Dr. R.S. Figliola
PAG-003	Design Specifications for Instru-mentation Data Acquisition and Control	Dr. J.B. Riester
PAG-002	Specifications and Requirements for the Off-Gas System	Dr. J.B. Riester
PAG-001	Literature Survey Concerning Present Plasma Arc Technology	Dr. L.P. Golan

Student Reports/Thesis

PAG-007	Anode Design for Plasma Arc Furnaces, Dec. 1990, Master Thesis, Dec. 1989	Mark Andrew Cote Dr. L.P. Golan, Research Advisor
PAG-0	A Material and Energy Balance of a Plasma Arc Furnace, Dec. 1990	Bill Novak, Senior Honors Student Dr. J.B. Riester, Research Advisor
PAG-008	A Thermal Finite Element Analysis for a Plasma Arc Furnace Master's Thesis, Dec. 1990	Christopher Dugail Dr. R.S. Figliola, Research Advisor
PAG-010	Off Gas Cleaning and Heat Recovery for a Plasma Arc Furnace, May 1991	Dan Townsend, Honors 415 Research Project Dr. J.B. Riester, Research Advisor