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ALLOY EVALUATION FOR FOSSIL FUEL
PROCESS PLANTS (LIQUEFACTION)

Quarterly Report

1 January 1978 through
31 March 1978

C.M. Woods and T. E. Scott

Work performed Under Contract
No. W-7405-eng-82

Ames Laboratory
Iowa State University
Ames, Iowa 50011

MASTER

U. S. DEPARTMENT OF ENERGY

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AMES LABORATORY

Iowa State University

Ames, Iowa 50011

April 15, 1978

PREPARED FOR THE UNITED STATES DEPARTMENT OF ENERGY

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FOREWORD

This report covers work performed during the period 1 January, 1978 through 31 March, 1978. The work was administered by the Division of Materials and Exploratory Research with Mr. Wate Bakker as project manager. The report was prepared by Charles M. Woods and T. E. Scott of the Mechanical Properties Section in the Metallurgy and Ceramics Division at the DOE - Ames Laboratory, Ames, Iowa.

The work was performed under the direction of Dr. Scott as principal investigator assisted by: C. M. Woods, S. Shei, C. V. Owen and L. K. Reed.

ABSTRACT

Pressure vessels have been received, installed, and are presently being checked out. Control systems have been wired in and calibrated. The coal slurry has been ordered and shipped. We are presently waiting its arrival.

OBJECTIVE AND SCOPE

The objective of this program is to evaluate the mechanical properties of liquefaction process plant "dissolver" vessel materials in a "dissolver" vessel environment including coal slurry and pressurized hydrogen gas at temperatures up to 900°F.

Specifically, the degradation of notched-bar and smooth bar tensile samples of 2 1/4 Cr - 1 Mo will be monitored as a function of exposure time and stress in the "dissolver" vessel environment.

Progress Summary

This quarter was spent entirely on installing and debugging the newly acquired pressure vessels and their controlling circuitry. The vessels were installed in the Ames Lab explosion-safe, hydrogen-containment building, specially designed for this program. Leak checks of 24 to 72 hours were performed on the vessels at pressures ranging from 1000 to 5000 psig at temperatures of 72°F and 800°F. Automatic pressure and temperature monitoring controls were tested and calibrated. Pressure vessel furnaces were installed and are being tested. Containment building safety systems including hydrogen detectors, vessel over-pressure alarms, vessel over-temperature alarms, hydrogen check valves, surge valves, power failure emergency backup systems and fire alarms were tested and found satisfactory. Individual pressure vessel containment cell blow out panels and cell ventilation systems were found to be satisfactory.

Procedures for the operation and maintainance of the vessels and controls as well as safety procedures for routine check-out of safety systems and emergency situations have been outlined and are presently being integrated into a procedural safety manual for the test facility.

Work Forecast

Testing will resume during the next quarter and, despite the equipment delays, it is possible that all test conditions indicated in the FY 1978 test matrix, Table 1, will be completed on schedule.

TABLE #1

FY 1978 TEST MATRIX

Test	Type	Exposure Conditions				Exposure ^A Stress (KSI)	Test Conditions ^{A,B}			
		Temp. (°F)	Pressure (Psig)	Envir- onment	Time (HRS)		Temp. (°F)	Pressure (Psig)	Envir- onment	Number of samples
23	Smooth	500	2000	Slurry-H ₂	1	-	500	2000	Slurry-H ₂	10
24	Notched	500	2000	Slurry-H ₂	1	-	500	2000	Slurry-H ₂	10
25	Smooth	900	2000	Slurry-H ₂	1	-	900	2000	Slurry-H ₂	10
26	Notched	900	2000	Slurry-H ₂	1	-	900	2000	Slurry-H ₂	10
27	Smooth	500	2000	Argon	1	-	500	2000	Argon	10
28	Notched	500	2000	Argon	1	-	500	2000	Argon	10
29	Smooth	900	2000	Argon	1	-	900	2000	Argon	10
30	Notched	900	2000	Argon	1	-	900	2000	Argon	10
31	Smooth	500	4000	Argon	1	-	500	4000	Argon	10
32	Notched	500	4000	Argon	1	-	500	4000	Argon	10
33	Smooth	900	4000	Argon	1	-	900	4000	Argon	10
34	Notched	900	4000	Argon	1	-	900	4000	Argon	10
35	Smooth	500	4000	Slurry-H ₂	1	-	500	4000	Slurry-H ₂	10
36	Notched	500	4000	Slurry-H ₂	1	-	500	4000	Slurry-H ₂	10
37	Smooth	900	4000	Slurry-H ₂	1	-	900	4000	Slurry-H ₂	10
38	Notched	900	4000	Slurry-H ₂	1	-	900	4000	Slurry-H ₂	10
39	Smooth	500	2000	Slurry-H ₂	168	0	Ambient	Ambient	Air	10
40	Notched	500	2000	Slurry-H ₂	168	0	Ambient	Ambient	Air	10
41	Smooth	900	2000	Slurry-H ₂	168	0	Ambient	Ambient	Air	10
42	Notched	900	2000	Slurry-H ₂	168	0	Ambient	Ambient	Air	10
43	Smooth	500	4000	Slurry-H ₂	168	0	Ambient	Ambient	Air	10
44	Notched	500	4000	Slurry-H ₂	168	0	Ambient	Ambient	Air	10
45	Smooth	900	4000	Slurry-H ₂	168	0	Ambient	Ambient	Air	10
46	Notched	900	4000	Slurry-H ₂	168	0	Ambient	Ambient	Air	10
47	Smooth	500	2000	Slurry-H ₂	168	25 ^C	Ambient	Ambient	Air	10
48	Notched	500	2000	Slurry-H ₂	168	25 ^C	Ambient	Ambient	Air	10
49	Smooth	900	2000	Slurry-H ₂	168	25 ^C	Ambient	Ambient	Air	10
50	Notched	900	2000	Slurry-H ₂	168	25 ^C	Ambient	Ambient	Air	10
51	Smooth	500	4000	Slurry-H ₂	168	25 ^C	Ambient	Ambient	Air	10
52	Notched	500	4000	Slurry-H ₂	168	25 ^C	Ambient	Ambient	Air	10
53	Smooth	900	4000	Slurry-H ₂	168	25 ^C	Ambient	Ambient	Air	10
54	Notched	900	4000	Slurry-H ₂	168	25 ^C	Ambient	Ambient	Air	10
55	Smooth	500	4000	Argon	Failure ^D	Various	-	-	-	12 ^E
56	Notched	500	4000	Argon	Failure ^D	Various	-	-	-	12 ^E
57	Smooth	900	4000	Argon	Failure ^D	Various	-	-	-	12 ^E
58	Notched	900	4000	Argon	Failure ^D	Various	-	-	-	12 ^E
59	Smooth	500	4000	Slurry-H ₂	Failure ^D	Various	-	-	-	12 ^E
60	Notched	500	4000	Slurry-H ₂	Failure ^D	Various	-	-	-	12 ^E
61	Smooth	900	4000	Slurry-H ₂	Failure ^D	Various	-	-	-	12 ^E
62	Notched	900	4000	Slurry-H ₂	Failure ^D	Various	-	-	-	12 ^E

A All loading is in tension

B Constant cross-head rate of 0.05 inch/min.

C Loading via precompressed rings

D Stress-rupture tests: Until failure or 1000 Hours whichever comes first

E Two samples at each of 6 different stress levels

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