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SUBJECT: Test of HRT Recombiners

TO: S. E. Beall

FROM: B. A. Hannaford

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TEST OF HRT RECOMBINERS

SUMMARY

Tests of the HRT fuel and blanket recombiners at several gas concentrations and steam rates disclosed satisfactory efficiency at approximately design conditions. At lower gas concentrations and steam flow rates a small recombiner downstream from the condenser is necessary to maintain 100 per cent recombination.

It is recommended that: 1) the platinized catalyst in the fuel and blanket HRT recombiners not be replaced and 2) a small recombiner be installed in the 1-in. off-gas line from each recombiner condenser.

TEST DESCRIPTION

Figure 1 is a schematic diagram of the equipment used in the test. Oxygen and hydrogen were metered into the flowing steam and the mixture passed through the recombiner bed into the condenser. Condensate overflowed from the separator tank through a water seal. Measuring this flow rate at the beginning and end of each run served to confirm the steam orifice measurements.

Residual gas flowed into the explosion meter detecting head, where hydrogen concentration was continuously measured. The flow could be valved directly from the separator tank to the explosion meter, or through the small after recombiner. The latter consisted of a 5-in. long section of 1-in. pipe, containing a roll of platinized wire mesh, and heated by an external steam coil.

DISCUSSION OF RESULTS

Table I summarizes the results of this test. Existing steam service at the test site did not permit a rate as high as HRT design; therefore, the highest flow reported is 300 lbs/hr. Steam pressure on the recombiner steam coil was 100 psi instead of 250 psi, for the same reason.

Values for stoichiometric gas concentrations and steam rates were suggested by Van Winkle¹. Efficiency is defined as simply: H_2 recombined/ H_2 fed. The gas temperature and efficiency obtained on the fuel and blanket recombiners

at 8 per cent stoichiometric gas concentration compare favorably with results obtained at the time the recombiners were installed at the reactor¹. Therefore, if loss of platinum occurred in the interval between the two tests, the loss was not great enough to affect recombination at near design conditions.

At stoichiometric gas concentrations of 0.8 and 0.08 per cent, a small after recombiner, suggested by Spiewak and Van Winkle, proved adequate to maintain 100 per cent recombination. A test made on the after recombiner only, with no steam diluent, demonstrated that adequate heat dissipation from the unit occurred, even at a flow of 750 cc/min stoichiometric gas. Steam pressure of 10 psi on the after recombiner steam coil was necessary to start the reaction. Once started, the reaction proceeded with no steam pressure on the coil.

An analysis of this test data has been reported by McLain².

CONCLUSIONS

The platinized catalyst in the fuel and blanket recombiners need not be replaced. A small recombiner section of platinized wire mesh should be installed in the off-gas line from each recombiner condenser.

¹R. Van Winkle, Personal Communication.

²H. A. McLain, After Recombiners for the HRT, ORNL-CF-57-8-78, August 15, 1957.

B. A. Hannaford
B. A. Hannaford

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FIGURE 1. Schematic Diagram of Test Equipment.

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TABLE I

TESTS MADE ON THE HRT RECOMBINERS

<u>Gas Temp. Recombiner Outlet, °F</u>	<u>Inlet Steam Rate lb/hr</u>	<u>Inlet Hydrogen Rate cc/min(STP)</u>	<u>Inlet Oxygen Rate cc/min(STP)</u>	<u>% Excess Oxygen</u>	<u>Stoichiometric Gas Concentration %</u>	<u>Exit Hydrogen Rate cc/min(STP)</u>	<u>Efficiency %</u>
BLANKET RECOMBINER							
690	300	(5.52 cu ft)	(4.50 cu ft)	63	8	0	100
635	200	(3.70 cu ft)	(2.25 cu ft)	20	8	28.5 ¹	99.97 ¹
265	120	5585	3500	25	0.8	21.6	99.6
260	120	5700	3550	25	0.8	47.6	99.2
260	120	5650	4400	55	0.8	53.5	99.1
250	120	560	580	107	0.08	1.8	99.7
FUEL RECOMBINER							
670	300	(5.60 cu ft)	(4.5 cu ft)	60	8.0	0	100
260	120	6000	3450	15	0.8	32	99.5
230	120	540	570	110	0.08	6	99.45
FUEL RECOMBINER PLUS AFTER RECOMBINER							
260	120	6000	3450	15	0.8	0	100
AFTER RECOMBINER ONLY							
90 ²	None	500	750	200	60	0	100

¹Based on gas bomb analysis.²Temperature of gas leaving the after recombiner.

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OAK RIDGE, TENNESSEE

October 30, 1957

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Gentlemen:

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CF 57-10-24 (Unclassified)
CF 57-10-48 (Unclassified) ✓

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Very truly yours,

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N. T. Bray, Supervisor
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