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SUBJECT: Efficiency of Fuel System Entrainment Separator
During Normal Operation, HRT Report II A (7c)b

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EFFICIENCY OF FUEL SYSTEM ENTRAINMENT
SEPARATOR DURING NORMAL OPERATION,
HRT Report II A (7c)b

Summary

During the preliminary testing of the fuel low-pressure system, the performance of the entrainment separator was checked by analyzing samples of the condensate from the condenser while boiling trisodium phosphate solution in the dump tanks. Samples were also taken from the dump tanks to establish the concentration there. Runs were made with tank levels between 95 and 600 liters, steam pressures from 30 to 100 psig and with and without cooling water passing through the coils in the entrainment separator. The decontamination factor, defined as the ratio of sodium concentration in the dump tank to that in the condensate, was in the range from 1000 to 10,000 in all runs. There was considerable scatter of the data and no clear relation between the decontamination factor and steam pressure or dump tank level was observed. The data are tabulated in Table I. In Fig. 1 the decontamination factor is plotted against steam pressure.

TABLE I

Entrainment During Normal Operation

Run	Dump Tank Level Liters	Steam Pressure Psig	Evaporation Rate lb/min	Cooling Water	Decontamination Factor
1	600	30	5.0	On	1000
2	520	60	9.3	On	1900
3	510	100	13.5	On	3800
4	140	30	5.0	On	1700
5	130	60	9.3	On	3900
6	120	90	12.5	On	2500
7	105	30	5.0	Off	7400
8	95	60	9.3	Off	4000
9	95	90	12.5	Off	7400

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Dump tank solution concentrations varied from 1.78 g Na⁺ per kilogram of solution to 7.4 g Na⁺/kg, while sodium concentrations in the condensate samples were reported to lie in the range <0.05 to 2 ppm. Analyses for sodium were performed by two different laboratories, with fair agreement in most of the cases where duplicate samples were submitted to each laboratory.

Test Procedure

A schematic diagram of the lines and equipment involved in the entrainment tests is shown in Fig. 2,

The normal operation entrainment tests were carried out as follows: The dump tanks were partially filled with distilled water and the evaporators operated for some time to rinse out the condenser and condensate drain line. A sample was taken from line 119 (condensate drain line) to determine the cleanliness of the system at this point. A concentrated solution of trisodium phosphate was then added to the dump tanks. The evaporator steam was turned on, first at low pressure to mix the dump tank contents and then at the desired test pressure. When steady state was reached, valve 335 was closed and the condensate diverted to the condensate storage tank. The net evaporation rate was determined by timing the increase in the weight in the condensate tank. Samples were then taken from the sample point in line 119 and from the dump tank drain line which was attached near the junction of line 107 with 107a and 107b. Sufficient liquid was drained through the lines before taking a sample that the sample was deemed to be representative. After the evaporation rate had been established, the condensate tank was drained back to the dump tanks and the steam pressure on the evaporators increased to the next higher test pressure.

PNH:be

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Figure 2
Equipment Diagram