UNCLASSIFIED

OAK RIDGE NATIONAL LABORATORY

Operated By

UNION CARBIDE NUCLEAR COMPANY

UCC

1

POST OFFICE BOX P
OAK RIDGE, TENNESSEE ORNL
CENTRAL FILES NUMBER

CF- 57-4-137

"EXTERNAL TRANSMITTAL AUTHORIZED"

COPY NO. 66

DATE: April 17, 1957

SUBJECT: Observed Pressure Drop Across HRT Off-Gas Adsorber Units
(Charcoal Beds) at Various Flows of Oxygen

TO: S. E. Beall

FROM: R. Van Winkle

DISTRIBUTION

1. HRP Director's Office	20. R. J. Harvey	40. C. L. Segaser
2. W. L. Albrecht	21. P. N. Haubenreich	41. A. J. Sharenberger
3. H. F. Bauman	22. J. W. Hill, Jr.	42. M. J. Skinner
4. S. E. Beall	23. J. P. Jarvis	43. I. Spiewak
5. N. C. Bradley	24. R. W. Jurgensen	44. W. Terry
6. N. A. Brown	25. S. I. Kaplan	45. R. Van Winkle
7. J. R. Buchanan	26. J. O. Kolb	46. W. E. Unger
8. W. D. Burch	27. J. A. Lane	47. B. H. Webster
9. R. D. Cheverton	28. M. I. Lundin	48. K. W. West
10. C. W. Collins	29. H. A. McLain	49. R. H. Winget
11. J. S. Culver	30. H. M. McLeod	50. F. C. Zapp
12. J. R. Engel	31. R. A. McNees	51. ORNL Doc. Reference
13. J. D. Flynn	32. R. C. Moren	Library, Y-12
14. D. F. Frech	33. R. M. Pierce	52. Central Res. Library
15. C. H. Gabbard	34. D. M. Richardson	53-54 REED Library
16. W. R. Gall	35. G. W. Rivenbark	55-57 Laboratory Records
17. T. H. Gladney	36. R. C. Robertson	<u>EXTERNAL DISTRIBUTION</u>
18. R. H. Guymon	37. J. N. Robinson	58. F. C. Moesel, AEC
19. P. H. Harley	38. R. E. Schappel	59-65 Westinghouse PAR Project
	39. H. K. Search	66-80. TISE-AEC

NOTICE

This document contains information of a preliminary nature and was prepared primarily for internal use at the Oak Ridge National Laboratory. It is subject to revision or correction and therefore does not represent a final report.

UNCLASSIFIED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

LEGAL NOTICE

This report was prepared as an account of Government sponsored work. Neither the United States, nor the Commission, nor any person acting on behalf of the Commission:

- A. Makes any warranty or representation, express or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or
- B. Assumes any liabilities with respect to the use of, or for damages resulting from the use of any information, apparatus, method, or process disclosed in this report.

As used in the above, "person acting on behalf of the Commission" includes any employee or contractor of the Commission to the extent that such employee or contractor prepares, handles or distributes, or provides access to, any information pursuant to his employment or contract with the Commission.

OBSERVED PRESSURE DROP ACROSS HRT OFF-GAS ADSORBER UNITS
(CHARCOAL BEDS) AT VARIOUS FLOWS OF OXYGEN

Summary:

A plot of the pressure-drop data shows that the pressure drop through a single HRT adsorption unit may be calculated by the simple equation:

$$\Delta P = 2.66 \times \text{oxygen flow}$$

where ΔP = pressure drop, psi

Flow = liters/min (measured at 70°F, 14.7 psia)

Experimental Limits:

Flow: From 0 to 1.5 liters/min

Temperature Range: 16 - 20°C

Oxygen Pressure in Charcoal Units: ΔP , psig, at inlet end to essentially atmospheric at exit end

Experimental Method:

Fig. 1

Oxygen was injected into the inlet end of a charcoal adsorption unit. The gas passes successively through 40-ft lengths of 1/2-in., 1-in. and 2-in. pipe and a 60-ft length of 6-in. pipe packed with charcoal. The inlet flow was controlled by a throttling valve and measured by reading a calibrated rotameter which was kept at a constant pressure, as indicated by a pressure gauge downstream from the rotameter. The outlet flow of oxygen was measured by reading the outlet rotameter which discharged directly to the atmosphere. The pressure drop was measured by reading the inlet pressure at the charcoal unit, using either a 0-15-psi pressure gauge, or a manometer. The pressure drop through the 1/8-in. I.D. tubing connecting the outlet rotameter to the discharge end of the charcoal unit was neglected, since it was estimated to be less than 0.1 psi at the maximum flow.

The charcoal units were immersed in water, which was kept at reasonably constant temperature by maintaining a flow of cooling water through the charcoal pit. The water temperature varied between 16 and 20°C during the several days and nights of the testing.

A number of readings of inlet and outlet flows and pressure drops were taken at a given inlet flow until the indicated inlet and outlet flows were approximately equal. It was difficult to reach a steady-state because slight changes in charcoal temperature would result in the adsorption or desorption of relatively large volumes of gas.

Later, measurements of the adsorptive capacity of charcoal for oxygen as a function of temperature showed that at 15°C and 740 mm Hg total oxygen pressure, the 520 pounds of charcoal in a single HRT adsorption unit would contain about 2240 liters (STP) of oxygen; about 2077 liters (STP) would be adsorbed at 20°C and 740 mm. Thus, if the charcoal temperature increased from 15 to 16°C, about 33 liters of oxygen could be released. Maximum flows of approximately 1.5 liters/min were used, so it usually took several hours at a given temperature to approach equality between inlet and outlet flow.

Conclusions:

It is unlikely that true steady-state flow (with no adsorption or desorption occurring) was attained in any of the runs reported; however, the best points of many readings on each of the four units are plotted in Fig. 2. The pressure drop appears to vary linearly with flow within the flow range of interest (0 to 1.5 liters/min per bed).

The reported pressure drops are sufficiently accurate to show that there will be approximately equal flow through each bed when two or three beds are operated in parallel, and to be used as an indication of off-gas flow rate, if necessary.

Fig. 2. Pressure Drop vs. Oxygen Flow; HRT Off-gas Adsorption Units.

Appendix:

Charcoal units 10a, 10b, and 10c each contain about 520 pounds of Columbia activated charcoal, Grade G, 8-10 mesh. Each unit is composed of successive lengths of the following sizes of Schedule 5 stainless-steel pipe:

2 20-ft lengths 1/2-in.

2 20-ft lengths 1-in.

2 20-ft lengths 2-in.

3 20-ft lengths 6-in.

Charcoal unit 10d is identical with the other units except it has only 2 lengths of 6-in. pipe, and contains an estimated 360 pounds of charcoal.

The pressure drop data used in Fig. 2 are located on pages 7, 15, 16, and 27 of the HRT Data Log Book. Dates of the testing were 4-26-56, 4-27-56, 5-1-56; 5-4-56 to 5-8-56.

R. Van Winkle

RVW:be