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A-3661

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CARBIDE AND CARBON CHEMICALS CORPORATION

PROCESS DIVISION

PROCESS DESIGN AND DEVELOPMENT DEPARTMENTS

Report No: A-3661
4.81.1

AEC RESEARCH AND DEVELOPMENT REPORT

Date: December 6, 1946

Written by: R. M. Vail
L. X. Chervenak

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ALUMINA TRAP TESTS

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CARBIDE AND CARBON CHEMICALS CORPORATION

PROCESS DIVISION

PROCESS DESIGN AND DEVELOPMENT DEPARTMENTS

Report No: A-3661
4.31.1

Date: December 6, 1946

TO: Mr. L. P. Huber

ALUMINA TRAP TESTS

Written by: R. M. Vail
M. C. Chervenak

The attached report by R. M. Vail and M. C. Chervenak presents the results obtained from C-616 adsorption tests in alumina traps at low C-616 concentrations.

It was on the basis of these tests that traps with bed dimensions of 4" x 36" and 6" x 36" were recommended for the 302-5 cold trap room, and purge and product room respectively. In addition it is recommended that two traps in series each with a bed 2" x 36" be used in the K-312 buildings.

A. A. Abbatiello

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CARBIDE AND CARBON CHEMICALS CORPORATION

PROCESS DIVISION

PROCESS DESIGN AND DEVELOPMENT DEPARTMENTS

Report No: A-3661
4.81.1

Date: December 6, 1946

ALUMINA TRAP TESTS

Written by: R. M. Vail
M. C. Chervenak

Abstract:

The results from C-616 adsorption tests performed on 2" diameter and 5" diameter alumina traps at various inlet concentrations of C-616 and flow rates are presented. The trap sizes required in the K-312 and K-302-5 cold trap and purge rooms under present conditions are given.

Introduction:

Recently it became necessary to design alumina traps which would satisfy special hazards and recovery requirements for the top purge effluent and for waste gases in K-302-5 cold trap rooms. A review of the literature by R. C. Olson revealed that there was no data available on the effectiveness of alumina as an adsorbent when the concentrations of C-616 feed to the trap was low. Since the maximum diameters of the traps are fixed by special hazards considerations the design depended only upon the

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height and the arrangement necessary for effective recovery. A short test program, based on Mr. Olson's recommendation, was undertaken to determine the characteristics of alumina traps within the range of conditions to be met at the proposed installations.

Summary:

1. The trap with a bed diameter of 5" and a height of 15" reduced the C-616 concentration from 0.6 mol percent to 6×10^{-5} mol percent .0006 and from 0.2 mol percent to 1×10^{-5} mol percent when operated with .0001 a contact time of 3 seconds.
2. The trap with a bed diameter of 2" and a height of 36" reduced the C-616 concentration from 0.2 mol percent to 1×10^{-6} mol percent .000001 when operated with a contact time of 3 seconds.
3. For a given inlet concentration and trap diameter halving the flow rate or doubling the trap length will decrease the outlet concentration by approximately a factor of two.
4. A comparison of the 5" trap with the 2" trap indicates a more effective stripping in the 2" trap at the same contact time due possibly to the higher surface velocity or higher h/D ratio. This was not investigated completely.
5. The following installations are recommended:
   (a) K-312 purge rooms — Two traps 2" in diameter with 36" bed heights connected in series.

(b) K-302-5 purge and product room -- Two traps 6" in diameter with 36" bed heights connected in series.

(c) K-302-5 cold trap room -- Two traps 4" in diameter with 36" bed heights connected in series.

In each case, one trap at a time may be taken off stream for servicing without undue loss.

Procedure:

The test loop, which was located in Bldg. K-1401, is shown in Fig. 1. It consisted of a G-74 supply, a 3.5 CFM capacity rotameter, a C-616 supply can, two alumina traps in series, and a carbon trap to remove all traces of C-616 from the alumina trap effluent before venting it to the atmosphere. Sample taps were placed at various points in the loop lines to facilitate sampling by the lab, and by means of paper type trace indicators. The test runs were made at atmospheric pressure.

The inlet concentration of the gas mixture to the first alumina trap was controlled by regulating the temperature of the cold bath around the C-616 cylinder, and the actual concentration determined by lab analyses of samples removed from sampling tap "A". The effluent gas concentrations from the first trap, position "B", (which coincided with the inlet concentrations of the second trap) and the effluent gas concentrations from the second trap, position "C", were measured by means of the paper type trace indicators.

Runs were made in the following manner:

1. The cold bath was brought to the temperature desired, and held for an hour to insure complete cooling of the C-616 can.

2. The G-74 supply was turned on, the flow set at the desired rate by means of the rotameter, and the stream allowed to pass through the C-616 can for 3 minutes.

3. Laboratory samples were taken at the sample point "A" to determine the inlet concentration.

4. Trace indicator samples were taken alternately at points "B" and "C", allowing different amounts of gas to pass through each test paper so that the actual amount of C-616 on the paper was within the effective range for semi-quantitative determination. The volumes of gas passed through the test papers were measured by means of a wet test meter calibrated in thousandths of a cubic foot.

Tests were run on the 5" diameter traps first, then on the 2" diameter traps, with different charges of alumina, and then check runs were made on the 5" traps. In the 2" trap the charges were as follows:

(a) New charge -- 36" bed.

(b) Charge from second trap split into 15" bed in each trap.

(c) Charge from second 5" trap -- 36".

(d) Charge from first 5" trap -- 36" bed.

The data obtained on these tests are presented in Table I.

The column headings in Table I are explained as follows:

Run Numbers: The run numbers were chosen arbitrarily. The "a" runs refer to the first trap in series, "b" the second trap in series, and "a + b" to the overall effect of both traps in series.

Inlet Concentration: The inlet concentrations in mol % were determined by laboratory analysis or by trace indicator tests (in the case of the low concentrations). A lab sample was not taken for each run, but at each combination of C-616 supply temperature and G-74 flow rate.

Flow Rate: The flow rates were read directly from the rotameter as CFM.

Surface Velocity: The surface velocity in ft/min. is a superficial value in that the bed is assumed to be empty. Thus

$$\frac{\text{Rate (CFM)}}{\text{Cross-Sectional Area}} = \text{Ft/min.}$$

Contact Time: The contact time in seconds is a superficial value as here again an empty bed is assumed.

$$\frac{\text{Volume of Bed}}{\text{Rate (CFM)}} \times 60 = \text{Seconds.}$$

Outlet Concentration: The outlet concentration in mol % was measured in all cases by trace indicator tests. By comparing the color of the spot paper after moistening with potassium-ferrocyanide to a standard color chart, the number of micrograms of C-616 adsorbed can be estimated. From the micrograms of C-616 and the volume of gas that was measured by the wet test meter as having passed through the paper, the mol % C-616 can be calculated.

$$\frac{\text{Micrograms}}{\text{Cu. Ft.}} \times (2.4 \times 10^{-7}) = \text{mol \% C-616.}$$

Discussion:

The results of the tests, tabulated in Tables I and II, are shown graphically in Figure 2. This is a plot of outlet concentration of C-616 against contact time for fixed inlet concentration and trap diameter. As expected, decreasing the flow rate or increasing the trap length (or the number of traps in series) decreases the outlet concentration. However, the outlet concentration appears also to decrease with decreasing trap diameter. The effect was not investigated further, but the tests on the 5" trap were assumed to apply to the 4" and 6" sizes considered for 302-5 and the tests on the 2" trap are directly applicable to conditions in K-312.

That the difference between the 5" traps and the 2" traps was not due to a difference in the alumina charge was shown when a sample of the alumina from the 5" trap was charged to the 2" trap and tested.

In applying the results of these tests to conditions in K-25, the following conditions were assumed:

	K-312	K-302-5 C.T.	K-302-5 P.&P.
Max. Purge Rate - CFM	2.0	10	15
Normal Purge Rate - CFM	0.8	3.5	5
Max. C-616 Conc. - Mol %	0.2	0.2	0.2
Max. Allowable Conc. in Exhaust Gas -- Mol %	10^{-6}	10^{-5}	10^{-5}

The alumina trap installations recommended are, in each case, two traps in series with a bed height in each trap of 36". The K-312 traps to be 2" I.D., the 302-5 cold trap room traps to be 4" I.D., and the 302-5 purge and product room traps to be 6" I.D. A design for these traps is given in Figures 3 and 4. In each case one trap will handle the normal purge rate while the second trap is being recharged.

R. M. Vail
R. M. Vail

M. C. Chervenak
M. C. Chervenak

/oc

TABLE I

5" TRAP — 15" DEEP BED

RUN #	INLET CONC. MOL % C-616	G-74 FLOW RATE CFM	SURFACE VEL. FT/MIN.	CONTACT TIME SEC.	OUTLET CONC. MOL % C-616
1a	.49	1.2	10	8.5	2×10^{-5}
1b	2×10^{-5}	1.2	10	3.5	6×10^{-6}
1a + b	.49	1.2	10	17	6×10^{-6}
2a	.69	3.5	30	2.9	5×10^{-5}
2b	5×10^{-5}	3.5	30	2.9	2×10^{-5}
2a + b	.69	3.5	30	5.8	2×10^{-5}
3a	.55	2.6	22	3.9	4×10^{-5}
3b	4×10^{-5}	2.6	22	3.9	1×10^{-5}
3a + b	.55	2.6	22	7.8	1×10^{-5}
4a	.19	3.5	30	2.9	8×10^{-5}
4b	8×10^{-5}	3.5	30	2.9	4×10^{-5}
4a + b	.19	3.5	30	5.8	4×10^{-5}
5a	.005	1.2	10	8.5	10^{-6}
6a	.010	3.5	30	2.9	2×10^{-5}
6b	2×10^{-5}	3.5	30	2.9	4×10^{-6}
6a + b	.010	3.5	30	5.8	4×10^{-6}
7a	.200	2.6	22	3.9	5×10^{-6}
7b	5×10^{-6}	2.6	22	3.9	2×10^{-6}
7a + b	.200	2.6	22	7.8	2×10^{-6}
8a	.100	3.5	30	2.9	1×10^{-5}
8b	1×10^{-5}	3.5	30	2.9	3×10^{-6}
8a + b	.100	3.5	30	5.8	3×10^{-6}

TABLE II

2" TRAP — 36" BED

RUN #	INLET CONC. MOL %	FLOW RATE SCFM	SURFACE VEL. FT/MIN.	SUPERFICIAL CONTACT TIME SECS.	OUTLET CONC. MOL. %
1a	.20	2.6	130	1.6	3.6×10^{-6}
1b	3.6×10^{-6}	2.6	130	1.6	6×10^{-7}
1a + b	.20	2.6	130	3.2	6×10^{-7}
2a	.15	1.3	65	3.0	10^{-6}
3a	.15	2.6	130	1.6	10^{-6}
4a	.15	3.5	175	1.2	10^{-6}
5a*	.15	3.5	175	1.2	10^{-6}
6a*	.15	2.6	130	1.6	10^{-6}
7a**	.15	2.6	130	1.6	10^{-6}
8a**	.15	2.6	130	1.6	10^{-6}
9a***	.15	1.4	70	1.2	10^{-6}

* 2" Trap — 36" Bed using charge from 5" Trap in 1b-7b runs.

** 2" Trap — 36" Bed using charge from 5" Trap in 1a-7a runs.

*** 2" Trap — 15" Bed.

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ALUMINA TRAP TEST LOOP

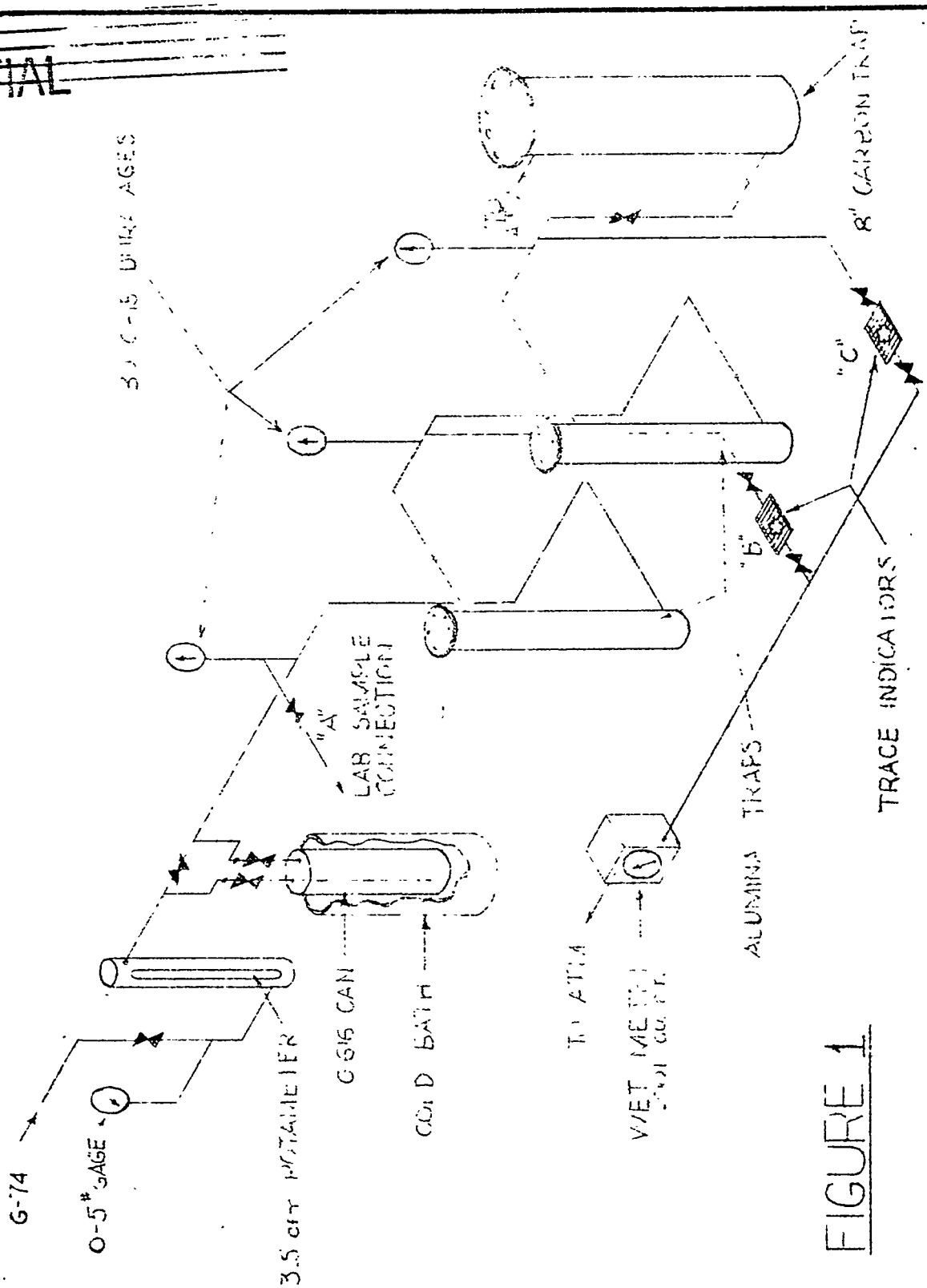

FIGURE 1

	REVISIONS	ALUMINA TRAP TEST LOOP	
NO.	DESCRIPTION	CARBIDE AND CARBON CHEMICALS CORPORATION	
		PLANT ENG. - DESIGN AND DEVELOPMENT DEPT.	
		DRAWN BY: [illegible]	APPV'D BY: [illegible]
		CHECKED BY:	DATE: 11-17-46
		SCALE: NONE	DWG. NO. 5-48

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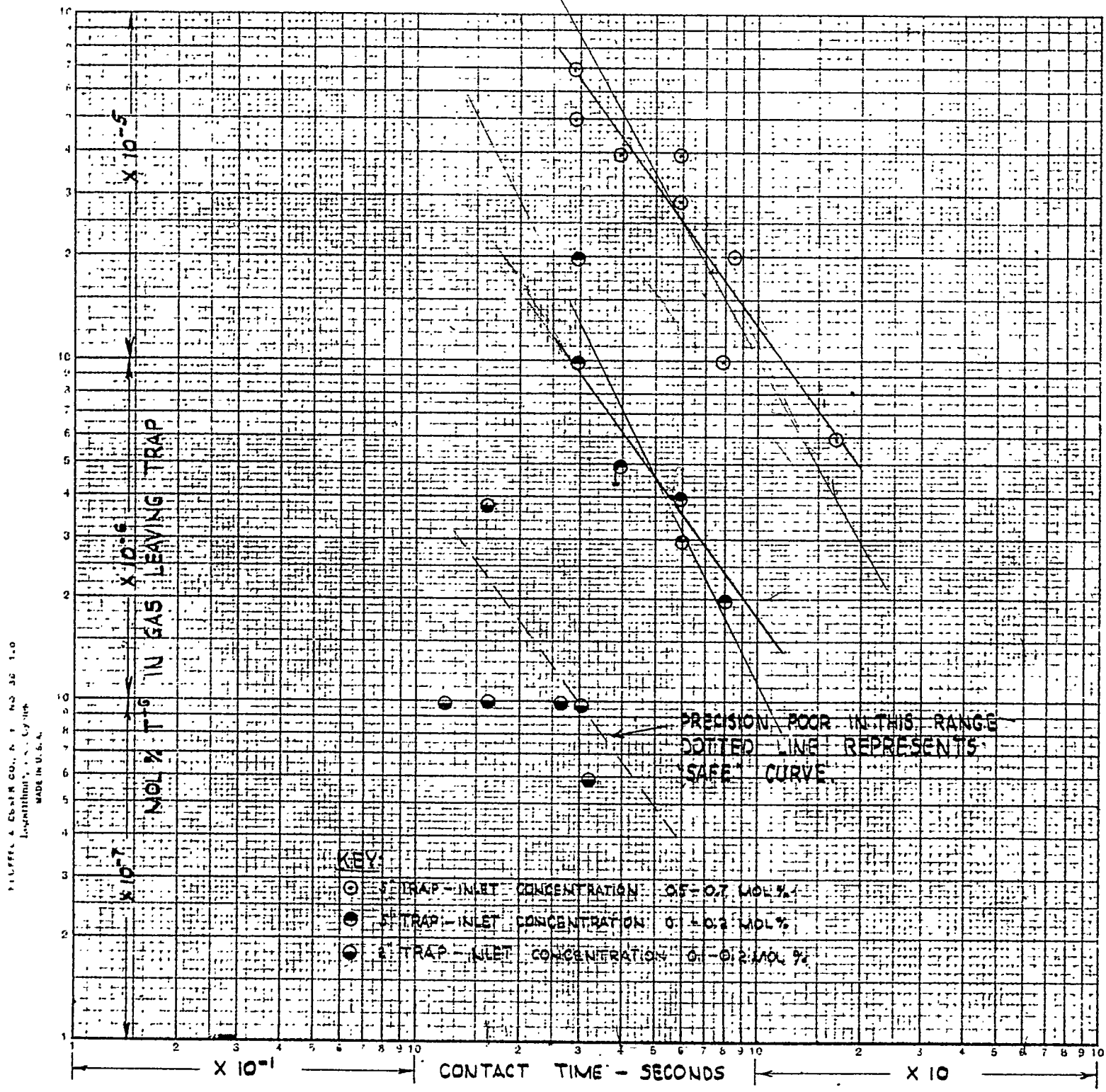

FIGURE 2

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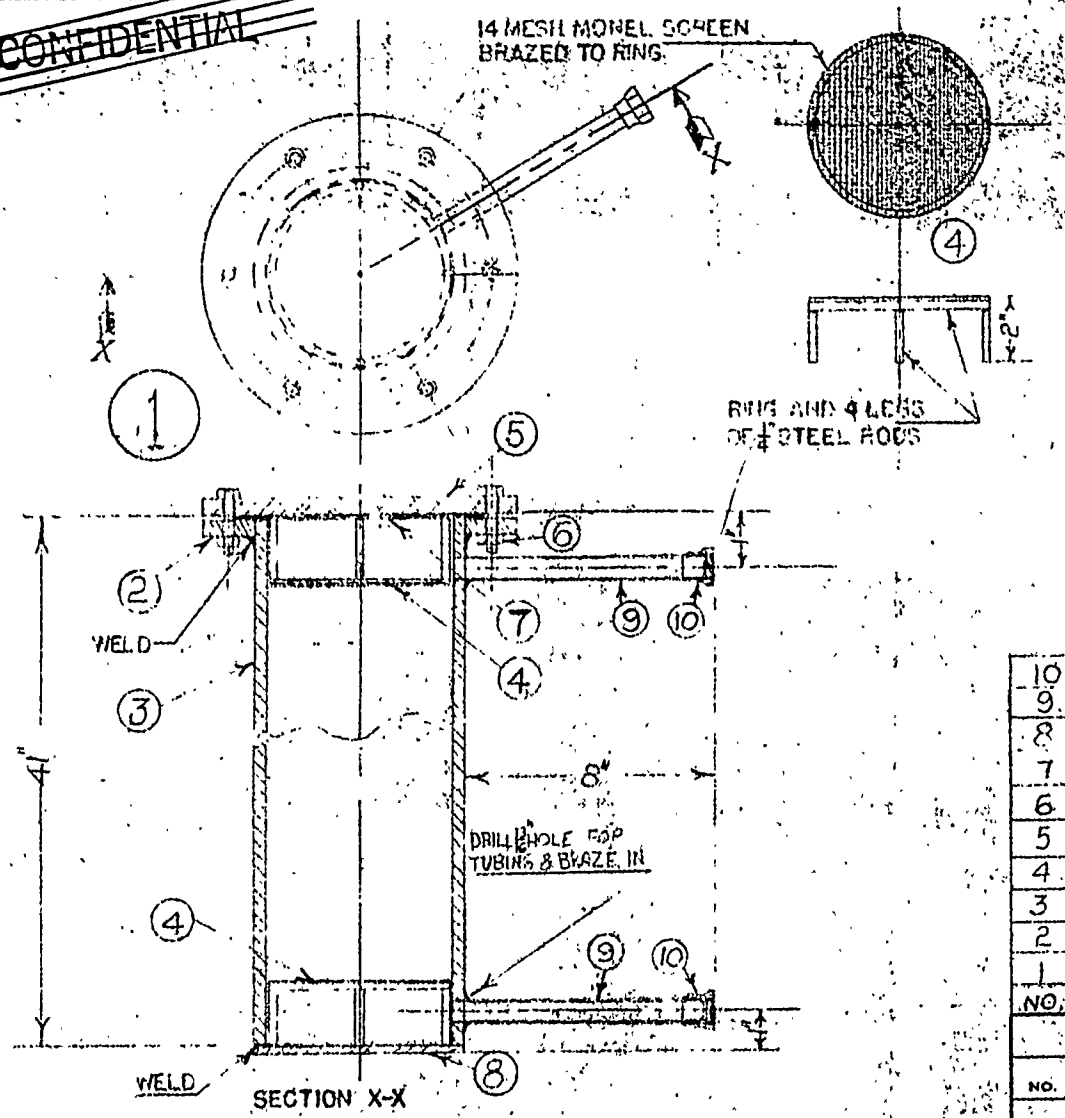

FIGURE 3

NOTE: TRAPS TO BE COATED WITH 0.016" CADMIUM AFTER ASSEMBLY.

2" TRAP

PART NO.	DESCRIPTION	REQ'D. PER ASS'Y
2	2 3/8" I.D. x 8" O.D. x 1/2" THICK; 6 EQ. SPACED BOLT HOLES 13/32" DIA. 4 3/4" B.C. DIA.	1
3	STANDARD 2" IRON PIPE, 2.07" I.D. x 2.375" O.D.	1
4	14 MESH MONEL SCREEN BRAZED TO 2" O.D. RING. MUST BE SLIDING FIT INSIDE TRAP.	2
5	6" O.D. BLIND FLANGE, 1/2" THICK, 6 EQ. SPACED BOLT HOLES 13/32" DIA. 4 3/4" B.C. DIA.	1
7	1/8" RUBBER GASKET, 2.07" I.D. x 4 1/2" O.D.	1
8	2 3/8" O.D. STEEL PLATE 1/4" THICK WELDED TO PIPE.	1

6" TRAP

PART NO.	DESCRIPTION	REQ'D. PER ASS'Y
2	6 5/8" I.D. x 10" O.D. x 1/2" THICK; 6 EQ. SPACED BOLT HOLES 13/32" DIA. 8 1/2" B.C. DIA.	1
3	STANDARD 6" IRON PIPE, 6.07" I.D. x 6.625" O.D.	1
4	14 MESH MONEL SCREEN BRAZED TO 6" O.D. RING. SLIDING FIT INSIDE TRAP.	2
5	10" O.D. BLIND FLANGE, 1/2" THICK, 6 EQ. SPACED BOLT HOLES 13/32" DIA. 8 1/2" B.C. DIA.	1
7	1/8" RUBBER GASKET, 6.07" I.D. x 8 1/2" O.D.	1
8	6 5/8" O.D. STEEL PLATE 1/4" THICK WELDED TO PIPE.	1

NO.	NAME OF PART	MATERIAL	DESCRIPTION	REQ'D. PER ASS'Y
10	FLARE FITTING	COPPER	3/4" FLARED TUBE NUT	2
9	TUBING	COPPER	1/2" DIA. x 8" LONG	2
8	BASE	STEEL	SEE CHART	1
7	GASKET	RUBBER	SEE CHART	1
6	BOLT & NUT	STEEL	3/8" x 2" HEX-HEAD BOLTS & NUTS	6
5	BLIND FLANGE	STEEL	SEE CHART FOR DIMENSIONS	1
4	SCREEN ASS'Y	MONEL & STEEL	SEE CHART	2
3	BODY	STD. IRON PIPE	SEE CHART	1
2	FLANGE	STEEL	SEE CHART	1
1	ASSEMBLY			1

REVISIONS		ALUMINA TRAP	
NO.	DESCRIPTION	CARBIDE AND CARBON CHEMICALS CORPORATION	
		PLANT WOX PROCESS DESIGN DEPARTMENT	
		DRAWN BY: SEXTON	APPV'D BY: RCOlson
		CHECKED BY: RMS	DATE: 10-2-46
		SCALE: 1/4" (6" TRAP)	DWG. NO. B-20063

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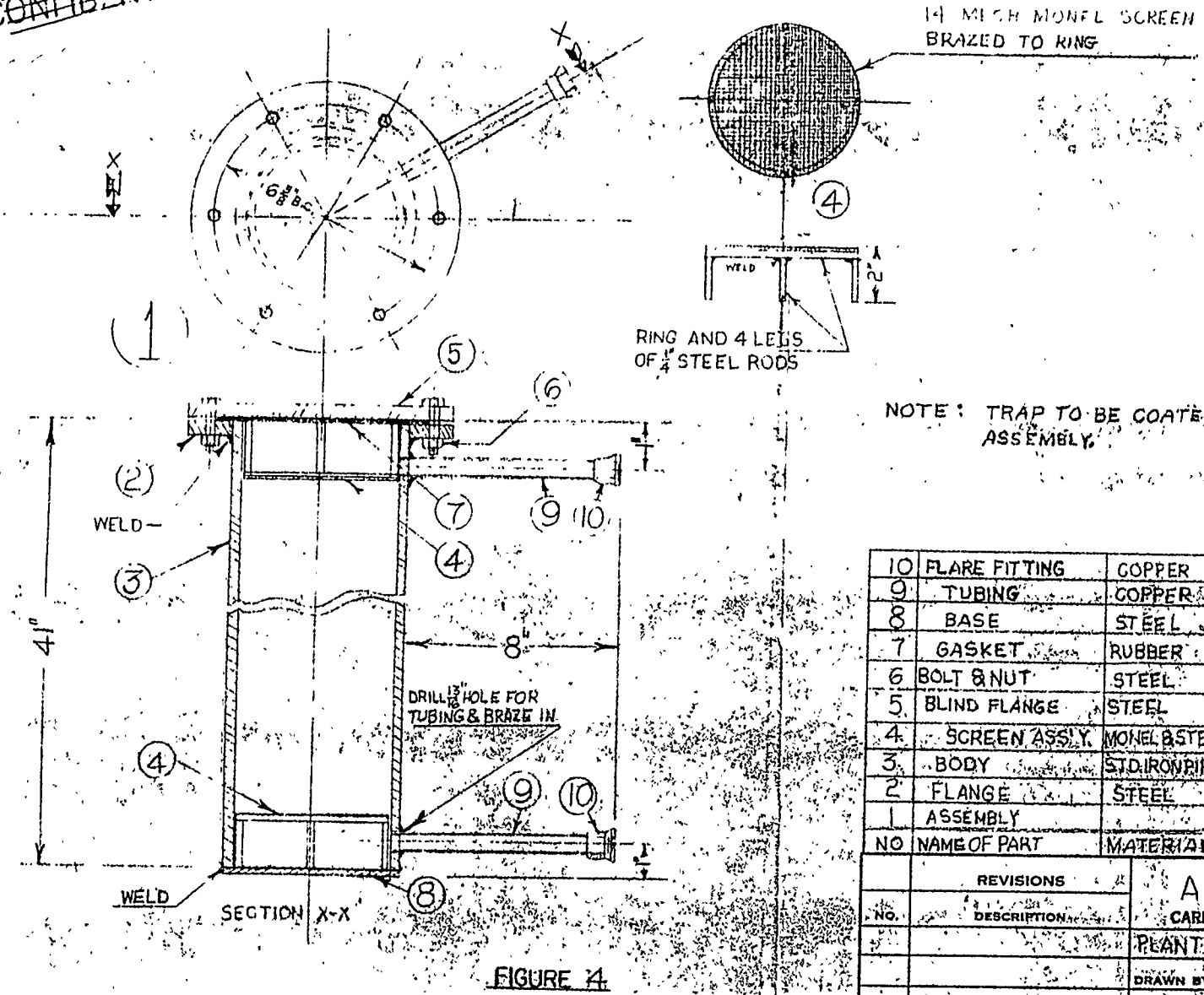

NOTE: TRAP TO BE COATED WITH 0.016" CADMIUM AFTER ASSEMBLY.

NO	NAME OF PART	MATERIAL	DESCRIPTION	REQ'D.
10	FLARE FITTING	COPPER	3/4" FLARED TUBE NUT	2
9	TUBING	COPPER	3/4" DIA. X 8" LONG 1/4" THICK.	2
8	BASE	STEEL	4 1/2" O.D. STEEL PLATE	1
7	GASKET	RUBBER	1/8" GASKET 4" I.D. X 6 3/8" O.D.	1
6	BOLT & NUT	STEEL	3/8" X 2" HEX-HEAD BOLTS & NUTS	6
5	BLIND FLANGE	STEEL	8" O.D. X 1/2" THK. 6 EQ. SPACED HOLES 13/32" DIA. 6 5/8" B.C.	1
4	SCREEN ASS'Y.	MONEL & STEEL	14 MESH MONEL SCREEN. 4" RING. (SLIDE FIT)	2
3	BODY	STD. IRON PIPE	STD. 4" IRON PIPE 4.026" I.D. X 4.5" O.D.	1
2	FLANGE	STEEL	4 1/2" I.D. X 8" O.D. X 1/2" THICK. 6 EQ. SPACED BOLT HOLES 13/32" D. 6 5/8" B.C.	1
1	ASSEMBLY			1

REVISIONS		ALUMINA TRAP-4"	
NO.	DESCRIPTION	CARBIDE AND CARBON CHEMICALS CORPORATION	
		PLANT WOX-PROCESS DESIGN DEPARTMENT	
		DRAWN BY: SEXTON	APPV'D BY: H.C. Olsen
		CHECKED BY: [illegible]	DATE: 11-19-46
		SCALE: NOT SCALED	DWG. NO. B-200-79

FIGURE 4

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To: Dr. H. C. Paxton

October 29, 1945

From: Sgt. J. F. Forkos

AEC RESEARCH AND DEVELOPMENT REPORT

Subject: Supplement #2 to Preliminary Results of Alumina Trap Adsorption Tests (Sept. 28, 1945)

CLASSIFICATION CHANGED TO
By authority of J. H. Kahn - 3-24-61 (Note from ORGDP Records Dept dated 11-28-67
By J. E. Arnwood Date 11-30-67

This report contains a summary of the tests performed thus for on the assorption of .05, 0.10, 0.20, and 0.50 mol % C-616 mixtures on dried Alorco 4-8 mesh Activated Alumina. Also contained in this report is a series of contact time tests of 0.20 mol% C-616 in G-74 on dried Alumina.

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Preparation of Activated Alumina

Each trap was prepared for the tests in the following manner. The traps were accurately weighed to the nearest gram, filled with commercial 4-8 mesh Alorco Activated Alumina and dried to a constant weight by passing dry G-74 at 275°F through the trap. The drying time was about 2½ hours.

Preparation of C-616 - G-74 Mixtures

On conditioning stand A19Q in the 1401 Building was placed a #2 Converter shell from which the tubes were removed. The shell provided a reservoir in which to make the mixtures for the tests.

Next the volume of the system was determined by filling the evacuated system with dry G-74 from a cylinder which was weighed before and after emptying and noting the pressure rise in the system.

The volume thus determined was 240 ft.^{3} after the necessary pressure and temperature corrections were made.

Quantities of C-616 necessary to make up the various concentrations were calculated and added to the system. The system so filled contained 240 ft.^{3} of the mixture. After 120 ft.^{3} of each mixture was passed through the trap, sufficient C-616 and G-74 was added to the system to bring the mixture back to 240 ft.^{3} and maintain the desired concentration. The mixtures were passed through the trap in 120 ft.^{3} batches.

This document has been approved for release to the public by:
David S. Gilliland 8/2/95
Asst. Technical Information Officer Date
Oak Ridge K-25 Site

INVENTORIED
AUG 16 1951
By

Carbide and Carbon Chemicals Corporation Operating Contractor for the U.S. Atomic Energy Commission.

Method of Adsorption

The trap was then installed in the system (See Sketch in Preliminary Report of C-616 Adsorption on Activated Alumina September 28, 1945) and the mixture passed through the trap at the desired rate of flow. 2400 S.C.F.D. were used in all tests except the contact time test, where the flow rate was varied. The temperature of the gases entering the trap was maintained at 85° by heating the mixture in the shell to 125°; the temperature difference being due to the heat loss in transferring the gas from the converter to the trap.

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A recorder connected to a thermocouple installed in the center of the Alumina provided a means of measuring and recording the temperature rise due to the combined heats of reaction and adsorption.

The trap was accurately weighed before and after the passage of each 120 SCF of mixture. Laboratory samples were drawn both up stream and down-stream of the trap to ascertain the gas concentrations at these points.

The analyses were used only as a check, for the concentrations at these points were calculated by weight balances. Fair agreement with the analyses were obtained; the differences probably being due to the difficulty in obtaining representative samples.

The flow rates were maintained by controlling the rate of pressure drop in the reservoir.

Contact Time Tests

In the report of September 28, 1945, on the Preliminary Results of C-616 Adsorption on Activated Alumina, it was noted that by quadrupling the contact time or cutting the flow rate by 75% to 600 SCFD, the adsorption efficiency during the falling rate period was raised from 19.0 to 60%. This result made it necessary to make series of contact time tests in the manner described above varying the flow rates. These tests were carried out using 0.20 mol % C-616 at the following flow rates:

1200 SCFD	-	3.70 Sec.	Contact Time
1600 SCFD	-	2.78 Sec.	" "
2400 SCFD	-	1.85 Sec.	" "

The adsorption efficiency, (i.e. the weight of C-616 picked up by the trap divided by the weight of C-616 passed through the trap expressed as a percentage) was plotted against the contact time. See Fig. 2.

Physical Properties of 4-8 Mesh Alorco Activated Alumina

(1) Density	49.1 # / ft.^{3}
(2) % Voids	49.0 %
(3) Total Air Space	75.0 %
(4) % Pores	26.0 %
(5) Moisture (Free)	0.9 %

Calculation of Contact Time

(1) Volume of Alumina in Trap .104 Cu. Ft.
(2) Volume of Voids 49 %
.49 x .104 = .051 Cu. Ft.
(3) Contact time = time required to pass .051 cubic feet of mixture through experimental trap at a given flow rate.

$$\text{Contact time} = \frac{.051 \text{ ft.}^3}{\text{Flow Ft./Sec.}} = \text{Seconds}$$

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Results:

(1) See tables 1, 2, 3, 4 and Figs. 1 and 2
(2) Contact time test (See Fig. 3)

Flow Rate	Linear Gas Velocity Based on 49% Voids	Pickup Efficiency
1200 SCFD	17.8 Ft./min.	98.0 %
1600 SCFD	23.8 Ft./min.	96.0 %
2400 SCFD	35.6 Ft./min.	91.5 %

Note: At 240° SCFD through experimental trap, the pressure drop should not exceed 0.5# water per ft. of height of Alumina. (Chem. Engr's. Handbook, Perry-Page 1324)

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RESULTS (TABLE #1)

(1)	C-616 Concentration (mol %)	0.05	.10*	0.20	0.50	0.10
(2)	Weight of Trap + Alumina (gms)	6879	6450	6731	6803	6651
(3)	Weight of Empty Trap (gms)	4429	4477	4428	4532	4410
(4)	Weight of Alumina (gms)	2450	2273	2303	2271	2241
(5)	Weight of Welded Trap + Alumina (gms)	6931	6497	6791	6853	6717
(6)	Weight of Dried Trap (gms)	6911	6474	6770	6833	6697
(7)	Loss in Weight due to Drying (gms)	20	23	21	20	20
(8)	Average Adsorption Efficiency (%) During Constant Rate Period	89	81	92	94	92.6
(9)	Pickup at Break Point (gm/gm)	.280**	.276	.260	.272	.281
(10)	Estimated Saturation Point (gms/gm)	.320	.326	.306	.350	.320
(11)	Maximum Temperature Rise (°F)	none	15	25	45	20
(12)	Contact Time Based on 49% Voids (Sec.)	1.85	1.85	1.85	1.85	1.85
(13)	Flow Rate (S.C.F.D.)	2400	2400	2400	2400	2400

* <u>Important Note</u>:

This run showed much lower efficiency than expected based on the other runs; therefore the .1 mol % test was rerun and the results will be found in column 5.

** Estimated

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*TABLE #2

RESULTS OF 0.05 MOL % C-616 TEST

P.G. Added to make 0.05 mol % C-616 (gms)	Weight gained by trap (gms. C-616)	gm/gm of C-616 Adsorbed by Alumina	Adsorption Efficiency %	gm C-616/120 Std. ft.^{3} of mixture passing through trap (chemical analysis)(not adsorbed)
31	24 21	.0102	78.5	0.0
28	28 52	.0212	100.0	3.5
29	25	.0315	86.5	6.2
28	27	.0425	96.5	7.3
22	18	.050	82.0	0.0

*Note: This test was not carried through to saturation because of the time required.

TABLE #3

RESULTS OF 0.2 MOL % C-616 TEST

P.G. Added to make 0.2 mol % C-616 (gms)	Weight gained by trap (gms. C-616)	Δ	Cum	gm/gm of C-616 Adsorbed by Alumina	Adsorption Efficiency %	gm C-616/120 Std. ft.^{3} of mixture passing through trap (chemical analysis)(not adsorbed)
106	98	8	8	.0425	92.5	2.6
111	102	9	11	.0870	92	2.5
112	110	2	13	.134	98	0.0
114.5	100	14.5	33.5	.178	87.5	2.5
109	97	12	45.5	.220	89.5	16.8
102	84	18	63.5	.256	77.5	26.8
93	65	28	91.5	.283	60.0	30.0
100	50	50	141.5	.305	50.0	46.0

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TABLE #4

RESULTS OF 0.50 MOL % C-616 TEST

P.G. Added to make 0.50 mol % C-616 (gms)	Weight gained by trap (gms. C-616)			gm/gm of C-616 Adsorbed by Alumina	Adsorption Efficiency %	gm C-616/120 Std. Ft.^{3} of mixture passing through trap (chemical analysis)(not adsorbed)
275	267			.118	96.5	9.0
259	247			.226	92.5	23.0
272	179	13	113	.305	67.0	110.0
270	76	174	307	.338	28.0	220.0
252	26	226	533	.350	10.0	242.0

TABLE #5

RESULTS OF 0.10 MOL % C-616 TEST

P.G. Passed Thro' Trap to Make 0.10 Mol % C-616 (gms)	Weight Gained by Trap (gms. C-616)			gm/gm of C-616 Adsorbed by Alumina	Adsorption Efficiency %	gm C-616/120 Std. Ft^3 of mixture not adsorbed by trap (Chemical analysis at trap outlet)
52.5	49	3.5	[illegible]	.022	93.3	1.92
56.8	54		6.3	.046	95.0	1.24
54.6	50		10.9	.068	91.5	0.00
56.8	49		18.7	.090	86.5	0.00
55.6	53		21.3	.114	95.5	1.68
52.8	48		26.1	.135	91.0	1.32
* 40.4	37		29.5	.152	91.8	0.00
* 48.2	46		[illegible]	.172	95.5	0.00
53.1	48		36.8	.194	90.5	0.00
54.1	50			.216	92.5	0.00
53.0	50		[illegible]	.238	94.5	2.04
51.5	51		[illegible]	.261	99.0	2.64
53.8	44			.281	81.8	8.65
51.4	34		71.6	.296	66.2	16.45
52.7	26		98.3	.307	49.4	21.25

* Undercharged due to plug in charging line; correction made by shortening flow interval on fig. 1.

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Conclusions:

(1) The C-616 adsorption saturation point on Alorco 4-8 mesh Activated Alumina is a function of the C-616 concentration and increases with concentration. See Fig. 1.

(2) The break point, which is characterized by the end of the constant rate adsorption period and the beginning of the falling rate period, for the concentration tested, showed no definite trend, but averaged 0.270 gm/gm. (Flow Rate 2400 S.C.F.D.- See Fig. 1)

(3) The adsorption efficiency increased both with increasing concentration and contact time. See Figs. 2 and 3.

(4) When designing a trap to pick up C-616 from the purge gases, it is suggested that a contact time of 6-7 seconds be used to give the highest adsorption efficiency.

Note: It is also recommended that the length of the trap be $2\frac{1}{2}$ - $3\frac{1}{2}$ times its diameter to approximate the dimensions of the experimental trap.

J. F. Forkos

C/3 J. F. Forkos
Development Test Section

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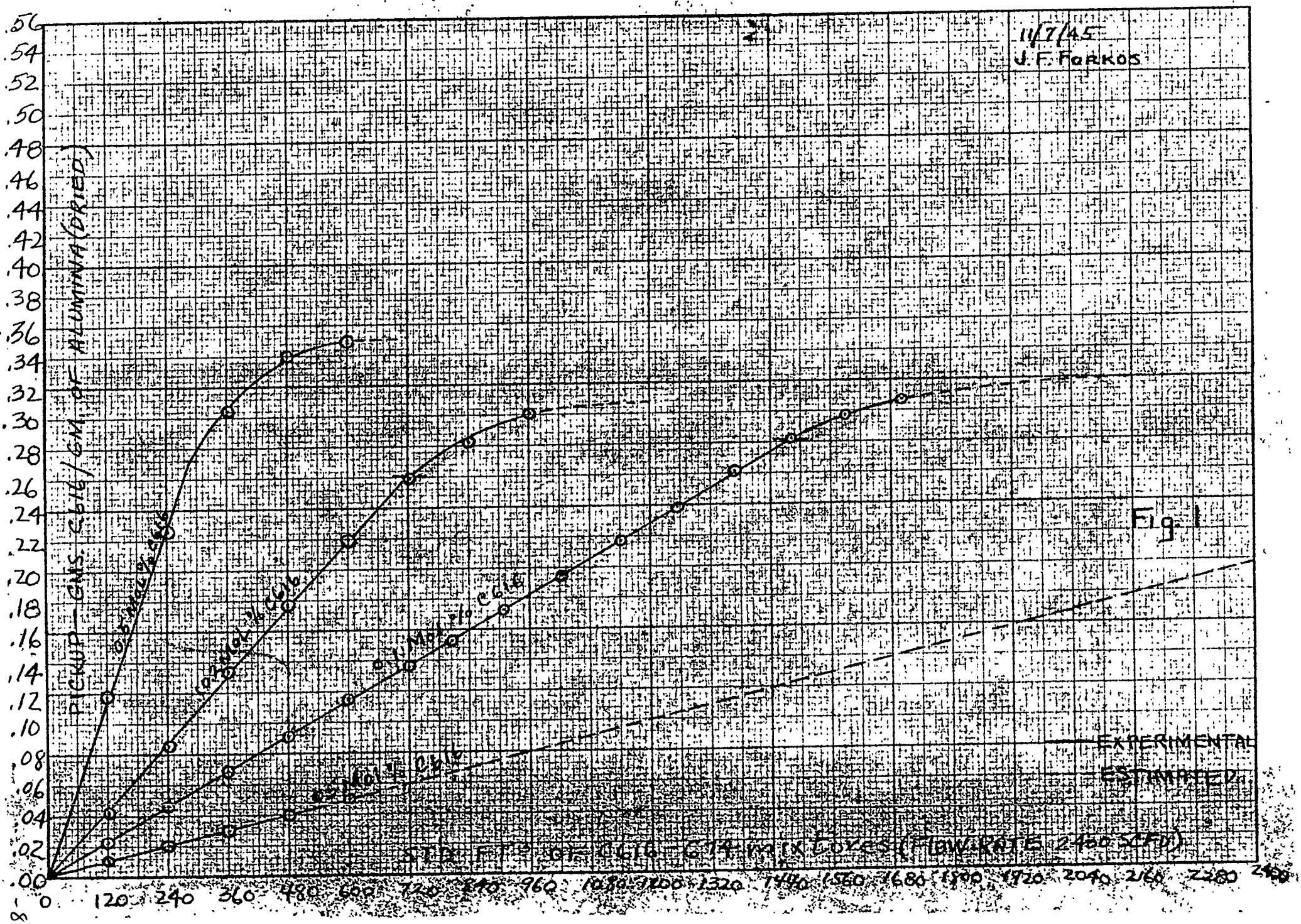

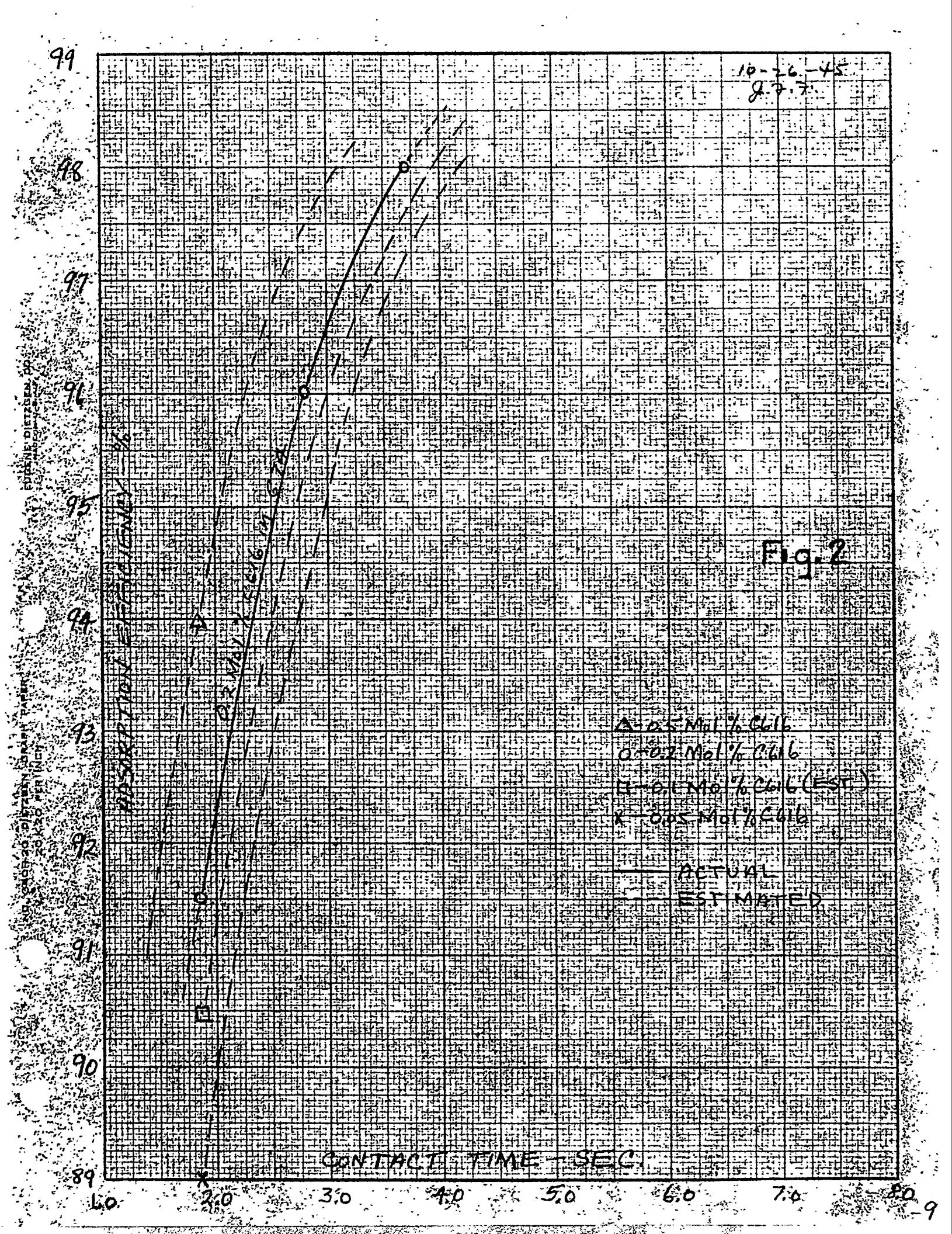
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Fig. 2
Δ-0.5 Mol % C6H6
O-0.2 Mol % C6H6
□-0.1 Mol % C6H6 (EST.)
X-0.05 Mol % C6H6
ACTUAL
ESTIMATED
CONTACT TIME - SEC.
99
98
97
96
95
94
93
92
91
90
89
1.0
2.0
3.0
4.0
5.0
6.0
7.0
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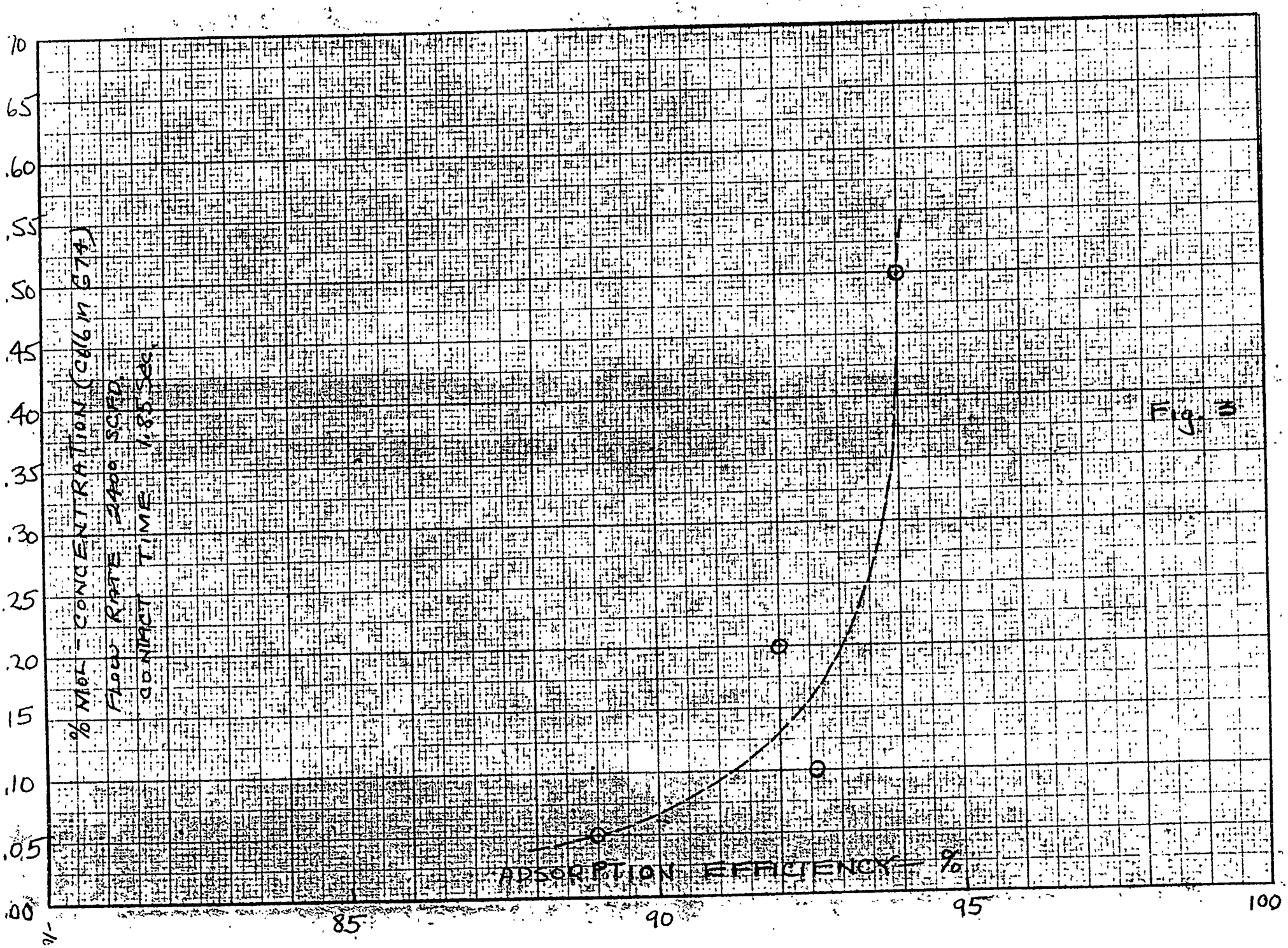

Fig. 11

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AEC RESEARCH AND DEVELOPMENT REPORT

A-3604 Cy #1

To: Dr. H. C. Paxton

September 28, 1945

From: J. Neidermeyer & J. F. Forkes

Subject: Preliminary results of alumina trap adsorbtion tests.

Prd-5-NS

The Alumina Trap

A light weight alumina trap containing a 4 3/8" D. x 12" long slug of 4-8 mesh Alorco activated alumina weighing 5# was used in this test. A thermocouple was installed in the center of the trap.

Preparation of Activated Alumina

The trap containing the alumina was conditioned to saturation by circulating a 5 mol % C-216 - G-74 mixture at room temperature. The initial reaction of the C-216 and alumina resulted in a rise in temperature of 270°F.

The trap and contents were then saturated with OA at room temperature. The maximum temperature rise during the OA treatment was 60°F.

Method Used in Adsorbing C-616 in Trap

A 0.1 mol % C-616 - G-74 mixture was prepared in a "B" type converter shell containing a volume of 240 cuft. This mixture was pulled through the alumina trap from an upstream pressure of 18 psia to 9 psia at a rate of 2400 SCFD, giving a contact time in the trap of 1.85 sec. (Based on 49% voids). The temperature of the mixture was maintained at 135°F. and the trap temperature was approximately 85°F. (These conditions approximate those met in the purge system in the process area). The converter was recharged to 18 psia with a 0.1 mol % C-616 - G-74 mixture after the press. was reduced to 9 psia, and repeated ~~5~~ 7 times.

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J. D. McCauley 7/24/95 ADD signature (final reviewer) Date

Results

1)	Trap + Alumina	6454.0	gms
2)	Trap	4189.5	gms
3)	Alumina	2264.5	gms (5 lbs.)
4)	Gross wt. sealed trap + alumina	6496.0	gms
5)	Gross wt. after C-216 + OA treatment	7211.0	gms
6)	Gain in wt. due to C-216 + OA adsorbtion	715.0	gms
7)	Gross weight after evacuation to 9.0 psia	7198.0	gms
8)	Evacuation loss pumping from 18 - 9 psia	13.0	gms
9)	Gross wt. of conditioned trap before passing 0.1 mol % C-616 through at the rate of 2400 SCFD (7)	7198.0	gms
10)	Volume of system	240	ft^3

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PG added to make 0.1 mol % C-616	Weight gained by trap (C-616)	gm/gm of PG adsorbed by Alumina	% C-616 charge adsorbed by Alumina	gms. C-616 not adsorbed passing through trap based on chemical analysis
54 gms	34 gms	.015	63%	--
47	28	.027	60	--
39	24	.038	62	--
59	28	.050	47	--
55	29	.063	52	32
60	23	.073	38	55
55	16	.080	29	28
57	13	.086	23	52
59	11	.091	19	40
Total 485	206			207

Each line in the above table indicate the passage of 120 ft^3 of 0.1 % PG at 85°F. through trap.

Results (cont'd)

After the rate of adsorbtion had decreased to 19% (last item in table) the rate of flow through the trap was decreased to 600 SCFD giving a contact time of 7.40 sec. The results were as follows:

PG added to make 0.1 mol % C-616	50 gms.
Weight gained by trap	30 gms.
% C-616 charge adsorbed	60%

Upon opening the trap after the adsorbtion test, it was found that there was no visual physical change in the alumina except that there was a slight crushing effect on the bottom of the trap. A slight odor, similar to OA, was detected.

Laboratory analyses taken on exit side of the trap during the test confirmed the fact that considerable quantities of C-616 was flowing past the trap.

Conclusions

(1) Contact time appreciably affects the amount of material adsorbed indicating that at the same velocity of flow a longer trap is necessary for adequate adsorbtion.

(2) The rate of adsorbtion of C-616 in the alumina trap declined rapidly after .073 gms of C-616 was adsorbed per gm. of the alumina.

(3) A considerable temperature increase occurs during conditioning with C-216 and a less appreciable rise occurs in the OA treatment.

Future Tests

(1) Similar tests are to be made with activated alumina dried at 300°F.

(2) Tests will also be made with 3 traps in series containing activated alumina. The type of conditioning of these traps will depend upon the results of (1) and discussion with the interested parties.

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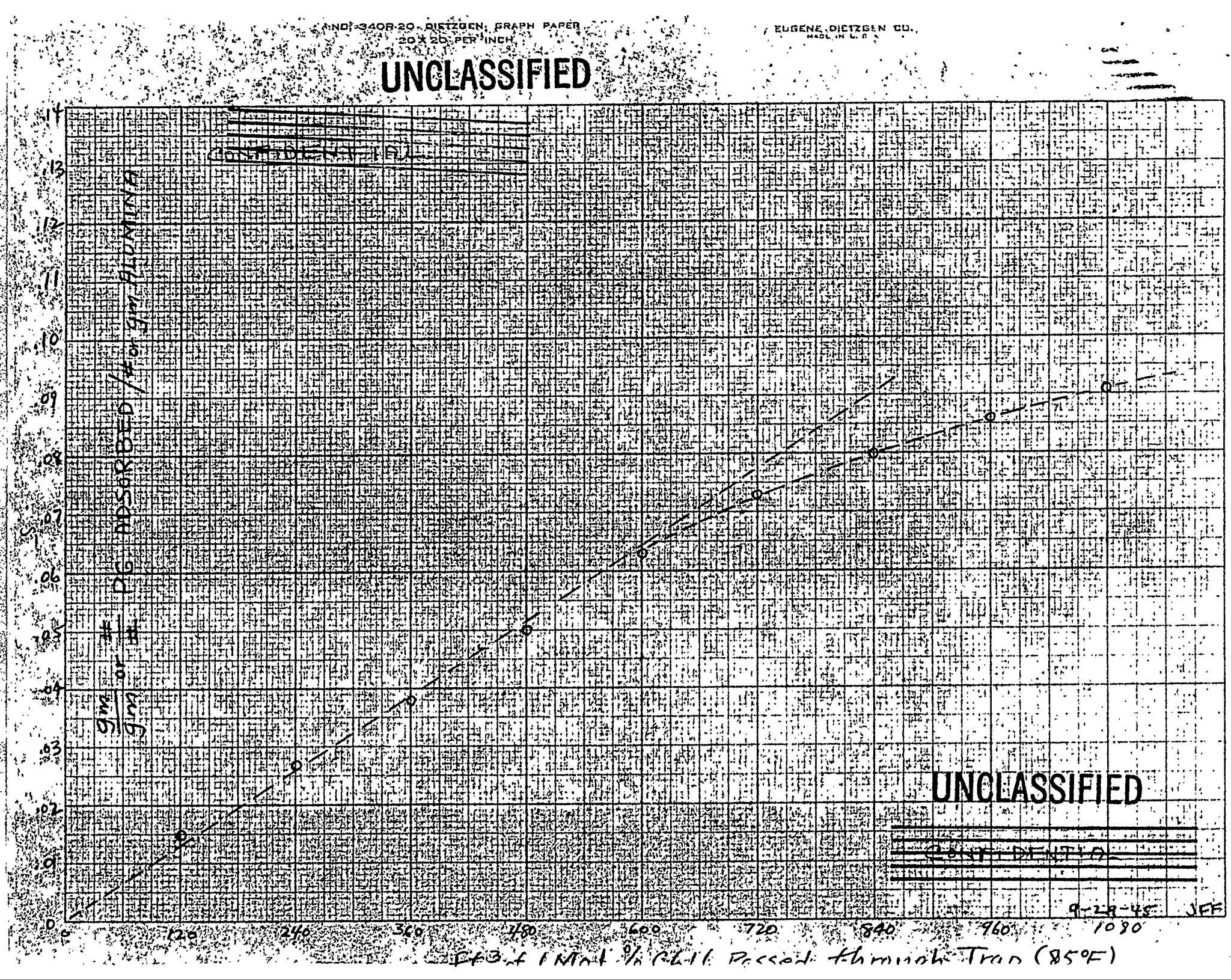
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0
120
240
360
480
600
720
840
960
1080
Ft3 of 1 Mol % Cell Passed through Trap (85°F)
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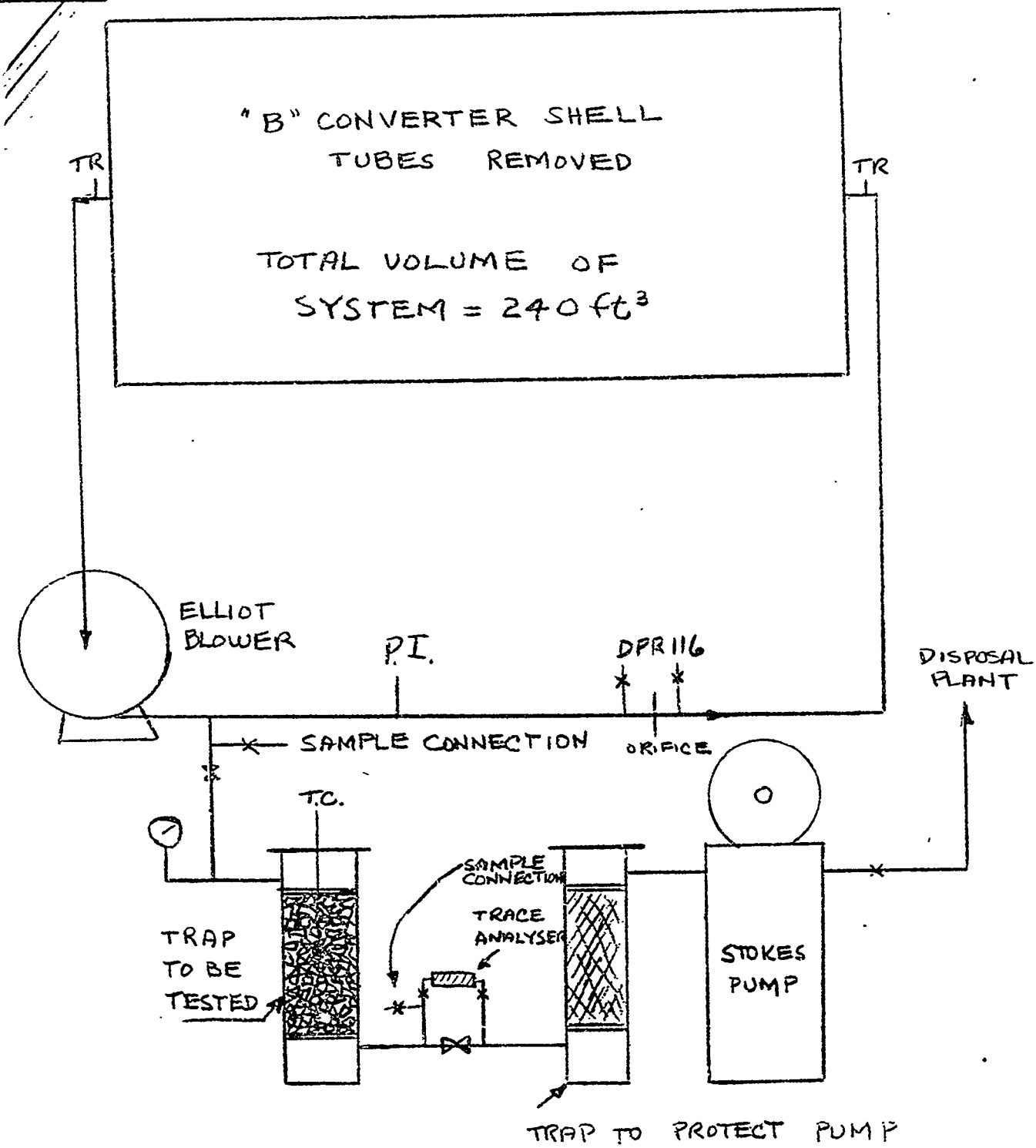

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Abstract

A-3604/AB

Activated Alumina Trap Adsorption Tests
9-28-45

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This is the first of a series of reports giving the results of tests on the use of activated alumina to adsorb small amounts of C-616 from G-74.

Five pounds of 4-8 mesh Alonco activated alumina were placed in a trap 4 3/8" dia x 12" long. The alumina was conditioned to saturation by a 5 mol % C-216-G-74 mixture followed by saturation with HF, both at room temperature. Temperature rises of 270°F and 60°F were noted in the respective operations.

A 0.1 mol percent C-616-G-74 mixture was passed through the trap under conditions approximating those met in the purge system of the plant.

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Two conclusions were reached:

1) Contact time appreciably affects the amount of material adsorbed thus indicating the possibility of using a longer trap.
2) The rate of adsorbtion of C-616 declined rapidly after 0.073 gm C-616/gm alumina was adsorbed.

Further tests are planned using activated alumina dried at 300°F as well as using 3 traps in series.

Classification changed to: UNCLASSIFIED (level and category)

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AEC RESEARCH AND DEVELOPMENT REPORT

A-3604
~~A-3608~~
Supplement #1.
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To: Dr. H. C. Paxton

Oct. 9, 1945

From: J. Neidermeyer & Sgt. J. F. Forkos

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Subject: Supplement to Preliminary Results of Alumina Trap Adsorption Tests, Sept. 28, 1945.

A test on an alumina trap similar to that discussed in our report of Sept. 28th has been made with the following change in preparation of the alumina:

The alumina was dried to constant weight at 250°F, but was not conditioned with C-216 and OA.

Carbide and Carbon Chemicals Corporation Operating Contractor for the U.S. Atomic Energy Commission.

The method used in adsorbing C-616 in the trap was the same as in the Sept. 28th report and the results are as follows:

(1) Trap + Alumina	6497 gms
(2) Trap	4224
(3) Alumina	2273
(4) Trap + Dried Alumina	6474
(5) Loss in wt. due to drying the alumina	23
(6) Average % C-616 adsorbed during constant rate of adsorption	81%

(7) (See Table)

(8) The rate of adsorption of C-616 declined rapidly after .276 gms of C-616 was adsorbed per gm of the alumina.

(9) There was no apparent rise in temperature in the alumina trap during the adsorption of the C-616.

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P.G. Added to make 0.1 mol % C-616 gms	Weight gained by trap (C-616) gms.	gm/gm of C-616 Adsorbed by Alumina	% C-616 charge Adsorbed by Alumina	gms. C-616 not adsorbed passing thru trap based on chemical analysis
52	39	.017	75	2.5
57	42	.036	74	4.8
61	50	.053	82	2.0
54	45	.078	83	2.5
46	40	.095	87	0.5
58	47	.116	81	0.0
48	49	.137	102	0.0
55	41	.155	75	2.3
57	49	.177	86	2.3
53	48	.198	91	4.1
55	46	.218	84	4.6
55	42	.237	76	4.6
57	43	.256	75	12.1
70	45	.276	64	--
57	35	.291	61	41.7
54	29	.304	54	26.1
74	26	.316	35	43.5
71	16	.322	23	57.6
73	10	.326	14	62.7

Each line in the above table indicates tha passage of 120 cu. ft. of 0.1 mol % C-616 - G-74 mixture through trap.

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Future Tests

It is felt that data relating to adsorption of higher and lower mol % C-616 than that used in this test, will be of more value than securing data on 3 traps in series as suggested in the Sept. 28th report. Plans are now being made to investigate adsorption rates on dried alumina using .5% and .02 mol % C-616 - G-74 mixtures.

J. Neidermeyer
J. Neidermeyer

J. F. Forkos
(Sgt.) J. F. Forkos

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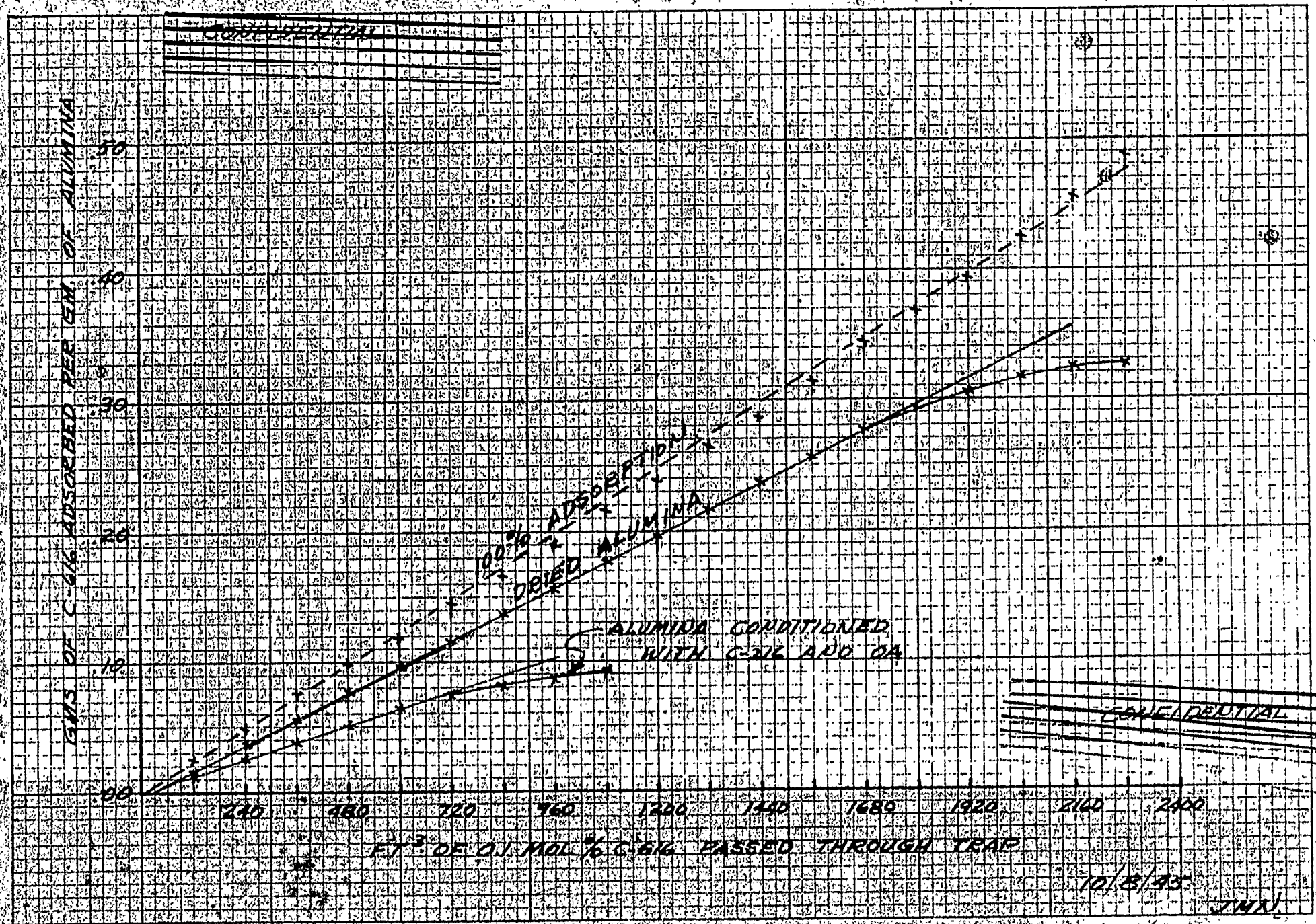

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