COMPANY TECHNICAL REPORT

Addendum Report #3: Additional Studies on VCM Adsorption

M. M. O'Mara/G. A. Lees

LOCATION: Avon Lake Technical Center

DATE: May 25, 1974
Typed: May 28, 1974

A number of VCM exposures involving new adsorbants, commercial adsorbants at low VCM exposures, and a variety of exposure conditions have been carried out. During the course of this continuing study we have replaced the Century OVA with a Bendix Hydrocarbon Analyzer. In summary we have found:

(1) The Bendix analyzer far outperforms the Century analyzer in terms of stability, background and accuracy,

(2) carbon remains to be the best adsorbant for VCM,

(3) the life-time of the Welsh cartridge in terms of 1 ppm breakthrough ranges between 30 minutes and 90 minutes,

(4) the Welsh canister outperforms anything evaluated to date.

GROUP FILE ACQ. NO.

J. L. Nelson
E. W. Harrington
G. D. Schaaf
B. A. DiLiddo
E. G. Schwaegerle
W. Wilcox

B. M. G. Zwicker
H. Waltemate
E. B. Katzenmeyer, Jr.
F. E. Krause
R. M. Kreager
J. Pausch
P. Zakriski

A. L. Schultz
R. W. Strassburg
M. N. Johnson
L. B. Crider
E. A. Collins
L. A. Chandler

R. J. Meyer
C. Flynn
D. L. Kent
Plant Managers
Plant Safety Engineers

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Introduction

Our last report (B.F.G. Technical Report, March 8, 1974) on the subject of VCM adsorption covered evaluations of new adsorbants and larger carbon canisters and cartridges. Since that report we have continued our studies in this area and have also prepared VCM standards in support of other investigations (gas chromatographic, chemical desorption, x-ray studies). This current report is a summary of this work. A summary of all experiments is provided in Table I. No detail is given for the Analytical Gas Standards (A.G.S.) prepared for other studies; a permanent record of this work will be retained.

During the course of this work we replaced the Century OVA with a Bendix Total Hydrocarbon Analyzer. One of the advantages with the Bendix instrument is the ability to determine VCM breakthrough times below T_5. An attempt was made to do this with the Century OVA at $T_{.5}$ (see #33, 34) but there is considerable error in the values. The main reason is due to the inherent 5-10 ppm background in the Century analyzer. This background can be zero suppressed with the Bendix instrument. We have also found that the baseline is much steadier with the Bendix instrument. Baseline drift is probably the greatest source of error with the Century OVA analyzer, especially in the 0-5 ppm region. The agreement between the two methods considering the above limitations with the Century is not that bad. Testing the Welsh cartridge (7500-1) at 15 liters/min. and 10 ppm of VCM we obtained the following breakthrough times ($T_{.5}$)* for the two analyzers: $T_{.5}$ = 162 (Century) and $T_{.5}$ = 120 (Bendix) (see Experiments #33 and #63). Previously we had determined a 12% deviation in determining T_5 with the Century analyzer.

In Table I, we have analyzed the Welsh 7500-1 cartridge at 30 l/min. and 10 ppm two times (#64 and #71) with the Bendix analyzer. The average T_0 is 50 ± 4 minutes which represents an 8% deviation. In our next report we will broaden the data base on this deviation analysis but reproducibility seems better with the Bendix instrument.

Effect of Rate on Breakthrough Time

Comparing experiments #63 and #64 a significant decrease in T_0 (initial breakthrough) takes place when the rate is increased from 15 l/min. to 30 l/min. A number of people have requested that more experiments be carried out at the 15 l/min. rate rather than the 30 l/min. rate. While the information obtained at 15 l/min. is of interest, it should be remembered that in our approach we correlate to the OSHA standard when we test at 30 l/min. not at 15 l/min. Since final acceptance of any device is based on the OSHA standard, most of our testing should be in the 30 l/min. range (or whatever rate best correlates to the standard).

T_1 Values

Our initial data involving the Welsh cartridge at 10-20 ppm (30 l/min.) indicates that T_1 is reached between 1 and 1½ hours. Although we have not yet

*$T_{.5}$ is defined as the time to .5 ppm VCM/

determined T_1 at 50 ppm, previous work with the Century analyzer at 50 ppm indicates a $T_1 = 41$. We believe this value is high, again due to the inherent problems with the Century analyzer at these low levels. Nevertheless in terms of the problem, the values (T_1) indicate the approximate life-time of the Welsh cartridge. If the concern is worker exposure to 1 ppm of VCM, the Welsh cartridges exhibit a life of ½ to 1½ hours depending on the concentration of VCM in the atmosphere.

Welsh Canisters

In our last report we showed the significant increase in protection offered by the Welsh canister (7800-1M). At 30 l/min. and 100 ppm, T_5 was reached after 11 hours. Recent studies with this canister (Experiment #70) indicate that initial breakthrough, T_0, at 10 ppm and 30 l/min is almost 17 hours and T_1 is not reached until ~20 hours. To date we have seen nothing that approaches the performance of the Welsh canister.

Other Adsorbants

A number of other adsorbants involving a number of principles of chemistry were tried. Nothing, so far evaluated, approached the effectiveness of carbon in scavenging VCM. In our last report we found that the coconut charcoal was not as effective as the petro-charcoal. Since that report, Harvard has also tested the coconut charcoal in their apparatus and have arrived at the same conclusion. Thus at this time, coconut charcoal offers no real advantage over the more abundant petroleum based charcoal.

Future Studies

We will continue our studies along the following lines:

(1) determine reproducibility (T_0, $T_{.5}$, T_1) at the low (5-20 ppm) exposure concentration,

(2) follow the Harvard work now in progress in which engineering redesign experiments with the entire masks are underway,

(3) continue to evaluate new adsorbants, and

(4) evaluate the standard cartridges and canisters at low levels of VCM (1-5 ppm).

Mike
M. M. O'Mara

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Attachment

Table 1

Summary of VCM Adsorption Data Obtained with the VCM Flow Chamber

Experiment No.	Experiment Involving	Flow Rate l/min.	VCM Concentration ppm	T_5 (1) (minutes)
31, 32 (3)	A.G.S. (2)			
33	Welsh 7500-1	15	10	$T_{.5}$ = 162; T_5 = 278
34	Welsh 7500-1L	15	10	$T_{.5}$ = 291
35 - 39	A.G.S.			
40	MSA Cartridge 44135	30	100	13.0
41	Willson R-13	30	100	0.0 (4)
42	Willson R-21	30	100	57.0
43 - 46 (5)	calcium carbonate absorbant	30	100	all 0.0
47	repeat of #42 (R-21)	30	100	46.5
48 - 53	A.G.S.			
54	MSA Cartridge 459315	30	50	32.0
55	MSA Cartridge 459315	30	100	25.0
56	Willson R-25	30	100	11.0
57 - 61 (5)	TiO_2, Lead Acetate absorbants	30	100	All 0.0
62 (6)	Welsh 7500-1	15	20	data in error; will be repeated
63	Welsh 7500-1	15	10	T_0 = 98, $T_{.5}$ = 120; T_1 = 148
64	Welsh 7500-1	30	10	T_0 = 54, T_1 = 92
65	Welsh 7500-1	30	20	T_0 = 35, T_1 = 57; T_5 = 77
66 (5)	Various carbon filters containing mixtures of carbon and other adsorbants; #67 is the control containing only carbon.	30	100	13.0
67 (5)		30	100	32.0
68 (5)		30	100	12.0
69 (5)		30	100	0.0
70	Welsh canister, 7800-1M	30	10	T_0 = 1010, T_1 = 1220, T_3 = 1335
71	Welsh cartridge 75001 (repeat of #64)	30	10	T_0 = 46, T_1 = 81

(1) T_5 is the time (in minutes) in which the concentration of VCM downstream from the cartridge becomes 5 ppm.

(2) Analytical Gas Standard.

(3) Runs 31 to 61 were made with the Century O.V.A.

(4) 0.0 means immediate breakthrough; no VCM adsorption was evident.

(5) Materials submitted by L. Chandler for evaluation as VCM adsorbants.

(6) Runs 62 - 71 and all future experiments were made with our new Bendix Total Hydrocarbon Analyzer.