RED 5-2-75

TO: L. B. Crider	ALTC	
FROM: M. M. O'Mara/C. [illegible] Tomanek	ALTC	April 28, 1975

PROGRESS ON PVC MODELING STUDY: PART 3 - FINAL CHECK-OUT OF THE SYSTEM

BFG TECHNICAL DOCUMENT

Summary

We have shown that a serious VCM diffusion problem exists in our modeling system. This problem prohibited us from making real time measurements of VCM diffusion from PVC resin. In-depth consultation with those more versed with gas diffusion problems (Berens, Daniels, Kim) has resulted in a rapid solution to the problem. We can now experimentally duplicate the theoretical diffusion of VCM in the 55-gallon drums which will be used in this study. This development removes the final concerns we had about VCM absorption. Final experimental modifications were made on 4/24/75: modeling studies will begin on 4/28/75 and will take approximately 2 - 3 weeks to complete.

Introduction

In Part 2 of this series, we described a series of experimental problems that had cropped up and have been subsequently solved. In Part 1, we described a mathematical model that was developed to predict the build-up of VCM in a 55-gallon drum. Initial indications were that we could experimentally duplicate the mathematical model. However, subsequent work on our system indicated the presence of a serious problem. Figure 1 shows the theoretical build-up of VCM in a 55-gallon drum when a 1 ppm (1000 ppb) VCM in air mixture is flowed into the drum at 1.82 liters/minute (see Appendix for the derivation of the mathematical model). Included in this figure is the experimental curve obtained by gas chromatographic sampling of the drum. It can be seen that the experimental curve is displaced significantly from the theoretical curve. However for any concentration, the two curves are displaced exactly 40 minutes. This suggested either a diffusion problem or an absorption problem. To check this out we mounted a small 3-inch fan in the drum and repeated the experiment. Figure 2 indicates how well this new experimental data tracks the theoretical data. It is obvious that a diffusion problem existed and could be overcome with the use of a small fan to provide mixing in the drum.

[illegible] equipped with a similar fan to avoid this problem. [illegible] been thoroughly checked out and modified, the [illegible] for this study will be initiated.

M. M. O'Mara

sh

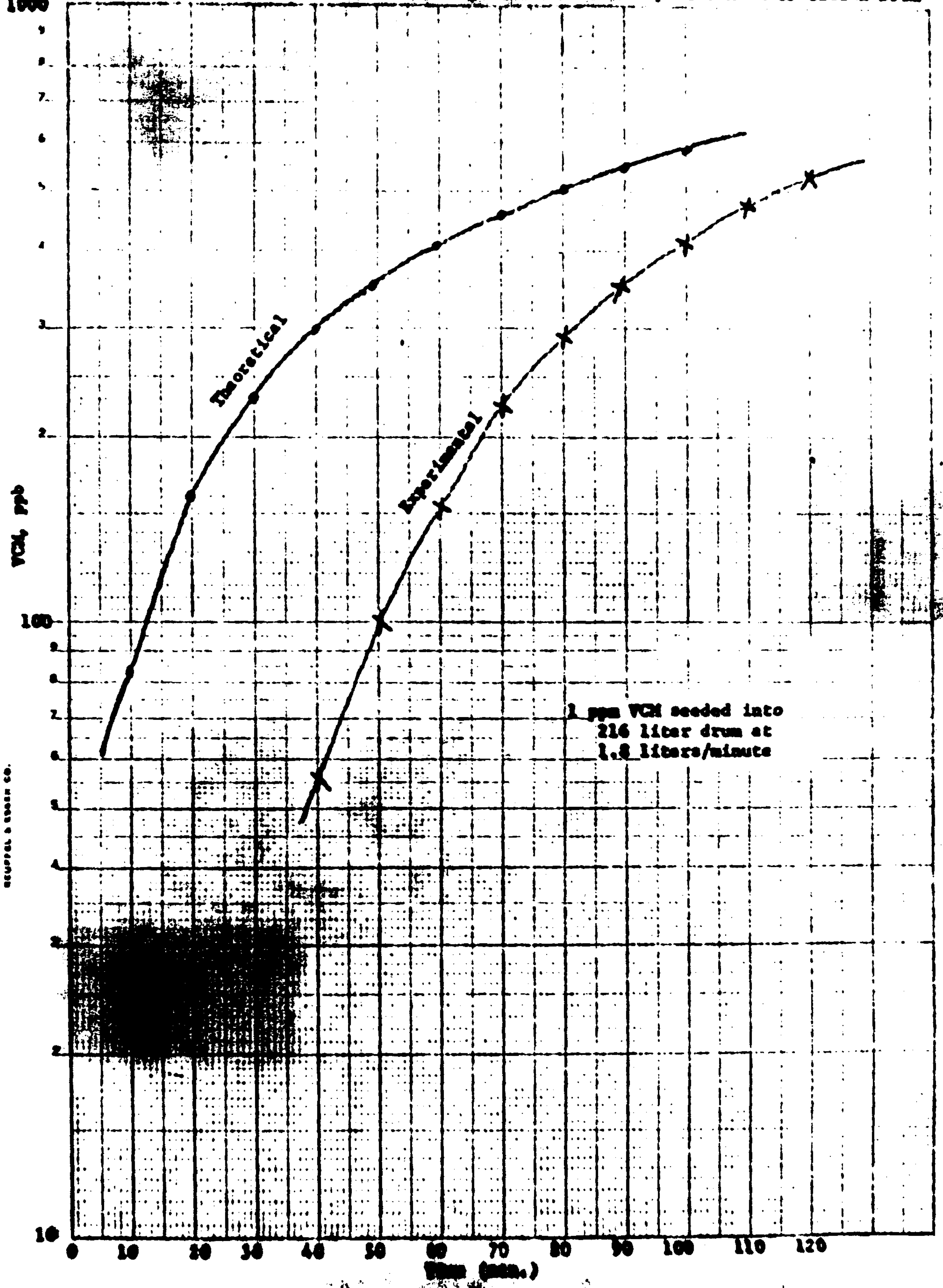
Attachments

41340

25241001

BFG39442

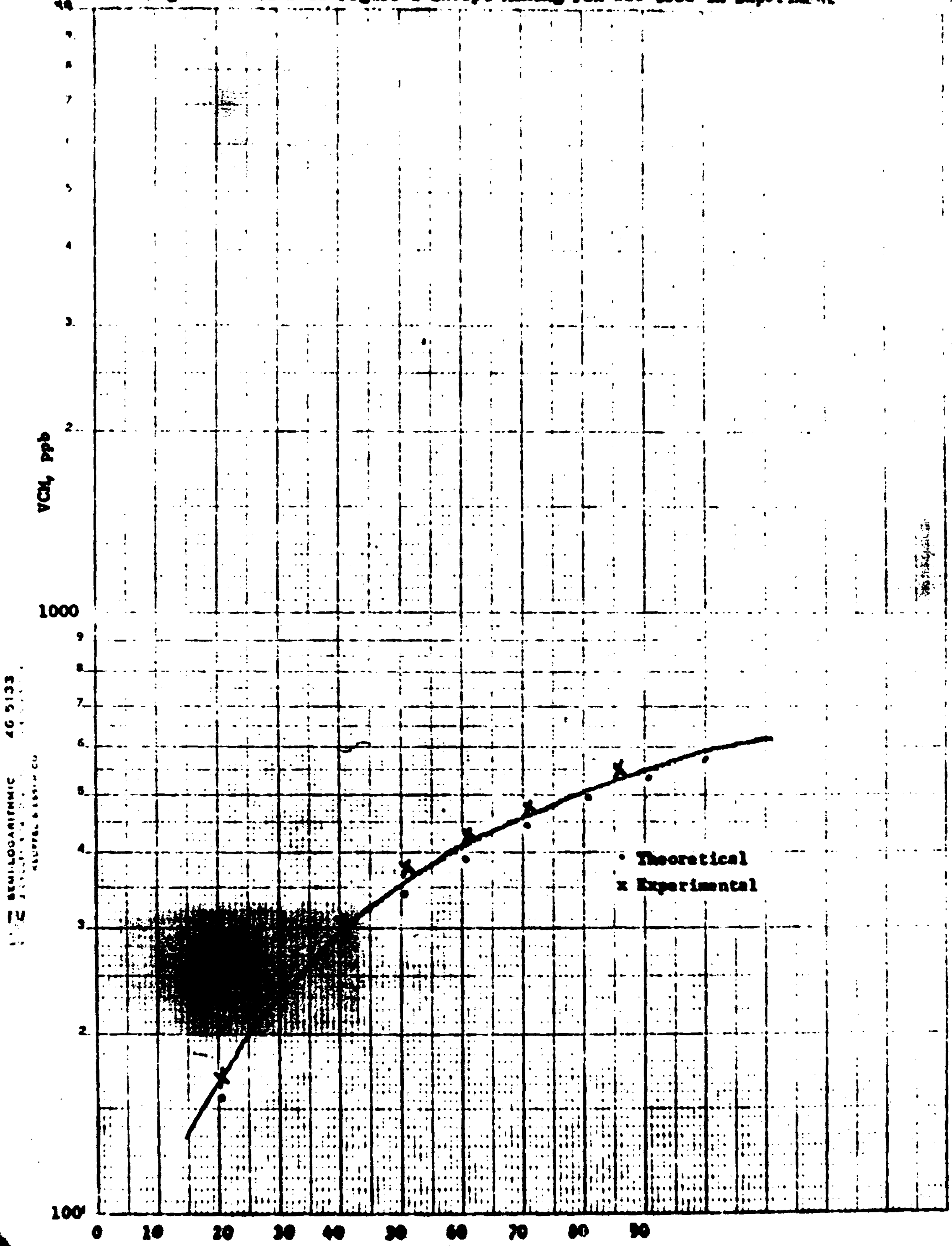
Figure 11 Theoretical vs. Experimental Build-Up of VCM in 55-Gallon Drum



25241002

BFG39443

Figure 2: Same as Figure 1 Except Mixing Fan Was Used in Experiment



APPENDIX

Derivation of the deferential equation for this problem was carried out by M. Kim:

C_o = concentration of incoming air stream (1ppm)

C_t = concentration in drum at any time (t)

V = volume of drum

m = flow into and out of drum

t = minutes

VCM into drum = VCM out of drum + accumulation

1 . . . . $m\,C_o\,dt = mc_t dt + V\,dc$

2 . . . . $V \frac{dc}{d}/dt = m\,C_o - m\,C_t$

3 . . . . $\frac{dc}{dt} = m/v\,(C_o - C_t)$

4 . . . . $\frac{dc}{C_o - C_t} = m/v\,dt$

integrating

5 . . . . $\int_0^{C_t} \frac{dc}{C_o - C_t} = m/v \int_0^{t} dt$

$-\ln (C_o - C_t) = m/v\,(t) + A$

$C_o - Ae^{-m/v(t)}$

at $t = 0,\ C = 0\ \therefore A = C_o$

$C_t = C_o\,(1 - e^{-m/v(t)})$

A program was written for this equation with the following predicted and actual values determined.

V = 216 liters, C_o = 1 ppm, M = 1.82 liters/min.

Time (Minutes)	Theoretical (ppb)	Found
10	81	77
20	155	169
30	223	244
40	286	309
50	344	378
60	397	429
70	446	484
90	531	576

These data are plotted in Figure 2. While there is an obvious upward bias in the experimental data (~ 5 - 7%) this is seen as a possible error in the flow rate or in the precise moment of setting t = 0 on the stopwatch. Nevertheless, the data correlate quite satisfactorily and indicate no real problems (diffusion, absorption, leakage) in sampling.

Distribution
E. M. Bagmond
A. R. Borage
R. J. [redacted]
A. L. [illegible]
E. G. Schnoegarle
R. W. Tannehill
R. L. Toole
CTF ✓

41340

25241005

BFG39446