The effect of relative humidity on the ability to collect vapors on charcoal is related to the change in the capacity of the charcoal for the gases or vapors. As background, it needs to be recalled that strong adsorption of gases on the carbon's surface is required so that the chemical does not come off in a zero air environment. For low boiling, less than 90°C compounds, this strong adsorption is achieved by adsorption in the micropores and higher boiling compounds can be strongly adsorbed in both micro and micropores.

At high relative humidities, some of these available micro and micropores are obstructed by capillary condensation of water in the appropriately-size pores.

It should be noted that the recommended sampling period listed in the 3M Sampling Guide recongizes and compensates for this change. Specifically in the column for 0.5 - 3 X PEL at Relative humidities greater than 70%, all the sampling periods are less than eight hours.

An article in the February 1983 issue of the American Industrial Hygiene Association Journal titled "Sample Retentivity Properties of Passive Organic Vapor Samplers and Charcoal Tubes Under Various Conditions of Sample Loading, Relative Humidity, Zero Exposure Level Periods and Competitive Solvent" provides an example for discussion of these concepts. Among the items this study considers is a

comparison of the weight loss of methyl chloroform when duPont, Gas Badge and charcoal tubes are loaded with the methyl chloroform and then allowed to sample a challenge of zero concentration for extended periods.

Table I shows some of the data appearing in the article. This set is representative of behavior that would be shown by the 3M No. 3500 since the sampling rate for Gas Badge is similar to 3M's 30.9 cc/min. value for methyl chloroform. At low humidity, no significant weight loss was observed for badges which sampled methyl chloroform at .75X, 1.5X, and 2X the PEL for 2 hours and air for an additional 1, 3, or 6 hours. At 70% RH, weight losses exceeding 25% were observed in air challenges when total sampling periods were 3 to 8 hours. Indeed methyl chloroform that was lost was not strongly adsorbed in the appropriate micropores because they had been blocked by water.

Table II summarizes the conditions used for these experiments and contrasts them to 3M's recommendation for the single sorbent OVM. It can be observed that the recommended sampling times were exceeded in all cases. Specifically, when the sampling periods ranged from a total 3 hours (2 hr.'s with methyl chloroform and 1 hr. of air) to 8 hours at .75X PEL to 2 X PEL. All were experiments in which the devices were used beyond their recognized limitations. If

correctly used, weight losses would not exceed 25%.

In the paper, this experiment with methyl chloroform was repeated but the zero air concentrations were replaced by 780 ppm of toluene. Clearly this exceeded sampling recommendations again. To paraphrase the capacity section of the 3M Analysis Guide: When sampling multiple contaminants, the sampling period should not exceed the period recommended for the single contaminant with the lowest capacity.

If longer sampling periods are desired under conditions of high humidities, then a two sorbent or two stage sampling device such as the 3520 or a charcoal tube with a backup section is recommended. In the latter case, low sampling rates should be used.

TABLE I

METHYL CHLOROFORM ON GASBADGE (30 CC/MIN.)

SAMPLING TIME		10% R.H.			70% R.H.		
	2 HR.	+1 HR.	+3 HR.	+6 HR	+1 HR.	+3 HR.	+6 HR.
	CONCENTRATION (PPM)	PERCENT WEIGHT LOSS					
EXPERIMENT 1	272 (.75 PEL)	ND	ND	ND	14	26	31
EXPERIMENT 2	533 (].5X PEL)	ND	ND	ND	7	21	37
EXPERIMENT 3	743 (2X PEL)	5	3	--	23	63	73

TABLE II

SUMMARY OF CONDITIONS AT 80% R.H.

	CONC.	SAMPLING TIME (HRS.)	WEIGHT (MG)	ADDITION SAMPLING TIME (HRS.)* +1	+3	+6
				%	WT.	LOSS
3M's RECOMMENDATION	.5 - .3 X PEL	1	-	-	-	-
EXP. 1	.75 X PEL	2	5.2	14	26	31
EXP. 2	1.5 X PEL	2	9.7	7	21	37
EXP. 3	2 X PEL	2	15.2	23	63	73

*WITH ZERO AIR