STUDIES ON

SKIN ABSORPTION OF VINYL CHLORIDE IN A CO-POLYMER PLANT

Skin absorption of vinyl chloride is not a problem under normal plant operating conditions. The following data was gathered in a continuously area monitored plant in which it was possible to determine the short-term peaks. Personnel monitors were worn to measure the amount of vinyl chloride breathed by the operator and two industrial hygienists. The operator wore an air supplied respirator while performing the job assignments. The industrial hygienists continuously wore cartridge respirators while accompanying the operator. There is only one air outlet at each station and that is the reason the industrial hygienists wore the cartridge type respirators. The sample tube was fitted to a cartridge respirator so that the air sample was taken from the inside of the respirator. Another sampler was also worn by the operator to determine the short-term TWA's while performing the job responsible for the observed peak value. At the end of the work day the operator and each industrial hygienist breathed into a glass capillary as described by Beratta, et al (1), and the samples were analyzed by gas chromatography (GC). The carbon slugs from the personnel monitors were eluted with CS_2 and analyzed by GC.

EIGHT HOUR JOB HISTORY

	Observed Peak ppm	Job TWA	Time Mins.
Washing kettle	87	7.8	30
Changing frangible	62	10.2	20
Changing filter sock	306	4.9	30
Washing kettle	48	2.3	20
Washing kettle	313	8.7	30
Catalyst addition	14	7.2	0.5
Washing kettle	138	13.1	25

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BREATHING AIR AND BREATH ANALYSIS

	8 hr TWA	Breath Sample	
		Immediate	4 Hours Post-Shift
Operator	2.14	0.13	-
Industrial Hygienist #1	0.02*	<0.02	<0.02
Industrial Hygienist #2	0.69*	0.06	<0.02

(1) American Industrial Association Journal, Vol. 30, page 537 Nov.-Dec. 1969.

* Sample taken inside of respirator. Also indicates effectiveness of respirators.

VI

ANSWER TO CALGON'S REPORT ON CARBON ADSORPTION OF VINYL CHLORIDE

The data in Table I of Mr. Lovett's presentation, showing no loss of adsorptive capacity for vinyl chloride over 15 cycles of operation is not in agreement with data we have developed in our laboratories for chlorinated hydrocarbons and Pittsburgh Type BPL activated carbon (4x10 mesh). Adsorption studies using carbon tetrachloride, trichloroethylene, perchloroethylene, and ethylene dichloride with steam regeneration at 356°F shows a steadily decreasing adsorption capacity with regeneration cycle. The decrease in adsorption efficiency ranges from 15 to 35% per regeneration cycle and shows no leveling off effect with repeated regenerations. While we do not have similar data for vinyl chloride specifically, we would expect its behavior to be similar to that of the other chlorinated hydrocarbons tested. Our data shows that the carbon would probably have to be removed from service frequently and discarded or thermally reactivated if possible.

Also, the adsorption capacity data presented in Table I; ~12 weight percent vinyl chloride adsorbed on Pittsburgh Type BPL activated carbon is considerably greater than we were able to obtain in laboratory tests with the aforementioned chlorinated hydrocarbons. Adsorption capacity of 3 to 5 weight percent was more typical for these materials.

From the breakthrough data presented in Figure 1, calculations (assuming the flow of 9 fpm is superficial velocity at 25°C and atmospheric pressure) show that the vinyl chloride adsorption by Pittsburgh Type PCB activated carbon would be 0.366 pounds/pound of carbon. Data from Figure 2 gives an adsorption capacity of 0.190 pounds/pound of carbon. Our laboratory data for Pittsburgh Type PCB activated carbon (12x30 mesh) shows a more limited adsorption capacity. Data were obtained at the following test conditions:

Air Flow	32 liters per minute
Vinyl Chloride Concentration	50 PPM_v
Carbon Bed	45 grams
Breakthrough Concentration	1 PPM_v
Time to Breakthrough	75 minutes

Calculations based upon the above experimental data show that Pittsburgh Type PCB carbon will adsorb 0.007 pounds of vinyl chloride per pound of carbon. Similar data, 0.005 pounds adsorbed per pound of carbon, was obtained for another low boiling, high vapor pressure halogenated hydrocarbon, Freon-11, at a 10 PPM_v concentration in air. Using these experimentally determined adsorption capacities, a carbon bed 2' x 130' would be required to remove one pound per minute vinyl chloride from a vent stream containing a vinyl chloride concentration of 50 PPM_v. Operation costs for this size adsorption system would be quite high, with regeneration steam alone costing $10 MM per year from each vent stream.

$1.25/MBTU Based on Freon 11 Experiments

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Adequate investigations have not been made into other operating parameters, i.e., the effect of impurities in the stream to be treated on the effectiveness of the carbon for adsorption of vinyl chloride and disposal or recycling of the vinyl chloride recovered in the regeneration cycle. Steam regeneration produces a water-vinyl chloride mixture that is not compatible with anhydrous vinyl chloride operations. Additional equipment is required for recovery of vinyl chloride from the condensed steam to prevent water pollution. Regeneration with nitrogen does not necessarily solve this problem since the nitrogen must ultimately be returned to the atmosphere through the adsorption bed.

Enough meaningful data have not been obtained to demonstrate that activated carbons are effective for vinyl chloride removal from air and inert vent streams and that adsorption systems can be operated economically. Although there exists the possibility of using activated carbon adsorption for limited applications, our data indicates that for low concentrations and high volume vent streams, carbon beds are not practical. Therefore carbon adsorption should not be considered as the ultimate solution to all vinyl chloride emission problems.