UNION CARBIDE CORPORATION
CHEMICALS AND PLASTICS
ENGINEERING
SOUTH CHARLESTON, WEST VIRGINIA

RECEIVED
JUN 13 1975
R. N. WHEELER, JR.

MEMORANDUM

June 12, 1975

TO: Mr. M. E. Eisenhour
Mr. R. H. Gregory, Jr.
Mr. H. R. Guest
Mr. G. J. Hanks, Jr.
Mr. R. W. Martin
Dr. A. B. Steele
Dr. T. T. Szabo
Mr. G. J. Triplett

FROM: W. R. Manning
R. N. Wheeler

SUBJECT: Excerpts From Arthur D. Little Report - Vinyl Chloride Monomer Emissions From The Polyvinyl Chloride Processing Industries

We are sending you herewith the Title Page, Table of Contents, List of Figures, List of Tables, Summary, and Table VI-1 from the subject report, copy of which was obtained by Mr. Wheeler from the Society of the Plastics Industry. The report was apparently prepared by Arthur D. Little, Inc. under contract to the EPA.

We think the essence of the report is contained in the Summary and the tables that we are attaching. Although the report does not say so specifically, it implies that there is little need for regulation of the PVC Processing Industries.

The entire report amounts to some 140 pages. If, after examining the attached material, you would like to see other parts of the report, please contact Mr. Wheeler.

W. R. Manning
W. R. Manning
R. N. Wheeler
R. N. Wheeler

WRM/RNW/skb

Attachment

UCC
033067

D R A F T

VINYL CHLORIDE MONOMER EMISSIONS FROM THE POLYVINYL CHLORIDE PROCESSING INDUSTRIES

Report to

U. S. Environmental Protection Agency
Research Triangle Park, North Carolina

By

Lita Nelsen
Jack Milgrom
Robert Eller

May 1975

76086-11

Arthur D Little, Inc.

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES (continued)

SUMMARY

The recognition of the potential link between the exposure of workers to vinyl chloride monomer (VCM) and the development of angiosarcoma of the liver has resulted in the Occupational Safety and Health Administration setting standards to limit the exposure of plant workers to VCM. These standards are expected to result in controls which reduce the concentration of VCM in plant air to very low levels. However, the ventilation methods used as one major route to meeting the OSHA regulations in no way reduce the total amount of VCM emitted from the plants to the atmosphere. There is therefore still concern about the effects of VCM emissions on the non-worker population in communities surrounding PVC production and fabrication plants.

The purpose of this present study was to attempt to quantify the extent of VCM emissions from polyvinyl chloride processing plants, including both compounders and fabricators who process the compound--through the melt or solvent phase--into semi-finished products.

In this report, we discuss the structure of the PVC processing industry, and document the emissions from each segment of the processing industry. Emissions are categorized primarily by the type of fabrication process. Data on emissions were obtained from interviews with resin producers, compounders, and fabricators. The primary approach to the estimation of emissions was the classic material balance. The VCM content of resins entering each process step was estimated, and the amount of monomer in the product emerging from each process step was separately estimated. The difference in VCM concentration between the material entering and exiting from each process step was used to estimate the VCM losses. Total nationwide emissions, by process, were then obtained by multiplying the VCM lost per kilogram at each process step by the total amount of material processed each year by that process. Since the residual VCM levels in resin are constantly changing as manufacturers seek to minimize them in order to minimize worker exposure to the monomer in fabrication plants, we used late 1974 levels of residual monomer as the basis of these calculations.

Table S-1 shows the total U.S. emissions of VCM from polyvinyl chloride processing, categorized by process. As shown by this table, the predominant emissions arise from the compounding portions of the processing operations. VCM emissions from later processing operations are negligible. Table S-2 compares the annual VCM emission rates from PVC processing with the emissions from vinyl chloride monomer production and from polyvinyl chloride polymerization. Emissions from compounding and subsequent fabrication processes together account for less than one-half of one percent of the total U.S. emissions.

At present there is no external control equipment used to limit VCM emissions from compounding and fabricating facilities. Although such controls as carbon adsorption and scrubbing have been considered for VCM emissions from polymerization plants, their application to compounding and fabricating facilities appears impractical because of the low levels of VCM in exiting air from these facilities. Compounding is the only step in the fabrication process where some external controls may be warranted practical, specifically in the dry-blending portion of the operation. However, such controls as may be practical run counter to the current high-ventilation trend in operation used to limit in-plant emissions.

The most promising control technique to limit VCM emissions to the atmosphere from compounding and fabricating facilities appears to be further reduction of residual monomer levels in resin input to these operations. At present, resin manufacturers are modifying their processes to reduce these levels in order to comply with OSHA regulations. The effect on external emissions from compounding and fabricating facilities is expected to be substantial. Table S-3 shows the estimated average residual VCM levels which manufacturers expect to achieve by 1975 and by 1980; the total annual U.S. emissions of VCM expected from compounding and fabricating facilities using those resins is also shown.

VI-1
page VI-3

TABLE S-1

TOTAL U.S. EMISSION RATE OF VCM FROM POLYVINYL CHLORIDE PROCESSING

Process	Estimated VCM Emission Rate* kg/year	(lbs/yr)
A. Flexible PVC		
1. Compounding	220,000	(480,000)
2. Extrusion	<3,000	(<6,000)
3. Calendering	<4,000	(<1,000)
4. Molding	<400	(<800)
B. Rigid PVC		
1. Compounding	300,000	(660,000)
2. Extrusion	<4,000	(<10,000)
3. Molding	<1,000	(<2,000)
C. Plastisols, Organosols, Solution and Latex Fabrication	2,000	(4,500)

* Based on 1974 production rates and late 1974 VCM contents of resins.

TABLE S-2

ANNUAL VINYL CHLORIDE EMISSIONS - 1974

Process	Emissions (kg/kg produced)	Amount Produced (kg)	Subtotal of U.S. Emissions by Process (kg)	Total U.S. Emissions (kg)	Percent of Total U.S. Emissions
A. Monomer Production	2.5×10^{-3}	2.2×10^{9}	-	5.7×10^{6}	4.0
B. P lymerization	-	2.4×10^{9}	-	1.3×10^{8}	95.4
Suspension Process	3.9×10^{-2}	1.9×10^{9}	7.6×10^{7}	-	-
Dispersion Process	6.0×10^{-2}	2.8×10^{8}	1.7×10^{7}	-	-
Solution Process	1.8×10^{-2}	5.9×10^{7}	1.0×10^{6}	-	-
Bulk Process	2.4×10^{-2}	1.2×10^{8}	2.9×10^{6}	-	-
C. Fabrication Processes	-	2.3×10^{9}	-	$5\text{-}6 \times 10^{5}$	0.4

Table VI-1

ANTICIPATED FUTURE VCM LOSS RATES FROM COMPOUNDING AND FABRICATION

Year	PVC Production Rates (kg)	Avg. VCM Content of Raw Resin (ppm)	Total Annual U.S. VCM Release from Compounding and Fabricating (kg)
1974	2.0×10^9	300	600,000
1975	$2.1 \times 10^{9*}$	50	105,000
1980	2.4×10^9 (est)	20	48,000

*Assumes 7% growth rate.

Finally, it appears that reduction of VCM emissions at later stages of fabricating (after compounding) is best accomplished by reducing the VCM levels either in the input raw resin or in the final compound. Techniques exist for both reductions, and it would appear wasteful to attempt to design and build equipment for removing VCM further downstream if it could be removed before it even entered the fabricating operations.