PRELIMINARY SURVEY REPORT:

OF

CONTROL TECHNOLOGY ASSESSMENT OF SOLID MATERIALS HANDLING, PHASE I BAG OPENING, EMPTYING, AND DISPOSAL

AT

Rohm and Haas Delaware Valley, Inc.
Bristol Plant
P.O. Box 219
Bristol, Pennsylvania 19007

REPORT WRITTEN BY:

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NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
Division of Physical Sciences and Engieneering
Engineering Control Technology Branch
4676 Columbia Parkway
Cincinnati, Ohio 45226

PLANT SURVEYED:	Rohm and Haas Delaware Valley, Inc. P.O. Box 219 Bristol, Pennsylvania 19007 (215) 785-8663
SIC CODE:	2821 (Plastic Materials, Synthetic Resins, and Non-Vulcanizable Elastomers
SURVEY DATE:	May 11, 1983
SURVEY CONDUCTED BY:	Paul E. Caplan
EMPLOYER REPRESENTATIVES CONTACTED:	Dr. Frank M. Renshaw, CIH, Corporate Director of Industrial Hygiene Mr. Henry C. Sullivan P.E., Plant Director of Health and Safety Mr. Edward J. Skorpinski, P.E., C.I.H. Plant Industrial Hygienist David Spratt, D.O., Plant Medical Director
EMPLOYEE REPRESENTATIVES CONTACTED:	Mr. James Evans, President, Local 88 Aluminum, Brick and Glass Workers Union Mr. Walter Binkley, Vice President, Local 88, Aluminum, Brick, and Glass Workers Union

I. INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) is the primary Federal agency engaged in occupational safety and health research. Located in the Department of Health and Human Services (formerly DHEW), it was established by the Occupational Safety and Health Act of 1970. This legislation mandated NIOSH to conduct a number of research and education programs separate from the standard setting and enforcement functions carried out by the Occupational Safety and Health Administration (OSHA) in the Department of Labor. An important area of NIOSH research deals with methods for controlling occupational exposure to potential chemical and physical hazards. The Engineering Control Technology Branch (ECTB) of the Division of Physical Sciences and Engineering has been given the lead within NIOSH to study the engineering aspects of health hazard prevention and control.

Since 1976, ECTB has conducted a number of assessments of health hazard control technology on the basis of industry, common industrial process, or specific control techniques. Examples of these completed studies include the foundry industry; various chemical manufacturing or processing operations; spray painting; and the recirculation of exhaust air. The objective of each of these studies has been to document and evaluate effective control techniques for potential health hazards in the industry or process of interest, and to create a more general awareness of the need for or availability of an effective system of hazard control measures.

This Preliminary Survey was conducted as part of our assessment of effective engineering control technology, used during Solids Material Handling Operations. In this phase of our assessment, we are investigating the opening, emptying and disposal of bags, containers and powdered chemicals. Bag handling operations were selected for study for the following reasons:

a) The general hazards of bag handling operations occur in many chemical process industries. Bagging and bag opening operations are usually labor intensive compared to other plant operations. They also offer high potential for excessive inhalation and skin contact exposures to workers.

b) Many new and innovative engineering designs of bag handling equipment, for the control of dust emissions, have been developed for these operations. These methods need to be identified, documented, evaluated and, subsequently, made available to other industries.

The goal of this Preliminary Survey was to evaluate the appropriateness of this plant for the conduct of an In-depth Study of dust control procedures during manual handling of bags. We are evaluating not only engineering controls, but also work practices, protective equipment programs, monitoring and other administrative controls, since they may all be important parts of a well designed hazard control system.

II. PLANT AND PROCESS DESCRIPTION

Plant Description:

Rohm and Haas Delaware Valley Inc., a Division of the Rohm and Haas Company, is a major producer of chemicals, including Agricultural Chemicals, Industrial Chemicals, Plastics, Polymers, Resins and Monomers. The main plant facility was constructed in 1919. The plant population of approximately 1,300 employees, includes approximately 700 production, 200 maintenance, 200 research and 200 salaried employees.

In the KYDEX(R) Department, Building 46 of this plant, the product KYDEX(R), an acrylic polyvinyl chloride alloy, is produced. This material, in the form of an acrylic-PVC sheet, is used to make thermoformed plastic parts, such as computer housings, and wall coverings. This department operates 5 days per week, 3 shifts per day, with a 6 man crew on each shift. Operations are carried out in a Mix Area and an Extruder Area. The Mix Area consists of a Mix Room, approximately 20 feet in length, by 20 feet in width, and 16 feet in height; and a Pigment Room of approximately the same dimensions. See Figure A.

Process Description:

<u>KYDEX(R) Mix Room</u>

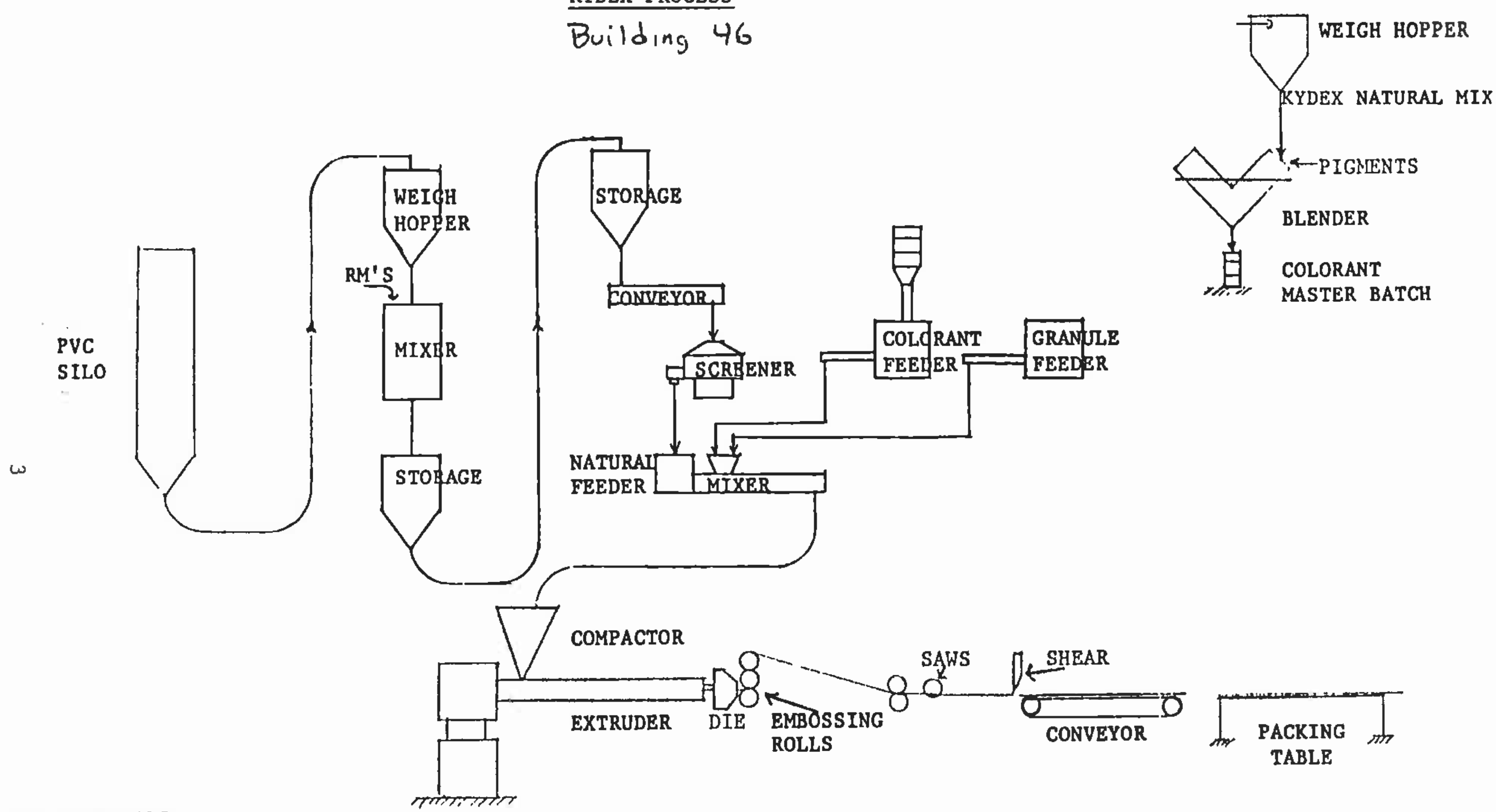
In the mix room, KYDEX(R) Department, batches of raw materials are formulated prior to polymerization. Raw materials for Natural Mix consist of PVC powder (major ingredient) plus acrylic resins (butyl and ethyl acrylates) stabilizers (such as Barium Cadmium Stearate) and lubricants (such as polyethylene type waxes). A normal batch contains approximately 3,200 pounds. PVC is gravity fed, automatically, from a 90,000 pound silo through a weigh hopper to a mixer. Other raw materials, such as acrylic resin, in 50 pound bags, are manually fed into the mixer, through a ventilated, hooded feed hopper. Bags are manually moved from a pallet to the hopper, opened and dumped. The empty bags are then manually placed in an empty drum and transported to a controlled land fill disposal dump. A pre-weighed quantity of Barium Cadmium Stearate, in a drum, is also emptied manually into the feed hopper. The mixer is exhuast ventilated, with exhaust air directed to a Mikro-D-Pulse air collector.

Normally, one man conducts the mixer operations; 4 or 5 batches are formulated per shift, and each batch operation requires 15 to 30 minutes for completion. Since each shift crew consists of 6 men (all operators), this operation is rotated daily to a different crewman. The normal work schedule is 3 shifts per day, 5 days per week.

<u>Patterson-Kelly Pigment Mix Room</u>

In an adjacent Pigment Mix Room, color pigment master batches are formulated for addition to the Natural Mix. Pigments consist of varying proportions of titanium dioxide, carbon black, cadmium-based salts, and cobalt salts. These colorant Master Batches are added to the Natural Batches, automatically, as

FIGURE A
KYDEX PROCESS
Building 46



RAW MATERIALS

POLY VINYL CHLORIDE (PVC)
ACRYLIC POLYMER
STABILIZER
LUBRICANT (POLYETHYLENE TYPE WAX)
PIGMENTS

not to scale
E.J.B. 7/27/79

needed. Basic ingredients are hand loaded from bags to a blender through a ventilated Pigment Weighing Booth, and then pneumatically transmitted to the No. 1 or No. 2 storage hopper. Normally, 4 Natural Mix batches (without pigment) are formulated for 2 Pigment Mix batches. This opertion is also conducted by one crew member, rotated daily.

Potential Hazards:

Mix Room

In the Mix Room, exposures to 3 types of particulates are possible:

1) Polyvinyl chloride (PVC) - Neither OSHA, NIOSH, nor ACGIH has proposed a hygienic standard for PVC dust. Although PVC is generally considered to be a "nuisance" type dust, recent epidemiological data, case histories, and animal studies(1-8) indicate that, at the "nuisance" dust level, 10 mg/m^3, PVC exhibits a weak biological reactivity. It may be the etiologic agent in a peculiar type of fibrosis,(1) or pneumoconiosis,(2) with slight restrictive respiratory function impairment.

2) Acrylic resins (polymers of butyl and ethyl acrylates) - These are considered to be "Nuisance Type" dusts, with a TLV of 10 mg/m^3 of total dust.

3) Barium-Cadmium Stearate - This is a heavy metal salt, which has a TLV (ACGIH), NIOSH Recommended Limit, and Rohm and Haas working limit, of 0.05 mg/m^3, as cadmium.

In previous years, Rohm and Haas industrial hygienists have also monitored for possible residual vinyl chloride monomer; possible decomposition products of PVC; hydrogen chloride; and physical stresses, such as noise and heat stress.

Pigment Mix Room

In the Pigment Mix Room, exposures to the following chemicals are considered possible:

1) Carbon black- TLV of 3.5 mg/m^3.
2) Cobalt pigment - TLV of 0.05 mg/m^3 (Intended Change for 1983-4).
3) Titumium dioxide (Nuisance Dust) - TLV of 10 mg/m^3.
4) Cadmium salts - TLV of 0.05 mg/m^3.

In recent years, NIOSH, OSHA, and others including the Rohm and Haas industrial hygiene staff have investigated the possibility of exposure to vinyl chloride momomer (a recognized carcinogen) as a residual vapor in PVC granules. This gas continues to be monitored yearly by the Rohm and Haas staff. Since noise is also considered to be a possible health hazard in this department, a Hearing Concentration Program has been instituted. This program includes audiometric testing and monitoring of personnel and areas for noise exposures.

III. CONTROL OF HAZARDS

At Rohm and Haas, control of hazards, including exposures to toxic dusts during bag handling operations, is accomplished by the application of several well established procedures. These procedures include engineering controls; good work practices, such as housekeeping; use of personal protection equipment; environmental and medical monitoring; and administrative controls.

A. Engineering Controls

The plant layout was designed to permit effective wash down of contaminated surfaces and floors. Additionally, specific areas in the plant were constructed as lunchrooms, washrooms, and showering facilities, where two lockers are provided for each employee.

Mix Room

In the Mix Room, dust dispersion has been reduced over the past 10 years by several modifications and installations. These changes include: the mixer was installed in 1974; improved pneumatic conveyance of mix was accomplished in 1974 and 1975; feed of PVC was changed from bag loading to bulk loading from a storage hopper; a local exhaust hood was placed over the mixer (designed for a hood face velocity of 100 fpm); and a central air vacuum system was installed to improve the clean-up of spilled dust. General room ventilation is also provided by a 24-inch wall fan.

Pigment Mix Room

In the Pigment room, a dust control hood was installed over the pigment mixer in 1977 and the central air vacuum system was extended to this area.

B. Work Practices

1. Hygiene practices include: required daily showers (15 minutes of paid overtime are allowed for showering); no smoking is allowed in work area; eating is permitted only is designated and maintained lunch rooms; and washing prior to lunch is encouraged.

2. No incentive pay program is offered to encourage accelerated production rates. Although this procedure has mixed effects in different work situations, generally, incentive pay programs tend to encourage short-cut work habits that may lead to unsafe work practices.

3. Two 10-minute work break periods per day (in addition to a lunch break) provide a reduction of stress and safer work practices.

4. A daily clean-up (housekeeping) period is provided for operators to clean up spills in their work areas. Since operator rotation occurs, all operators are responsible for housekeeping. Spills and other contaminations are either washed down (by hose) or vacuum cleaned. In the Pigment Room, clean up is done at least two times per day.

5. "Scheduled Maintenance" is provided for the oiling of equipment. A "breakdown maintenance" schedule is followed for other types of maintenance. General ventilation systems are monitored annually, while laboratory hoods are monitored quarterly.

C. Personal Protective Equipment

A strict respiratory protection program requires all workers (and visitors) to wear respiratory protection at all times in the Mix Room and the Pigment Room. This is required, even though recent environmental and medical monitoring data indicate that exposures to PVC, acrylic resins and cadmium - containing dusts are well below recommended hygienic standards. Willson R2 respirators, with HEPA (High Efficiency Particulate Air) filter cartridges, are used.

Workers are also provided with safety shoes and clean clothes daily, including under-shorts, shirts, trousers, and work gloves. Each worker is provided with a weekly supply of clothing, which he stores in his "clean" locker.

D. Monitoring Control

Environmental Monitoring

Environmental monitoring has been conducted at this facility for at least 11 years. Both Short term (S) and Full Shift (T) Personal (P) samples and Area (A) samples have been collected and analyzed for Total Dust (essentially acrylates and PVC), Cadmium salts, carbon black, and several other chemical and physical agents.

Significant reductions of Total Dust and Cadmium have been achieved in the Mix Area as shown in Table I. For example, measurements of Total Dust in 1974 averaged (geometrically) 160 mg/m^3 (range: less than 6 to 1480 mg/m^3); in 1979, they averaged 1.3 mg/m^3 (range: 0.6 to 4.8 mg/m^3). Additionally, a single measurement of cadmium dust level, in 1974, yielded a result of 1.2 mg/m^3; it was reduced to an average of 0.013 mg/m^3 (range: less than .01 to 0.02 mg/m^3) in 1979. These reductions were achieved by the above mentioned engineering control modifications. Monitoring data for carbon black, vinyl chloride monomer, hydrogen chloride, butyl and ethyl acrylates, and other chemicals also show good dust and vapor control.

Noise levels in some areas have been above the OSHA Standard of 90dBA; therefore, an active Hearing Concentration Programs, including periodic audiometric testing and environmental monitoring, is in effect.

Table I

TOTAL DUST CONCENTRATIONS IN KYDEX(R) DEPARTMENT*

	Operations and Location	Year	Short Term Personal and Area Samples mg/m^3	Full Shift Personnel Samples mg/m^3
1.	Filling PK Mixer	1974	480, 25, less than 6, 156, 27.5, 1054, 906, 1480 geo. mean = 160	
		1977		2.1
2.	a. Dumping bags of PVC and Acrylic resin in mixer.	1974	231, 725, 1256 465, 56, 370, 437, 40, 1416, 1399, geo. mean = 384	
		1976	106, 33 geo. mean = 59	
	b. Mixing Operation	1977		8, 4.2, 3.5, 2.1, 2.0, 2.5 geo. mean = 3.3
				0.7, 0.4, 4.4, 1.0, 0.9, 1.0, 0.2, 0.8 geo. mean = 1.2
3.	Weighing pigments	1972	2.5, 3.9, 1.1, geo. mean = 2.2	
		1973	5.3	
4.	Mixing ingredients	1979		4.8, 0.6, 1.1, 1.3, 0.6, 1.8 geo. mean = 1.3

* Rhom and Haas Delaware Valley, Inc. Data.

Table II

CADMIUM DUST CONCENTRATIONS IN KYDEX(R) DEPARTMENT*

Operator/Location	Year	Short Term Personal Samples mg/m^3	Full Shift Personnel Samples mg/m^3
1. Loading PK Mixer	1977	0.029	.02
2. Loading Nauta Mixer	1976	.31, .27, 1.3 geo. mean = .48	.03, .09, .05, .05, .01, .11, .07 geo. mean = .05
	1977		.04, .04, .04 geo. mean = .04
3. Weighing pigments	1974	1.2	
4. Mixing ingredients	1976		.03,.09,.05,.05,.01, .11,.07,.06 geo. mean = .05
	1977		.04, .04, .04, .01, .01, .13 geo. mean = .03
	1978		.21, .02, .01 geo. mean = .03
5. General mix area	1979		.01, .02, .02, .01, geo mean = .013

*Rhom and Haas Delaware Valley, Inc. Data

2. Medical Monitoring

An effective management program including scheduled physicals and biological monitoring, is carried out by the Medical Staff under the direction of David Spratt, D.O. The effectiveness of the environmental control program has been verified by the simultaneous reduction in urinary cadmium levels among exposed workers, according to a letter from Dr. J. Rosenthal, Corporate Director of Health and Safety to Dr. Anthony Robbins, Director of NIOSH, dated September 20, 1979.

IV. CONCLUSIONS/RECOMMENDATIONS

1. Dust control procedures, used during manual bag handling operations, appear to be very effective based on company data. These procedures include good housekeeping procedures; work practices; engineering controls, including plant layout and design, process equipment and unit operations modification, and use of mechanical ventilation systems; and enforcement of a strict respiratory protection program.

2. The effectiveness of the control systems are further verified by company medical and environmental monitoring programs.

3. This plant should be considered as a prime candidate for an in-depth study of effective dust control during manual handling of bagged products.

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