

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO.77-22-409

PUREX CORPORATION
LONDON, OHIO

AUGUST 1977

I. TOXICITY DETERMINATION

Concentrations of soap dust measured at Purex on four different shifts showed all but three samples were below the Threshold Limit Values (TLV's) for total and respirable nuisance dust. Mean total and respirable dust concentrations measured were 3.43 mg/M^3 and 0.60 mg/M^3 respectively. Seventy-five employees from three shifts were involved in the medical portion of the study. No statistically significant difference was found between the pre and post shift pulmonary function tests. While the group as a whole showed no significant difference from pre and post shift studies, there were a number of individuals who had abnormal pulmonary function results. Some of these abnormalities are difficult to explain. There was also a high incidence of upper respiratory symptomatology that indicated moderately severe irritation. Because of the presence of unexplainable pulmonary function changes, the high incidence of upper respiratory irritation and the high alkalinity of the soap dust, it is the investigators' opinion that this particular dust should not be categorized as a mere nuisance dust. Therefore, the existing ventilation should be operative at all times and steps taken to see that exposures are reduced. Because of the potential health effects from exposure to this dust, a medical surveillance program should be instituted which includes a preplacement history, physical examination, a chest x-ray and basic pulmonary function studies. These tests should be repeated on a routine basis every one to three years.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are currently available upon request from NIOSH, Division of Technical Service, Information and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service, NTIS, Springfield, Virginia. Information regarding its availability through NTIS can be obtained from NIOSH, Publications Office, at the Cincinnati address. Copies of this report have been sent to:

- a) Purex Corporation, London, Ohio
- b) Authorized representatives of employees
- c) U.S. Department of Labor - Region V
- d) NIOSH - Region V

For the purpose of informing the approximately 85 "affected employees", the employer shall promptly "post", for a period of 30 calendar days, the Determination Report in a prominent place(s) near where exposed employees work.

III. INTRODUCTION

Section 20 (a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669 (a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by an employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The National Institute for Occupational Safety and Health, (NIOSH), received such a request from an authorized representative of employees regarding employees exposure to soap dust from soap impregnated steel wool pads. The request stated that employees were experiencing breathing difficulties due to exposure to the dust.

IV. HEALTH HAZARD EVALUATION

A. Conditions of Use

Purex Corporation in London, Ohio, is engaged in manufacturing steel wool soap pads. The hazard evaluation was conducted in Building 6, where the soap pads are sorted and then bagged or boxed. Two employees per shift work as sorters. The sorters remove, by hand, pads from a conveyor belt that do not meet specifications. The "scrap pads" are then hand packed into plastic bags and placed in cartons for shipment. Two to ten employees at any given time may be working as scrap packers. One to two employees are typically packing pads into boxes by hand. This is a hand operation because of the large number of pads placed in each box. The remainder of the pads are packed into boxes by machines. One machine operator and one helper work at each machine. There are approximately eight machines in operation. In addition, there are approximately two to four employees that work as floorboys on each shift. The floorboys sweep and clean up throughout the area during the shift.

It should be noted that local ventilation is present at the various work sites. The ventilation, however, was not in operation during the time of the surveys at Purex. The company stated that the ventilation is not in use during the winter months (November - April) due to the need to conserve energy.

B. Evaluation Design and Methods

An initial survey was conducted at Purex, on December 8, 1976. Personal breathing zone samples for total and respirable dust were collected on seventeen employees. Non-directed medical interviews were also conducted with the employees in the area.

A follow-up environmental/medical survey was conducted on February 14 and 15, 1977. During three shifts, a total of 34 total dust and 32 respirable dust personal breathing zone samples were collected. On both surveys, the total dust samples were collected using closed faced cassettes containing VM-1 filters and sampling at a flow rate of 1.5 lpm. Respirable dust samples were collected using 10 mm nylon cyclones and VM-1 filters using a flow rate of 1.7 lpm.

All workers on each of the three shifts were invited to participate in the medical evaluations. The study consisted of occupational histories, physical examinations and pre and post shift pulmonary function studies. At the beginning of each shift, employees were asked to sign a standard consent form and then have their pre shift pulmonary function studies performed. During the work shift an occupational medical questionnaire with specific emphasis on respiratory and upper respiratory symptomatology was administered. A brief physical examination concentrating on the mucous membranes of the nose, throat, eyes and examination of the lungs was then performed. At the end of each shift, employees were recalled, a post shift questionnaire, physical examination and pulmonary function studies were done.

Pulmonary studies were done on two bellows-type Vitalograph spirometers. In performing these studies, care was taken that each individual patient was tested by the same examiner and on the same machine that he or she had had his or her morning studies performed on. Predicted spirographic indices were taken from the article by Kamburoff.¹

C. Evaluation Criteria

Soap Dust - A review of the literature indicates that soap dust is an entity that has not been investigated with respect to its capability of causing diseases in humans. In the past, it has been considered simply a nuisance dust and has had the threshold limit values (TLV's) as set forth by the American Conference of Governmental Industrial Hygienists (ACGIH), of 5 mg/M³ for respirable dust and 10 mg/M³ for total dust applied to it as is the case with other "nuisance dusts".

Soap is defined as the alkaline metal salt of fatty acids. Sodium and potassium hydroxide are the alkalines used in most soap products and the fatty acids are derived from animal fats or vegetable oils.

Occasionally an organic alkaline material such as biphenyl amine is used to increase lability, particularly in liquid soap preparations.

D. Results and Discussion

Seventy-five employees from three shifts at the Purex Corporation were evaluated during this study. The graphic information defining this group can be seen in Table I. The symptoms solicited during this evaluation can also be found in Table I. A large percentage of individuals during each shift complained of stuffy or runny nose and nasal irritation. Physical examinations revealed a large number of individuals on each shift to have reddened mucous membranes, especially of the nasopharynx (Table II).

Tables III, IV and V show the results of pre and post shift pulmonary function studies performed on each individual. The three parameters measured with the pulmonary function studies were the forced expiratory volume in one second (FEV₁), the forced vital capacity (FVC) and the maximal mid-expiratory flow rate (MMEFR). Tables III, IV and V show that there were no significant differences on any of the three shifts between the pre and post shift tests. In addition, smokers were compared with nonsmokers on each shift and there was no significant differences in these groups either.

While the group as a whole showed no significant differences from pre and post shifts, there are a number of individuals who have abnormal pulmonary function studies. These are indicated on the tables by asterisks. There are thirteen individuals whose pulmonary function studies were abnormal. This group was divided into two fractions. The first, the smokers, numbered eight. Their average length of employment at Purex was 2.7 years and most if not all their pulmonary function abnormalities probably can be attributed to cigarette smoking. The second group numbered five and were not smokers. The pulmonary function study abnormalities in these five individuals are more difficult to explain. By and large, they occur in people who are relatively young and do not have any other evidence of pulmonary disease. The average length of employment for these individuals was 4.3 years.

Table VI shows the concentrations of soap dust measured on December 8, 1976. Tables VII, VIII and IX show the soap dust concentrations measured on February 14 and 15, 1977. A review of the tables show only three concentrations exceeded the TLV for total nuisance dust. The respirable dust samples were all well below the current respirable dust standard for nuisance dust of 5 mg/M³. Table X shows the soap concentrations measured on February 14 and 15 broken down on a shift basis. The mean concentrations and standard deviations show levels that are well below current nuisance dust TLV's.

In testing the particular soap in question at Purex, the NIOSH laboratory took a bulk sample of the soap dust and added it to pH 7 water at a ratio of one milligram of soap dust per milliliter of water. The pH of the solution was found to be 10.5. This is considered moderately to severely alkaline.

After comparing the pre and post shift pulmonary function studies on each of three shifts at Purex, it is obvious that there is no statistically significant difference between pre and post shift tests done on these seventy-five workers. There is, however, a high incidence of upper respiratory symptomatology that indicates moderately severe irritation. The finding of reddened mucous membranes in the nasopharynx substantiates this historical data. In addition, because of the extreme alkalinity of the soap being used and the fact that there are respirable sized particles, it is not unreasonable to assume that there might be occasional individuals, who, because of their hyperactive respiratory airways, might exhibit some bronchial constriction due to the deposition of these highly alkaline particles in the smaller airways of the lung. Because of these factors and because of the presence of unexplainable pulmonary function changes, the high incidence of upper respiratory symptomatology and the high alkalinity of the soap dust, it is the investigators opinion that this particular dust be categorized as more than simply a mere nuisance dust. Since soap is made from and has a high alkalinity similar to sodium and potassium hydroxides for which the standard of 2 mg/M^3 applies, it is felt that for this alkaline dust a more reasonable limit would similarly be 2 mg/M^3 for total dust and less than 1 mg/M^3 for respirable dust.

E. Recommendations

1. The existing ventilation should be operative at all times and measurements made to see that exposures are reduced to the levels recommended in this report.
2. The ventilation system should be changed to provide for recirculation, including filtration of air. The recirculation of air requires the proper selection of a particulate air cleaner. A review of exhaust air recirculation criteria can be found in HEW Publication No. (NIOSH) 76-186, "Recirculation of Exhaust Air". This change would eliminate the waste of energy involved in heating the air in the cold winter months and then expelling it outside through the ventilation system.
3. Employees using personal protective equipment should be provided with the appropriate respirator and instructed in the proper use, fitting and cleaning of that respirator according with the requirements outlined in the General Industry Standards (Code of Federal Regulations), Title 29, Part 1910.134 - Occupational Safety and Health Standards.
4. Employees should be educated in proper work procedures and handling methods of this material so as to help reduce airborne concentrations.
5. A vacuum system could be used for clean-up procedures rather than sweeping. This procedure would help reduce airborne concentrations of dust.
6. A medical surveillance program should be instituted which includes a preplacement history, physical examination, a chest x-ray and basic pulmonary function studies. These tests should be repeated on a routine basis, every one to three years, depending on the age of the employee.

V. REFERENCES

1. Kamburoff, P.L. and Woiewetz, H.J., Prediction of Spirometric Indices, British Journal of Diseases of the Chest, 1972.
2. Gleason, Marion, Clinical Toxicology of Commercial Products, Third Edition, 1969.
3. Documentation of the Threshold Limit Values, American Conference of Governmental Industrial Hygienists, Third Edition, 1971.

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Table I
Respiratory Symptoms
Purex HHE 77-22
By History
2/13, 2/14 1977

Symptoms	1st Shift		2nd Shift		3rd Shift	
	Yes	No	Yes	No	Yes	No
1. Dry or sore throat	5 (19%)	22 (81%)	9 (32%)	19 (68%)	6 (30%)	14 (70%)
2. Burning or itching eyes	3 (11%)	24 (89%)	2 (7%)	26 (93%)	0 (0%)	20 (100%)
3. Headaches	4 (15%)	23 (85%)	2 (7%)	26 (93%)	1 (5%)	19 (95%)
4. Stuffy or runny nose	14 (52%)	13 (48%)	14 (50%)	14 (50%)	11 (55%)	9 (45%)
5. Nasal Irritation	11 (41%)	16 (59%)	9 (32%)	19 (68%)	7 (35%)	13 (65%)
6. Cough	5 (19%)	22 (81%)	4 (14%)	24 (86%)	2 (10%)	18 (90%)
7. Chest Tightness	4 (15%)	23 (85%)	5 (22%)	23 (78%)	1 (5%)	19 (95%)
8. Wheezing	1 (4%)	26 (96%)	3 (11%)	25 (89%)	2 (10%)	18 (90%)
9. Shortness of Breath	3 (11%)	24 (89%)	4 (14%)	24 (86%)	0 (0%)	20 (100%)

Demographic Information

Smokers	Yes 10	No 17	Yes 21	No 7	Yes 11	No 9
Years at Purex	Mean 3.5 yrs Range .05-12 years		Mean 2.8 yrs Range 0.01-19		Mean 3.7 yrs Range .04-15	
Age	Mean 42.6		Mean 32.1		Mean 37.6	
Sex	Male 6	Female 21	Male 10	Female 18	Male 4	Female 16
Race	White 25	Black 2	White 23	Black 5	White 18	Black 2

Table II
 Physical Examination
 Purex HHE 77-22
 2/13, 2/14 1977

	Shift 1		Shift 2		Shift 3	
	Normal	Abn.	Normal	Abn.	Normal	Abn.
Nose	14 (52%)	13 (48%)	18 (64%)	10 (36%)	12 (60%)	8 (40%)
Eyes	21 (78%)	6 (22%)	27 (96%)	1 (4%)	20 (100%)	0 (0%)
Throat	26 (96%)	1 (4%)	20 (71%)	8 (29%)	18 (90%)	2 (10%)
Lungs	26 (96%)	1 (4%)	25 (89%)	3 (11%)	20 (100%)	0 (0%)

Nose, eye, and throat examinations were aimed at detecting mucous membrane irritation

Lung abnormalities revealed 3 cases of expiratory wheezing and 1 case of markedly reduced breath sounds.

TABLE III

Pulmonary Function Studies
 Purex Corporation - 1st Shift
 February 13, 1977, HHE 77-22

Worker Number	Forced Expiratory Volume (1 Sec)(Liters)			Forced Vital Capacity (Liters)			Maximal Midexpiratory Flow (25-75%) (Liters/Sec)		
	Pred	Pre	Post	Pred	Pre	Post	Pred	Pred	Post
001	2.4	2.9	2.95	3.0	3.75	3.75	2.6	2.0	2.2
002	2.85	2.65	2.65	3.45	3.3	3.35	2.95	2.0	1.9
003	2.90	2.85	2.85	3.41	3.15	3.2	3.18	4.5	4.3
004	2.85	3.15	3.2	3.36	3.65	3.7	3.2	3.6	3.4
005	4.82	4.02	4.15	5.88	4.42	4.55	5.55	6.1	7.0
006	2.38	1.6	1.7	3.0	2.42	2.4	2.62	.85	1.01
007	3.15	4.1	4.3	4.08	5.05	5.1	3.2	3.6	4.3
008	2.5	3.1	3.1	3.1	3.62	3.52	2.72	3.65	3.8
009	2.6	3.22	3.4	3.3	4.1	4.25	2.62	2.68	2.8
010	3.6	3.95	3.85	4.8	5.4	5.3	3.61	2.7	2.5
011	4.0	3.85	4.1	4.72	4.6	4.65	4.6	3.7	4.2
012	2.85	3.18	2.95	3.35	3.7	3.65	3.2	3.45	2.5
013	2.7	3.05	3.08	3.35	3.6	3.45	2.8	3.55	4.25
050	2.31	2.6	2.65	2.91	3.05	3.15	2.6	2.7	2.7
051	2.75	3.0	2.7	3.4	3.6	3.35	2.85	2.9	2.25
052	2.75	3.0	2.93	3.3	3.95	3.9	3.05	2.01	1.85
053	Poor Tracing - Unable to Interpret								
*054	3.11	2.88	2.45	3.83	3.3	2.82	3.11	4.1	5.5
055	2.81	2.45	2.35	3.46	2.9	2.85	2.92	2.8	2.35
056	2.95	3.4	3.35	3.52	3.6	3.5	3.21	4.5	4.2
057	3.75	4.55	4.5	4.95	5.7	5.6	3.75	3.8	4.25
058	3.05	3.6	3.48	3.7	4.22	4.1	3.15	3.8	3.35
059	2.95	3.42	3.45	3.51	3.78	3.8	3.25	5.2	4.8
060	2.9	3.25	3.15	3.4	3.6	3.6	3.24	3.2	2.8
*061	2.41	2.2	2.25	3.05	3.1	3.45	2.6	1.24	3.1
062	1.88	2.05	2.05	2.45	2.6	2.62	2.28	1.6	1.5
063	Poor Tracing - Unable to Interpret								
MEAN	2.93	3.13	3.10	3.61	3.76	3.73	3.15	3.21	3.32
S.D. ±	0.71	0.71	0.77	0.85	0.80	0.83	0.82	1.26	1.39
NONSMOKERS									
MEAN	2.96	2.99	3.00	3.36	3.68	3.63	3.06	3.43	3.47
S.D. ±	.66	.60	.95	.91	.76	.79	1.04	1.40	1.51
SMOKERS									
MEAN	2.85	3.17	3.16	3.16	3.99	4.04	3.07	2.76	2.91
S.D. ±	.44	.68	.70	.70	.91	.83	.36	.89	.79

* - Abnormals
 Pred - Predicted values
 Pre - Pre-shift
 Post - Post shift

Table IV

Pulmonary Function Studies
 Purex Corporation-2nd Shift
 February 13, 1977 HHE 77-22

Worker Number	Forced Expiratory Volume (1 sec)(liters)			Forced Vital Capacity (liters)			Maximal Midexpiratory Flow (25-75%)(liters/sec)		
	Pred	Pre	Post	Pred	Pre	Post	Pred	Pre	Post
201	3.3	3.96	4.05	3.89	4.66	4.55	3.49	4.2	4.7
202	1.9	2.9	2.85	2.1	3.27	3.2	2.85	3.4	2.9
203	2.5	3.2	3.11	3.21	3.75	3.65	2.6	3.9	3.9
204	4.2	4.68	4.5	4.75	5.4	5.38	4.9	4.35	4.0
205	2.96	3.01	2.9	3.5	3.55	3.55	3.28	2.7	2.25
206									
*207	2.28	.8	.6	2.85	1.15	.76	2.61	.38	.35
208	4.85	4.5	4.7	5.55	5.13	5.35	5.6	5.15	5.15
209	2.09	2.8	2.75	2.68	3.2	3.3	2.4	3.25	2.45
210	2.6	2.78	2.95	3.15	3.6	3.75	2.86	1.95	2.26
211	4.25	4.35	4.05	4.95	5.16	5.12	4.9	4.05	3.05
212	2.4	3.05	3.15	3.01	3.65	3.75	2.65	3.15	3.4
213	5.32	5.25	5.1	6.2	5.95	5.95	6.2	4.5	4.5
214	4.35	4.45	4.65	4.95	5.1	5.37	5.2	4.6	4.6
*251	3.02	4.12	3.85	3.51	4.58	4.25	3.4	4.4	4.4
	3.19	3.2	3.02	3.71	3.05	3.65	3.45	2.85	2.6
253	4.73	4.0	4.1	5.69	4.45	4.62	5.2	4.9	4.9
*254	5.45	5.5	4.95	6.4	5.85	5.55	6.2	6.5	4.9
255	3.0	3.9	3.6	3.7	4.6	4.35	3.02	4.0	3.6
*256	2.08	2.15	2.0	2.75	3.67	3.4	2.28	.82	.85
*257	4.72	4.9	4.95	5.35	6.4	6.52	5.51	3.7	3.6
258	5.0	5.0	5.0	5.72	5.55	5.5	5.75	5.1	5.6
259	5.11	5.25	5.2	5.9	5.5	5.62	5.9	6.25	5.8
260	2.8	3.55	3.55	3.26	4.05	4.05	3.15	3.6	3.6
261	2.75	2.15	2.3	3.35	2.55	3.0	2.94	2.1	1.5
262	3.15	3.85	3.45	3.7	4.4	4.07	3.43	4.0	3.6
*263	2.55	2.75	2.55	3.01	3.62	3.45	2.95	1.85	1.8
264	2.89	2.85	2.67	3.55	3.55	3.5	2.99	2.3	2.01
MEAN	3.51	3.67	3.58	4.09	4.30	4.26	3.95	3.63	3.42
S.D.+	1.12	1.10	1.10	1.23	1.14	1.18	1.33	1.43	1.39
NONSMOKERS									
MEAN	3.67	3.53	3.38	3.67	4.14	4.01	3.39	3.49	3.44
S.D.+	.83	.75	.77	.87	.69	.68	1.01	1.05	1.23
SMOKERS									
MEAN	3.62	3.65	3.65	4.26	4.37	4.37	4.14	3.46	3.41
S.D.+	1.21	1.22	1.25	1.35	1.31	1.36	1.41	1.77	1.53

Abnormals

- Predicted values

Pre - Pre-shift

Post - Post shift

Table V

Pulmonary Function Studies
 Purex Corporation-3rd Shift
 February 14, 1977 HHE 77-22

Worker Number	Forced Expiratory Volume (1 sec)(liters)			Forced Vital Capacity (liters)			Maximal Midexpiratory Flow (25-75%)(liters/sec)		
	Pred	Pre	Post	Pred	Pre	Post	Pred	Pre	Post
301	3.01	2.95	3.2	3.61	3.94	4.2	3.21	2.1	2.6
302	2.32	2.6	2.4	2.85	3.0	2.95	2.71	3.2	3.0
303	2.95	2.35	2.4	3.55	3.0	3.05	3.15	1.68	1.8
*304	2.38	1.65	1.7	2.95	2.5	2.37	2.65	.74	.95
305	3.25	4.05	4.1	3.8	4.7	4.65	3.48	4.0	4.0
306	2.15	2.6	2.5	2.75	2.9	2.7	2.4	3.7	4.1
307	2.35	2.75	2.65	2.85	3.25	3.05	2.73	3.1	2.9
308	2.49	2.25	2.4	3.11	2.02	3.1	2.65	1.52	1.7
309	4.85	4.05	4.1	5.52	4.55	4.63	5.6	3.9	4.25
310	4.6	4.35	4.25	5.3	5.4	5.1	5.25	3.4	3.6
351	2.61	3.1	3.12	3.2	3.75	3.75	2.85	3.3	3.2
352	4.71	4.15	3.71	5.45	5.3	4.95	5.4	3.2	2.65
353	4.75	6.05	5.8	5.45	6.2	6.0	5.5	6.5	6.25
354	2.75	3.2	3.1	3.5	3.8	3.75	3.0	2.9	3.0
355	2.75	2.9	2.85	3.16	3.37	3.35	3.06	3.0	2.85
356	2.2	2.8	2.7	2.9	3.3	3.25	2.58	3.0	2.9
357	2.9	2.65	2.6	3.55	3.15	3.2	3.0	3.0	2.35
358	3.25	4.3	4.5	3.8	4.93	5.05	3.46	4.2	4.6
359	2.92	3.5	3.3	3.48	4.1	3.95	3.15	3.4	2.8
360	2.09	2.55	2.67	2.7	3.05	3.23	2.35	3.0	2.85
MEAN	3.06	3.24	3.20	3.67	3.86	3.81	3.38	3.14	3.12
S.D. ±	0.92	1.00	0.96	0.96	1.01	0.97	1.04	1.17	1.15
NONSMOKERS									
MEAN	2.80	3.13	3.07	3.39	3.62	3.58	3.11	3.20	3.14
S.D. ±	.80	1.17	1.07	.84	.77	.99	.95	1.44	1.36
SMOKERS									
MEAN	3.28	3.33	3.31	4.00	4.05	4.01	3.65	30.9	31.0
S.D. ±	.99	.90	.90	1.02	.99	.95	1.18	.97	1.02

* - Abnormals

Pred - Predicted values

Pre - Pre-shift

Post - Post shift

TABLE VI

Purex Corporation
London, Ohio

Personal Breathing Zone Airborne Dust Concentrations
December 8, 1976

<u>Sample Location</u>	<u>Sample Number</u>	<u>Sampling Period</u>	<u>Sample Volume (liters)</u>	<u>Total Dust Concentration (mg/M³)</u>
Sorter	1955	7:10-14:43	619	1.4
Messanine Foreman	1976	7:17-14:40	604	11.0
Floater	1917	7:22-14:40	597	2.0
Machine Operator	1909	7:26-14:53	610	2.7
Machine Operator	1919	7:35-14:45	585	5.2
Machine Operator	1993	7:46-14:48	573	4.7
Scrap Packer	1910	7:50-14:25	532	13.3
Clean-up Worker	1950	8:00-14:55	562	3.5
Clean-up Worker	1985	7:55-14:41	549	5.0
Boxer	1908	8:10-14:46	436	2.3
				<u>Respirable Dust Concentration</u>
Sorter	2383	7:15-14:42	419	0.42
Machine Operator	2036	7:20-14:45	433	0.27
Machine Operator	1957	7:30-14:52	428	0.48
Machine Operator	1913	7:37-11:30	144	0.42
Machine Operator	2371	7:45-14:50	427	0.69
Scrap Packer	2387	7:53-14:38	421	0.68
Boxer	1963	8:07-14:47	620	0.14

Table VII
 Purex Corporation
 London, Ohio
 Personal Breathing Zone Airborne Dust Concentrations
 February 14, 1977

(Shift 7:00 a.m. - 3:00 p.m.)

<u>Sample Location</u>	<u>Sample Number</u>	<u>Sampling Period</u>	<u>Sample Volume (liters)</u>	<u>Total Dust Concentration (mg/M³)</u>
Machine Operator	2989	7:18 - 14:14	416	3.7
Floorboy	2814	7:30 - 13:58	388	2.8
Gluer	2949	7:38 - 14:00	352	1.8
Machine Helper	2960	7:46 - 14:17	401	1.3
Scrape Packer	3321	7:55 - 14:02	623	3.7
Machine Helper	2963	8:05 - 14:00	355	1.2
Machine Operator	2908	8:12 - 14:03	351	3.8
Machine Operator	2948	8:15 - 14:05	350	3.3
Machine Operator	2939	8:21 - 14:07	346	2.8
Floater	2924	8:27 - 14:28	361	5.1
Machine Operator	2987	8:35 - 14:10	335	3.0
Machine Helper	2950	8:51 - 14:13	322	3.8
ter	2933	8:57 - 14:35	338	2.8
Assanine Foreman	2915	9:06 - 14:35	299	3.6

				<u>Respirable Dust Concentrations</u>
Machine Operator	135	7:18 - 13:58	680	0.93
Boxer	3233	7:25 - 14:16	698	0.34
Machine Operator	142	7:36 - 14:20	686	0.82
Machine Helper	3242	7:45 - 14:00	637	0.17
Floorboy	3321	7:55 - 14:02	623	1.2
Machine Operator	142	7:58 - 14:26	659	0.66
Machine Operator	144	8:05 - 14:25	646	0.29
Floorboy	141	8:14 - 14:30	639	0.94
Floater	2780	8:20 - 14:30	629	0.27
Machine Helper	3240	8:35 - 14:30	552	0.43
Boxer	2754	8:37 - 14:11	534	0.26
Relief Worker	3285	8:47 - 14:32	586	0.48
Bailer	126	8:56 - 12:30	214	2.1
Sorter	138	8:58 - 14:15	539	0.54

Table VIII

Purex Corporation
 London, Ohio
 Personal Breathing Zone Airborne Dust Concentrations
 February 14, 1977

(Shift 11:00 p.m. - 7:00 a.m.)

<u>Sample Location</u>	<u>Sample Number</u>	<u>Sampling Period</u>	<u>Sample Volume</u> (liters)	<u>Total</u> <u>Dust Concentration</u> (mg/M ³)
Floater	2997	23:15 - 6:40	445	3.1
Machine Operator	2945	23:20 - 6:45	445	5.3
Machine Helper	2982	23:32 - 6:43	431	3.0
Machine Operator	2980	23:41 - 6:50	429	2.4
Gluer	2925	23:56 - 6:50	414	1.5
Machine Helper	2996	24:05 - 6:55	410	3.0
Floorboy	2940	24:21 - 6:45	384	1.7
Boxer	2981	24:35 - 6:40	365	2.0
Floorboy	2952	24:42 - 6:50	368	2.8
Sorter	2946	24:48 - 6:50	362	2.5
				<u>Respirable Dust</u> <u>Concentrations</u>
Floater	130	23:16 - 6:43	759	0.42
Machine Helper	128	23:22 - 5:43	664	0.96
Machine Operator	2788	23:33 - 6:44	732	0.48
Machine Helper	3294	23:43 - 6:45	717	0.71
Boxer	139	23:55 - 6:45	697	0.36
Machine Operator	3241	24:07 - 6:55	693	0.32
Boxer	140	24:23 - 6:45	649	0.45
Floorboy	125	24:34 - 5:37	608	0.38
Floorboy	136	24:40 - 6:45	620	0.95
Packer	2768	24:45 - 6:43	608	0.61

Table IX

Purex Corporation
 London, Ohio
 Personal Breathing Zone Airborne Dust Concentrations
 February 15, 1977

(Shift 3:00 p.m. - 11:00 p.m.)

<u>Sample Location</u>	<u>Sample Number</u>	<u>Sampling Period</u>	<u>Sample Volume</u> (liters)	<u>Total Dust Concentration</u> (mg/M ³)
Boxer	3052	16:43 - 22:42	359	3.1
Machine Operator	2934	16:50 - 22:44	354	4.2
Machine Operator	2984	17:00 - 22:45	345	5.1
Scrap-Packer	2999	17:06 - 22:46	340	3.7
Machine Operator	2912	17:08 - 22:46	338	4.7
Floater	2917	15:10 - 21:58	408	3.5
Scrap-Packer	2926	15:19 - 22:03	404	4.0
Scrap-Packer	2919	15:35 - 22:07	392	2.9
Floorboy	2944	15:43 - 22:12	389	13.6
Machine Operator	2973	15:50 - 20:30	280	1.9
				<u>Respirable Dust Concentrations</u>
Floater	127	15:20 - 21:58	676	0.52
Scrap-Packer	137	15:21 - 22:03	683	0.42
Scrap-Packer	145	15:42 - 22:13	664	1.0
Relief Worker	131	15:43 - 22:09	656	0.46
Machine Operator	3322	15:51 - 22:21	663	0.35
Floorboy	3284	16:42 - 22:46	618	0.55
Machine Operator	3276	16:51 - 22:41	595	0.39
Machine Operator	3293	17:01 - 22:45	584	0.63

Table X
 Dust Concentrations
 On Each Shift
 Purex Corp HHE 77-22

			mg/M ³
Shift 1	Total Dust	Mean	3.05
		St Dev	± 1.07
	Respirable Dust	Mean	0.67
		St Dev	± 0.50
Shift 2	Total Dust	Mean	4.66
		St Dev	± 3.28
	Respirable Dust	Mean	0.54
		St Dev	± 0.21
Shift 3	Total Dust	Mean	2.73
		St Dev	± 1.06
	Respirable Dust	Mean	0.56
		St Dev	± 0.24
All Shifts	Total Dust	Mean	3.43
		St Dev	± 2.09
	Respirable Dust	Mean	0.60
		St Dev	± 0.37