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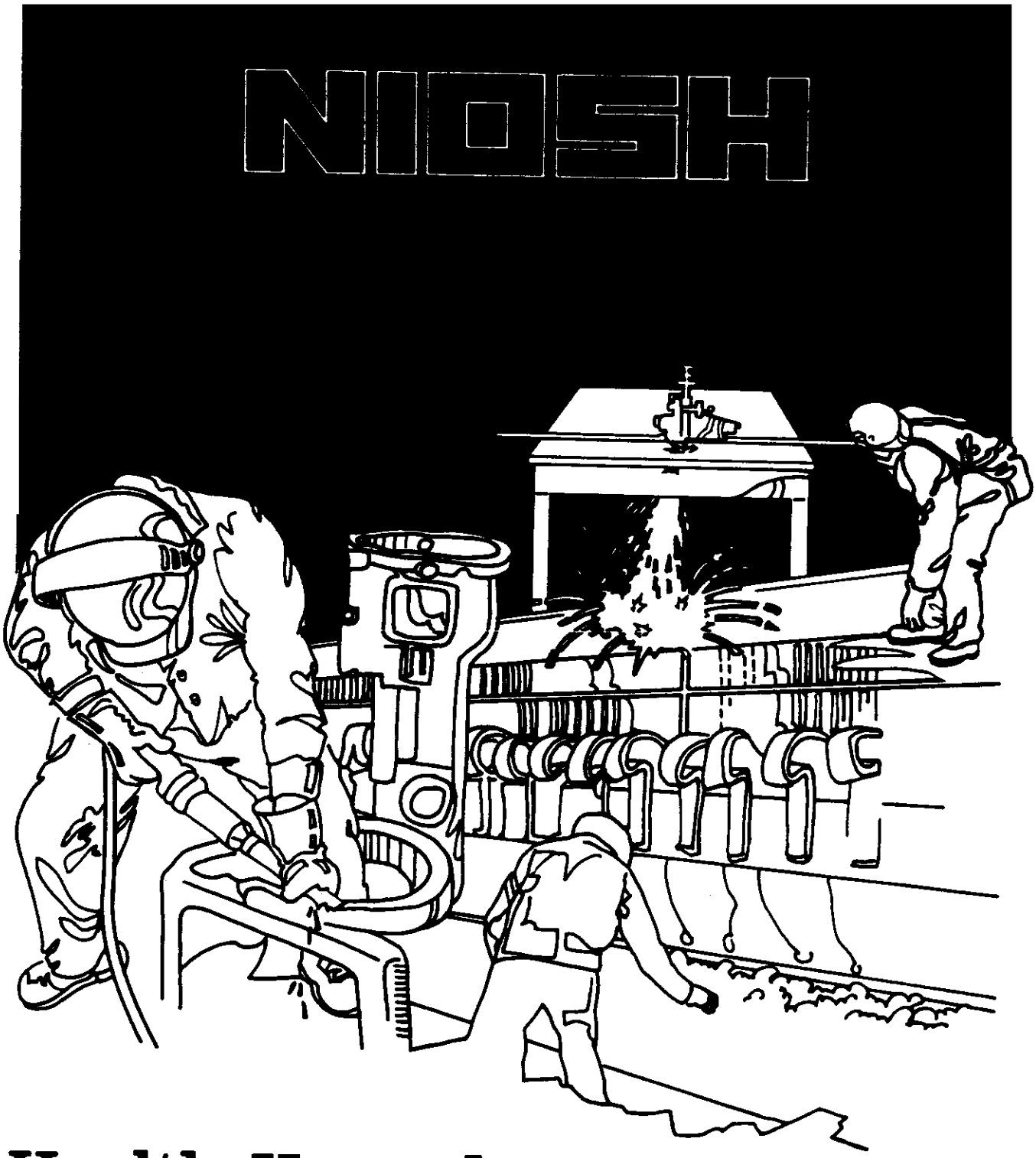

Health Hazard Evaluation Report

MHETA 88-249-1931
COMMUNITY SAVINGS ASSOCIATION
FINLEYVILLE, PENNSYLVANIA

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any 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 Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

MHETA 88-249-1931
SEPTEMBER 1988
COMMUNITY SAVINGS ASSOCIATION
FINLEYVILLE, PENNSYLVANIA

NIOSH INVESTIGATORS:
Wayne T. Sanderson, CIH
Carol Costa

I. SUMMARY

On April 28, 1988, the Division of Respiratory Disease Studies (DRDS), National Institute for Occupational Safety and Health (NIOSH) received a request from the Occupational Safety and Health Administration (OSHA) to conduct a health hazard evaluation of the Finleyville Branch of Community Savings Association. Employees at this bank office had reportedly experienced sensitization to fungus and were continuing to have symptoms of skin rash, nausea, headache, fatigue, sinus congestion, and difficulty breathing even after action to control the fungus had been taken. On May 25, 1988, a health hazard evaluation was conducted. This was followed on June 24, with pulmonary function testing of three full time and one part time employee, as well as one employee who had been transferred to another branch.

Exposure to microorganisms and inadequate supply of fresh air are likely causes of the symptoms experienced by employees at the Finleyville Branch. The pulmonary function tests results suggest there was no association of airway reactivity to the bank environment. Recommendations are made to alter the ventilation system to bring in fresh air and reduce exposure to microorganisms.

KEYWORDS: SIC 6036 (Savings and Loans) Office-buildings, indoor air pollution, tight building syndrome, ventilation.

II. INTRODUCTION

On April 28, 1988 the Division of Respiratory Disease Studies (DRDS) - National Institute for Occupational Safety and Health (NIOSH) received a request from the Occupational Safety and Health Administration (OSHA) to conduct a health hazard evaluation of the Finleyville Branch of the Community Savings Association. Employees at this bank office had reportedly experienced sensitization to fungus and were continuing to have symptoms of skin rash, nausea, headache, fatigue, sinus congestion, and difficulty breathing even after action to control the fungus had been taken.

The Finleyville Branch is a small office for the Community Savings Association located in Finleyville, Pennsylvania. There are 3 full time and 3 part time employees (all young white females) who handle traditional banking transactions. The office is situated at street level in the business district of Finleyville. The office space is leased from the American Legion, Post # 613, and is between a restaurant and lounge on one side and a barber shop and printing shop on the other. The American Legion hall is above the bank and an unoccupied basement below. The Finleyville Branch office has occupied this space since 1975.

The bank is partitioned into a front half which serves as the lobby and teller area and a back half which serves as a storage area. Between these two areas is a small break room. The lobby and teller areas are separated by a counter, across which banking transactions take place. The floor in this area is carpeted as is the lower portion of the counter, and the wall behind the teller area. The break room floor is also carpeted. These two areas have a suspended ceiling above which are lighting fixtures and ventilation ducts. Open cardboard boxes containing envelopes and files are stored in the backroom, as are holiday decorations and obsolete business machines. The backroom has a wooden floor with small pieces of carpeting covering portions of the floor.

One worker began to have complaints of skin rashes, hives, and welts, nausea, and headaches in October, 1986. This employee, who was the first to experience symptoms (index case), was diagnosed by an allergist as having allergic sensitivity to dusts and molds. By December 5, four additional employees were reportedly experiencing the same complaints. The employees believed their symptoms were being caused by fungus growing on a plaster wall in the back storeroom.

During the first two weeks of February, 1987 the wall in the storeroom was scraped, cleaned, and painted with a fungal resistant paint. However, on Tuesday, March 16, 1988 the office was closed early because all three full time employees were having symptoms of nausea, headaches, severe fatigue, difficulty breathing, irritability, sinus congestion, along with skin rash, hives, and welts. The wall in the storeroom was again cleaned and sprayed with a disinfectant, but employees had symptoms again on March 27, after a fan had been installed to blow on the wall in the backroom in order to dry moisture from the wall. After this date the index case was transferred to another branch office and has not work in the Finleyville Branch again.

Community Savings Association has implemented several measures to try to solve the problems. The wall has been cleaned and sprayed numerous times; a dehumidifier was placed in the storeroom to remove moisture; an exhaust fan was placed in the back wall of the bank; and a consultant service was hired to test for air contaminants. However, employees continue to complain of periodic episodes of skin rashes, sinus congestion, and difficulty breathing.

On May 25, 1988 a health hazard evaluation of the bank was conducted. This was followed on June 24, with pulmonary function testing of three full time and one part time employee, as well as the index case.

III. METHODS

Environmental

Air samples were collected for concentrations of carbon dioxide (CO_2) and viable aerosols (microorganisms). Colorimetric indicator tubes were used to test for concentrations of CO_2. Short-term samples (collected over a 5 minute period) and long-term samples (collected over a two hour period) were collected every two hours in the teller area, storeroom, and outside. These indicator tubes use colorimetric methods where the length of a color change in the sampling tube is a measure of gas concentration.[1]

Viable aerosol sampling was done using a modified Andersen viable sampler at a flow rate of one cubic foot per minute (cfm).[2] Samples were collected on malt extract agar for fungi and trypticase soy agar for bacteria. Samples were collected for 4, 6, and 12 minutes in the teller area, backroom, and outside. The agar plates were incubated in the dark at room temperature and colony counts made at 24, 48, and 90 hours. No identification/speciation of the microorganisms was done.

The office area was inspected for problem conditions, such as mold growth, flooding/water incursions, and design and maintenance of the ventilation system. Air flow patterns in the office area were determined using smoke generating tubes and temperature and relative humidity measurements made.

Carbon monoxide and ethanol vapors had been suggested as possible hazards, but there was no reason to suspect exposure to these contaminants. Therefore no sampling for these agents was done.

Medical

Three full time, one part time, and the index case who had been transferred to another branch were questioned regarding type and onset of their symptoms which they believed were associated with their work environment. Each one of the current workers was also given a pulmonary function test at the beginning of their work shift and again approximately four hours later. The index case was given a pulmonary function test in her home.

Pulmonary function testing was done using a rolling seal spirometer attached to a computer to calculate the following pulmonary function parameters: forced vital capacity (FVC), forced expiratory volume in one second (FEV_1), and the ratio of these two parameters (FEV_1/FVC). Each person performed at least five maximum expiratory maneuvers with their FVC, FEV_1, and FEV_1/FVC calculated from their best effort.

IV. EVALUATION CRITERIA

Environmental

Evaluation criteria are used as guidelines to assess the potential health effects of occupational exposures to substances and conditions found in the work environment. These criteria consist of exposure levels for substances and conditions to which most workers can be exposed day after day for a working lifetime without adverse health effects. Because of variation in individual susceptibility, a small percentage of workers may experience health problems or discomfort at exposure levels below these existing criteria. Consequently, it is important to understand that these evaluation criteria are guidelines, not absolute limits between safe and dangerous levels of exposure.

Several sources of evaluation criteria exist and are commonly used by NIOSH investigators to assess occupational exposures. These include:

1. The U.S. Department of Labor (OSHA Federal Occupational Health Standards; permissible exposure limits (PEL's); [3]

2. The American Conference of Governmental Industrial Hygienist (ACGIH) Threshold Limit (Exposure) Values (TLV's); [4]

3. NIOSH criteria documents and recommendations. (Recommended exposure limits.) [5]

These criteria have been derived from industrial experience, from human and animal studies, and when possible, from a combination of the three. consequently, due to differences in scientific interpretation of these data, there is some variability in exposure recommendations for certain substances. Additionally, OSHA considers economic feasibility in establishing occupational exposure standards; NIOSH and ACGIH place less emphasis on economic feasibility in development of their criteria.

The exposure criteria described below are reported as time-weighted average (TWA) exposure recommendations (averaged over the full work shift). These exposure criteria and standards are commonly reported as parts contaminant per million parts air (PPM), or milligrams of contaminant per cubic meter of air (mg/m^3). Occupational criteria for the contaminants evaluated in this study are as follows:

Substance	NIOSH (REC.)	ACGIH (TLV)	OSHA (PEL)
Carbon Dioxide	10,000 ppm	5,000 ppm	5,000 ppm
Carbon Monoxide	35 ppm	50 ppm	50 ppm
Ethanol	No Std.	1,000 ppm	1,000 ppm
Microorganisms	No Std.	No Std.	No Std.

- These criteria refer to time-weighted-average (TWA) exposure levels.

- ppm = Parts contaminant per million parts air.

-No Std. = No standard.

There are no established criteria for airborne fungi and bacteria to which our findings could be compared. Thus, viable aerosol concentrations were simply compared by area to concentrations in outside air.

Some research suggests that industrial exposure criteria may be inappropriate for evaluating IAQ problems in office buildings. [6,7] The American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) is one organization with environmental criteria designated to maintain acceptable IAQ in office building environments. They define acceptable IAQ as, "air in which there are no known contaminants at harmful concentrations and with which a substantial majority (usually 80%) of the people exposed do not express dissatisfaction." [6] ASHRAE recommends that outdoor air acceptable for ventilation (without treatment) meet the requirements established by the U.S. Environmental Protection Agency in the National Ambient Air Quality Standards and Additional Ambient Air Qualify Guidelines. [6]

ASHRAE also recommends criteria for indoor temperatures and ventilation rates for office buildings as detailed below:

Temp./Relative Humidity		Air Changes Per Hour	Minimum Outdoor Air
Winter	Summer		5 cu. ft. per min. (CFM)/person (non-smoking)
70-74°F	74-78°	4 to 10	
20-30% RH	40-50% RH		20 CFM/person (smoking)

ASHRAE is in the process of revising their recommendations on minimum outside air requirements for office buildings; however, the revisions are not in final print.

Carbon dioxide (CO_2) concentrations in indoor air are often used as an indirect measure of a building's capability to dilute indoor generated odors and irritants. The following CO_2 criteria have been used to assess IAQ in office environments: [8,9]

Carbon Dioxide (ppm)	Comments
Less than 600	Adequate outside air intake
600 - 800	There may be occasional complaints, particularly if the air temperature rises
800 - 1000	Complaints more prevalent
>1000	Insufficient make-up air, complaints are general

Medical

Individual pulmonary function parameters (FVC, FEV_1, and FEV_1/FVC) were compared to predicted values for healthy non smoking subjects with the same age, sex, race, and height characteristics. [10] FVC and FEV_1 were considered below normal limits if they were less than 80% of the predicted value. FEV_1/FVC is considered below normal limits if it is less than 0.7. "Normal limits" should not be interpreted as separating health from disease. A small subset of the population will be perfectly healthy but have below normal pulmonary function values, and within the normal range there will be an increasing probability that disease exists as one progresses from above predicted to low - normal values. [11] Therefore, comparison with predicted values is used to evaluate the general lung function of the Finleyville Branch population.

The early-shift pulmonary function tests were also compared to the pulmonary function tests taken four hours later. A greater than 5% decline over the shift in any parameter was considered to be abnormal.[12]

V. RESULTS

Environmental

Carbon dioxide (CO_2) levels in the teller area ranged from 600 parts per million parts air (ppm) in the morning to 800 ppm in the afternoon; CO_2 levels in the backroom ranged from 680 ppm in the morning to 750 ppm in the afternoon, while CO_2 concentrations outside ranged from 350 to 400 ppm. Each time CO_2 measurements were taken the levels were higher, indicating that the CO_2 concentration gradually increases over the workshift.

The concentrations of airborne bacteria and fungi are presented in Table 1. There was no appreciable difference between the concentrations of fungi in the teller area and the backroom. But, the concentrations of bacteria in the teller area were higher than in the backroom. However, outside concentrations of bacteria and fungi were clearly much higher than those inside the bank.

The Branch office is heated and cooled by a heating, ventilating, and air conditioning unit (HVAC) located near the ceiling of the storage room. The air is distributed to the break room, lobby, and teller areas through vents in the suspended ceiling, while the storage room is heated by a furnace located in the rear of the room. An exhaust fan is located adjacent to the back door in the rear wall of the store room.

There is no provision for fresh air to be brought into the bank through the HVAC unit; the unit provides only recirculation of office air. The air intake duct for the HVAC is above the drop ceiling and does not have a branch running to the outside to bring in fresh air. When the exhaust fan in the back wall of the bank is running, the office is under a slight negative pressure. Some outside air would be brought in whenever the front door is opened, but this would not provide the 5 or 20 cfm of fresh air per person recommended by ASHRAE.

Although no standing water or fungal growth was observed in the HVAC during the investigation, rust and water stains were observed and air supply ducts and vents were contaminated with black dirt. The HVAC filter was fiberglass mesh which appeared to be clean. When the exhaust fan is on, the general air flow pattern is from the front of the bank to the rear, but in the teller area, break room, and lobby the air moves very slowly. During the investigation on May 25 the HVAC had not been operating until 3:00 pm. After the system was turned on, one atopic (history of allergies) employee developed itchy, red welts on her arms, neck, and face.

A visitor to the bank is immediately struck by a musty odor. The carpeting was stained, but there was no obvious areas of water damage, nor were the floors found to be damp. The ceiling and suspended ceiling tiles were free of stains and water damage. The odor is more pronounced in the backroom; the files smell particularly musty and are dust covered. A small dehumidifier is operated in the backroom. During both investigations (May 25 and June 24), the wall in the backroom was free of fungal growth. The basement below the bank has a very strong musty odor and there were damp areas indicating water incursion through the walls or from leaky plumbing.

Temperature and relative humidity measurements for the May 25 investigation are given in Table 2. The backroom was somewhat cooler and had a higher percent relative humidity than the teller lobby area.

Medical

All five employees who were interviewed regarding their health complaints and given pulmonary function tests were young white females between the ages of 24 and 38. Their length of employment at the Finleyville Branch ranged from 1 to 6 years. Two of them had never smoked cigarettes and three were exsmokers. Only one had a history of allergies (atopic) and none had a history of asthma.

The symptoms and number of workers who complained of these symptoms are presented in Table 3. The most common complaints were skin rashes, shortness of breath, dizziness, chest tightness, and, surprisingly, heart palpitations. Skin rashes, also described as welts, hives, and itching skin, were usually the initial symptom. Skin rashes also occurred most frequently and were the most persistent complaint. When symptoms occurred, usually they began sometime in the morning and persisted throughout the day. All employees claimed that their symptoms were either better or did not occur at all when away from work, except for the index case. The index case still has periodic skin problems and sinus congestion, but her breathing is better.

None of the five bank employees had pulmonary function parameters below normal limits. Four had FVC and FEV_1 values greater than 100% of their predicted values. One employee had an FVC value 83% of predicted and an FEV_1 93% of predicted. The ratio FEV_1/FVC was greater than 0.80 for all employees. These measurements indicate that the employees have not experienced chronic long-term decrements in their lung function.

Although all four employees who had early and late shift pulmonary function tests had slight decreases in FVC, FEV_1 and FEV_1/FVC over the shift, none of these decreases were greater than 5% of the early morning values. The pulmonary function tests suggest there was no association of airway reactivity to the bank environment on the day of testing.

VI. DISCUSSION AND CONCLUSIONS

Exposure to microorganisms and inadequate supply of fresh air are likely causes of the symptoms experienced by employees at the Finleyville Branch. The bank has a history of hygienic problems with mold growing on a wall in the backroom. The probable cause of this growth was water leakage through the wall and moisture on the paint and plaster providing a suitable substrate for microbial growth. Although this problem has apparently been rectified, microorganisms are likely to still be contaminating the ventilation system, carpeting, and files stored in boxes in the backroom. Airborne microorganism concentrations are quite variable and will change as conditions change. In particular, increasing airborne microbial concentrations are correlated with increasing humidity. Steps should be taken to reduce contamination and dissemination of microbial aerosols.

Individual susceptibility to airborne microorganisms is also quite variable. Skin rashes, sinus congestion, fevers/chills, muscle-aches, and fatigue may be reactions to microorganisms disseminated through office ventilation systems. Nausea, headaches, eye irritation, dizziness and fatigue are commonly associated with a lack of adequate fresh air. However, some of these workers'

symptoms, for example heart palpitations, may be caused or exacerbated by anxiety about their working environment. There is no evidence that workers have experienced pulmonary changes associated with their work at the Finleyville Branch.

The ventilation system is inadequately designed and maintained. Although the exhaust fan in the back wall of the storeroom has helped, there is still no provision for fresh air intake.

VII. RECOMMENDATIONS

Officials for Community Savings Association propose to relocate the Finleyville Branch to a new facility. If employees are to remain at the present location these recommendations should be followed:

1. The heating, ventilating, and air conditioning unit (HVAC) should be operated according to ASHRAE standards; some design/operation changes are needed.

   A. An outside air source should be added to the system to assure at least 5 cfm of fresh air per occupant. Because of a history of contaminated air and complaints of a musty odor, a greater intake of fresh air is suggested (20 cfm per occupant).

   B. Frequent cleaning of the HVAC cooling coils, condensate pans, side panels and fan blades is needed to remove build up of dirt/debris. No special cleaning chemicals are needed; soap/over-the-counter cleaning solutions and water are sufficient. This task would be simplified by providing a convenient access panel to the HVAC which could be opened without removal of numerous screws.

   C. The air supply ducts and vents should be inspected and cleaned.

2. Relative humidity should range between 20-50% as specified by ASHRAE. The small dehumidifier in the storeroom may provide some reduction in the humidity, but during damp conditions high outside relative humidity this small unit may not be adequate to reduce the humidity to recommended levels.

3. The storeroom wall should continue to remain free of microbial growth. This may require frequent inspection and cleaning.

4. The files in open boxes in the storeroom should be cleaned and placed in enclosed cabinets to reduce further contamination.

If problems continue to occur, the Finleyville Branch should be closed and the ventilation system, ceiling, floors, walls, fixtures, furniture, and files should be cleaned with a vacuum using a high efficiency filter and disinfected with cleaning solutions.

VII. REFERENCES

1. Leichnitz, K. Detector tube handbook, 6th Ed. Draeger Werk Ag. August 1985, pp 1-59.

2. Jones W, Morring K, Morey P, and Sorenson W. Evaluation of a single stage viable sampler. American Industrial Hygiene Association Journal 46:294-298, 1985.

3. CRF. Code of Federal Regulations. Occupational Safety and Health Administration Standards. 29 CFR 1910 and 1926 (1987).

4. ACGIH (1986) Threshold limit values for chemical substances and physical agents in the work environment with intended changes for 1987-1988. Cincinnati, OH. American Conference of Governmental Industrial Hygienists, pp 1-42.

5. Centers for Disease Control (CDC). NIOSH recommendations for occupational safety and health standards, MMWR 35:1-33, 1986.

6. ASHRAE (1981) American Society of Heating, Refrigerating, and Air-Conditioning Engineers. ASHRAE handbook: ventilation for acceptable indoor air quality. Atlanta, GA. Standard 62-1981:1-4.

7. ASHRAE (1982) American Society of Heating, Refrigerating, and Air-Conditioning Engineers. ASHRAE handbook: 1982 applications. Atlanta, GA. pp 31-34.

8. Rejhans G. Indoor air quality and CO_2 levels. Occupational Health in Ontario. 4:160-167 (1983).

9. Bell S, Khati B. Indoor air quality in office buildings. Occupational Health in Ontario. 4:103-118 (1983).

10. Knudson R, Lebowitz M, Holber C, Burrows B. Changes in the normal expiratory flow-volume curve with growth and aging. American Review of Respiratory Disease 127:725-735 (1983).

11. Merchant J, Boehlecke B, Taylor G. Occupational Respiratory Diseases, U.S. Department of Health and Human Services, DHHS(NIOSH) Publication No. 86-102, September 1986, pp 155-168.

12. Hankinson J. Pulmonary function testing in the screening of workers: guidelines for instrumentation performance and interpretation. Journal of Occupational Medicine 28:1081-1092 (1986).

VIII. AUTHORSHIP AND ACKNOWLEDGMENTS

Report prepared by: Wayne T. Sanderson, CIH
Clinical Investigations Branch
Mining Hazard Evaluation and Technical Assistance Program

Originating Office: Mining Hazard Evaluation and Technical Assistance Program
Division of Respiratory Disease Studies, NIOSH
Morgantown, West Virginia

IX. DISTRIBUTION AND AVAILABILITY OF REPORT

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1. OSHA District Office - Pittsburgh, PA
2. OSHA Regional Office - Philadelphia, PA
3. Community Savings Association
4. American Legion, Post 613
5. NIOSH Regional Office

For the purpose of informing affected employees, copies of this report should be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

TABLE 1

Airborne Bacteria and Fungi Concentrations
at Finleyville Branch - Community Savings Association
Finleyville, PA
May 25, 1988
MHETA 88-249

Fungi - Malt Extract Agar

Area	Sample Time	Concentration - CFU/M^3
Teller	12:41 - 12:45	288
Teller	12:52 - 1:04	>245
Teller	3:55 - 4:01	>286
Backroom	1:25 - 1:29	315
Backroom	1:35 - 1:47	154
Backroom	3:10 - 3:16	>256
Outside	2:05 - 2:09	708
Outside	2:17 - 2:29	422

Bacteria - Trypticase Soy Agar

Teller	12:46 - 12:50	79
Teller	1:06 - 1:18	>87
Teller	4:02 - 4:08	175
Backroom	1:30 - 1:34	35
Backroom	1:48 - 2:00	32
Backroom	3:17 - 3:23	87
Outside	2:11 - 2:15	210
Outside	2:30 - 2:42	495

- CFU/M^3 = Colony forming units per cubic meter of air

- When a '>' symbol appears before a concentration, colony overgrowth occurred on the sample plate, obscuring other colonies.

TABLE 2

Temperature and Relative Humidity Measurements
at Finleyville Branch - Community Savings Association
Finleyville, PA
May 25, 1988
MHETA 88-249

Area	Time	Temperature°F	Relative Humidity %
Lobby	10:37	72.0	37
	12:05	73.5	38
	2:20	73.0	32
Backroom	10:35	71.5	42
	12:00	71.0	48
	2:26	71.0	44
Outside	10:40	53.0	50
	12:10	59.0	44
	2:23	57.0	66

TABLE 3

Number of Employees Complaining of Various Symptoms
at Finleyville Branch - Community Savings Association
Finleyville, PA
MHETA 88-249

Symptom	Number of Employees
Skin rash	5
Shortness of breath	5
Dizziness	4
Chest tightness	4
Heart palpitations	4
Headache	3
Nausea	3
Runny nose/sinus congestion	3
Sore throat	2
Cough	2
Muscle aches	2
Loss of appetite	2
Fever/chills	1
Eye irritation	1