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United States Postal Service
Mail Processing and Distribution Center
Tampa, Florida

Daniel Hewett, CIH
David Weissman, M.D.

PREFACE

The Respiratory Disease Hazard Evaluations and Technical Assistance Program (RDHETAP) of the National Institute for Occupational Safety and Health (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.

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Dan Hewett, CIH
David Weissman, MD

SUMMARY

In August 1998 the National Institute for Occupational Safety and Health (NIOSH) received a confidential health hazard evaluation (HHE) request from the American Postal Workers Union, AFL-CIO (APWU) to conduct a health hazard evaluation at the Tampa Mail Processing and Distribution Center (TMPDC), Tampa, Florida. The request listed exposures to paper dust, bathroom cleaning chemicals, and rust / dust in the ventilation system as potential health hazards by inhalation, skin exposure, and ingestion. Health effects resulting from these exposures were listed as chronic respiratory conditions and skin conditions including rashes and hives.

On October 6 - 7, 1998, NIOSH investigators performed a walkthrough survey of the worksite and met with APWU and US Postal Service representatives to discuss worker exposure to dusts including paper dust and dusts associated with the operation of heating, ventilating, and air conditioning (HVAC) systems. NIOSH investigators monitored real-time aerosol concentrations before and after "blowout" of paper dust from a mail sorting machine (delivery point bar code sorter) and collected 10 particle size selective area air samples. The investigators inspected 27 HVAC systems. Workers were notified by public address that NIOSH investigators were available to discuss respiratory symptoms.

On November 11 - 13, 1998, NIOSH investigators returned to obtain three personal respirable dust samples from maintenance workers performing "blowout" of paper dust. A total of 12 airborne spore samples were collected and analyzed for fungal structure counts and fungal identification among plant (10), office (1) and outdoor (1) areas. Four area air samples were collected in the center of both the first (2) and third (2) floors for mite and roach antigen. Three bulk floor dust samples were collected for roach antigen in the first (2) and third (1) floors. Bulk dust samples were collected from each of 12 HVAC systems which service the first (7) and third (3) floors and the office area (2). The bulk samples were analyzed for viable fungi and mite antigen. Bulk drain pan water was collected from the same 12 HVAC systems for endotoxin analysis. A total of 12 airborne dust samples were collected and analyzed for endotoxin among plant (10), office (1) and outdoor areas (1).

Of the 56 workers who discussed respiratory symptoms with NIOSH investigators during the walkthrough in October, 38 workers were contacted by telephone for follow-up interviews with a questionnaire in December 1998. Respiratory symptoms and worker job descriptions were obtained during the interviews. Nearly all interviewed workers reported that they experienced nasal symptoms: irritated, stuffy, or runny nose (97%); and sinus fullness or post nasal drip (89%). Seventy-nine percent (79%) reported eye problems; 74% reported irritated throat; 66% had headaches, and about 60% reported cough. Sixty-eight percent (68%) reported flu-like symptoms [fevers,

aches, tiredness]; 34% reported wheezing, 39% were bothered by tightness in the chest, and 35% reported that they were short of breath more than once a week while at work.

Of the 27 HVAC systems inspected, 21 had internal components that were in need of cleaning or adjustment to address problems ranging from dusty coils, slime within drain pans and coils, poor drain pan drainage, filter blow-by, dusty surfaces, and accumulation of dust in drain pans.

Bulk dust was collected from each of 12 HVAC units for mite antigen analysis. Ten units were free from dust mite antigen, two which service the first floor were positive for antigen at a concentration associated with mite sensitization. Bulk floor dust collected in the areas adjacent to the cafeteria and lunch rooms on the first and third floors were negative for roach antigen.

Mite antigen was not detected in airborne dust from the first floor, but was detected in airborne dust from the third floor. The concentration of mite antigen in the airborne dust exceeded the level associated with an allergic response in mite-sensitized individuals. No roach antigen was detected in the airborne dust samples.

The average concentration of viable fungi per gram of bulk dust collected from 3 air handlers servicing the 3rd floor was 15 times greater than average concentrations of fungi in bulk dust collected from air handlers that service the office and 1st floor areas.

Bulk dust samples from three air handlers that service the third floor were dominated by *Tritirachium (*80 - 86%) and *Acremonium* (69 - 93%). Of the bulk dust samples collected from seven air handlers that service the first floor, one was dominated by *Exophalia* (92 - 93%), five by *Cladosporium* (30 - 99%) and *Penicillium* (10 - 43%), and one by *Aspergillus niger* (21 - 29%) and *Penicillium* (49 - 53%).

Counts of fungal spores in third floor and office samples ranged from 386 to 1157 spores per cubic meter of air (spores/m^3); first floor counts ranged from 771 to 3470 spores/m^3. These indoor spore counts were below the outdoor concentration of 6169 spores/m^3.

Respirable paper dust concentrations measured during five hours of blowout activity by maintenance workers ranged from 0.052 to 0.056 milligrams of dust per cubic meter of air (mg/m^3). No exposure limits as enforced by the Occupational Safety and Health Administration (OSHA) or recommended by NIOSH or the American Conference of Governmental Industrial Hygienists (ACGIH) were exceeded for paper dust concentrations in air.

Endotoxin in bulk fluid samples from 12 air handler drain pans ranged from 0.3 to 2312 endotoxin units per milliliter of water (EU/ml). The drain pan fluid in air handler 37 (which services the third floor) was 2312 EU/ml, about 5.6 times the next highest concentration.

Endotoxin concentrations in airborne dust samples in third floor, first floor, and office areas averaged 4.4, 6.5, and 5.6 endotoxin units per cubic meter of air (EU/m^3) respectively. These endotoxin concentrations were below the outdoor concentration of 8.8 EU/m^3.

On the basis of environmental data and information gathered from employee interviews, NIOSH investigators did not find clear evidence that employee symptoms were caused by exposure to microbial contaminants or paper dust.Recommendations are made to control the accumulation of paper dust, improve the operation and cleaning of HVAC systems, and provide respiratory protection from paper and non-specific dusts if exposures initiate or aggravate respiratory conditions. Recommendations for respirator selection are presented in this report. In addition, the presence of airborne mite antigen indicates

that dust containing this antigen was aerosolized. The concentration of the mite antigen in the airborne dust was high enough that it should be considered as a potential factor for triggering symptoms in employees with dust mite sensitivity.

Keywords: SIC 7331 (Mailing service), Paper Dust, Fungi, Mite, Antigen, HVAC, Mail Handling, Mail Processing, Mail Sorting, Bulk Dust, Particle Size, PNOR, PNOC

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INTRODUCTION

In August 1998 the National Institute for Occupational Safety and Health (NIOSH) received a confidential request from union representatives of the American Postal Workers Union, AFL-CIO (APWU) to conduct a health hazard evaluation (HHE) at the Tampa Mail Processing and Distribution Center (TMPDC), Tampa, Florida. The TMPDC receives, sorts, and prepares mail for delivery.

The request was initiated by reports of inhalation, ingestion, or skin exposures to paper dust, cleaning chemicals, or non-specific dusts associated with the ventilation systems. Union representatives identified workers who associate exposures to paper dust or other dusts with asthma, allergies, and chronic sinusitis. The union representatives associated the health effects with dust aerosolized by mail processing and maintenance of mail processing machines.

In response to this request, NIOSH investigators performed a walkthrough survey on October 6 - 7, 1998. Upon meeting with management and union representatives, the primary complaint was identified as the aerosolization of paper dust by cleaning paper dust from machines (hereafter referred to as "blowout") and "sweeping" the floor with compressed air. NIOSH investigators performed quantitative area air sampling to assess the particle size distribution of airborne particulate and conducted real-time aerosol concentration measurements in proximity to blowout operations. Interviews were conducted with both management and workers. NIOSH investigators inspected 27 heating, ventilating, and air conditioning (HVAC) systems, and reviewed occupational safety and health program records.

On November 11 - 13, 1998, NIOSH investigators returned to perform an environmental survey which included sampling indoor and/or outdoor locations for airborne fungal structures, airborne mite and roach antigen, and airborne endotoxin. Twelve HVAC systems were inspected and HVAC maintenance procedures were reviewed. Bulk HVAC dust and water samples from HVAC drain pans were collected for analysis of microbial contaminants including fungi, mite antigen, and endotoxin. Bulk floor dust was collected and analyzed for roach antigen.

The purpose of this report is to provide observations from the two site visits, report the results of airborne dust and microbiological sampling, and offer conclusions and recommendations based on observations, worker interviews, and measurement results. This is the final report of this NIOSH safety and health evaluation.

BACKGROUND

The TMPDC is located near the Tampa International Airport, Tampa, Florida. The building is a three story steel frame and concrete structure built in 1969. The building contains loading docks, mail sorting machinery, administrative offices, a post office, and conveyors for transporting packages and trays filled with letters. This building, hereafter referred to as the "plant," is where packages and letters are received, sorted, and shipped. The first and third floors of the plant are the primary work areas for mail sorting; the second floor contains administrative offices.

The facility employs approximately 1700 mailhandlers, clerks, maintenance, and other workers throughout three work shifts, seven days per week. Shifts in the plant are referred to as Tier 1, 12:00 a.m. - 7:00 a.m. (630 workers); Tier 2, 7:00 a.m. - 3:30 p.m. (380 workers); and Tier 3, 3:30 p.m. - 12:00 a.m. (630 workers).

After machine sorting or manual coding, mail is sent to the first floor (Figure 1) which is a large open bay with a 25 foot ceiling. The floor also contains a cafeteria, restrooms, maintenance areas, offices, ceiling-suspended conveyors, and HVAC ducts and diffusers. Mezzanines about 15 feet above the plant floor house several HVAC systems which ventilate the first floor. Mail is either sorted manually or by optical character readers (OCR) which apply routing information in the form of a bar code. Letters enter auto facer counter sorters (AFCS) or bar code sorters (BCS) where they are set into cardboard trays according to mail routes. Letter trays are sent to flat sorting machines (FSM), then to a loading dock for subsequent delivery.

The third floor (Figure 2) contains BCS and FSM machines in an open bay with a 12 foot ceiling. The floor also contains a small eating area or breakroom, restrooms, and HVAC ducts and diffusers. Six rooftop HVAC systems service the third floor.

The larger HVAC system air handlers are single-zone, constant volume heating and cooling-coil equipped units. Outdoor and return air is filtered by roll-type filters composed of spun synthetic material of relatively low efficiency (less than 30% efficiency, dust spot testing method). Maintenance workers have annual and semi-annual maintenance schedules for HVAC systems and chillers.

Maintenance workers clean readers and sorters to keep paper dust from inhibiting the flow of mail through the machines and clean paper dust from optics to prevent malfunctions. Maintenance work is conducted during all Tiers; however, most maintenance work is performed on Tier 2 (7:00 a.m. to 3:30 p.m.) when lower mail volume allows greater access to mail sorters / readers for routine cleaning. Sorter and reader cleaning (hereafter referred to as "blowout") procedures require workers to open machine panels and vacuum as many interior and exterior surfaces as possible before using compressed air [compressed air is limited to about 30 pounds per square inch (psi) to prevent skin injury from the decompressed airstream] to blow the remaining paper dust from the machines. Workers performing blowouts are required to wear "goggles or face mask" eye protection when using compressed air.

Some particulate is collected by HEPACON air filtration units equipped with low efficiency roll-type filter media. A few of these units are suspended from the ceiling on the first and third floors. According to management, curtains have been used during blowout to attenuate the movement of paper dust. Currently, the curtains are not hanging since many of the machines on the first and third floor have been moved from where curtains were in use.

METHODS

Environmental

Since most sorters and readers are on the first floor of the plant, this area was selected for paper dust sampling in proximity to blowout operations. The investigators performed bioaerosol and bulk sampling to identify potential sources of microbial contamination that could plausibly explain certain respiratory complaints among employees.

The first environmental evaluation took place on October 6 - 7, 1998. On October 6, 1998, NIOSH investigators inspected 27 heating, ventilating, and air conditioning (HVAC) systems which service the first and third floors and offices. The inspections consisted of a brief visual assessment of filter seating, dust and insect accumulation, condensate drainage, visible mold or slime, chemical storage within air handler rooms, and outdoor air intake position and screening.

Sorting machinery and HVAC maintenance checklists, as well as accident logs were reviewed. NIOSH researchers conducted interviews with individuals who had experienced respiratory symptoms in the workplace. These workers came to interviews after announcements via the public address system. Some interviews were facilitated by union representatives who had been asked to help identify workers with respiratory complaints.

On October 7, 1998, NIOSH investigators performed quantitative area air sampling to assess the particle size distribution of airborne particulate. Area particle size distribution samples were collected for approximately 7.5 hours using 8-stage Anderson Marple 298 impactors with impaction grease coated Mylar substrates at a calibrated flow rate of 2.0 liters per minute (L/min). Samples were collected from seven locations in the first floor plant (see locations 1 - 7, Figures 3 and 4) and three locations in the third floor plant (see locations 8 - 10, Figure 5). Three samples (locations 1, 2, and 5) were collected in close proximity to blowout of bar code sorters. In parallel with particle size sampling, qualitative real-time aerosol concentrations were characterized (Figure 6) with a DUSTRAK™ Model 8520 Aerosol Monitor laser photometer in location 2 (Figure 3).

The second environmental evaluation took place on November 11 - 13, 1998. On November 11, 1998, three bulk dust roach antigen samples were collected; one from the first floor in front of the cafeteria entrance (location "P" Figure 1), another from Operation 150 area (location "K" Figure 1), and one from the entrance to the third floor lunch / break room (location "Q" Figure 2). Antigen was collected from the floor by vacuuming[1] dust onto 37 millimeter (mm) poly-vinyl chloride (PVC) 0.8 micrometer (µm) filters attached to air pumps. Dust samples were analyzed by enzyme immunoassay for roach antigen (*Blattella germanica*).

On November 12, 1998, three partial-shift personal respirable dust samples were collected from each of three maintenance mechanics as they performed blowout of sorting machines on the 1st floor. Each mechanic performed blowout on three machines from approximately 9:45 a.m. to 3:15 p.m. Dust samples were collected for approximately five hours through 10 mm Dorr Oliver nylon cyclones onto 37 mm PVC 5 µm pore size filters attached to air pumps calibrated at 1.7 L/min. Filters were analyzed according to NIOSH Manual of Analytical Methods (NMAM) Method 0600.[2]

On November 12, 1998, twelve bulk dust samples were collected, one from each of 12 HVAC systems; 7 systems servicing the first floor, 3 servicing the third floor, and 2 servicing office areas. The bulk samples were split for analysis of viable fungi and mite antigen. Dust was collected from the interior of the HVAC units by vacuuming dust onto 37 mm PVC 0.8 µm filters attached to air pumps. The bulk dust samples were analyzed by enzyme immunoassay for mite antigens (*Dermataphagoides pteronyssinus* and *Dermataphagoides farinae*) and cultured onto DG-18 agar for xerophilic fungi, and 2% MEA agar for mesophilic fungi. Agar plates were incubated at 25 "C. Fungi were identified and enumerated.

On November 12, 1998, twelve bulk drain pan water samples were collected from the same 12 HVAC systems mentioned above. The endotoxin content of the samples was determined by using a modification of the Limulus Amebocyte Lysate test (Kinetic-QCL, LAL Testing Made Easy, BioWhittaker, Inc., Walkersville, MD) that has been described in the literature.[3]

On November 13, 1998, twelve area airborne endotoxin samples were collected; one outdoor location (1st floor loading dock, location "I", Figure 1) and one from each of eleven indoor locations (1st floor plant locations "J" to "N" Figure 1, 1st floor office location "O" Figure 1, and 3rd floor plant locations "A" to "E" Figure 2). Endotoxin was collected for approximately five hours with open face cassettes onto 37 mm PVC 0.8 µm filters attached to air pumps calibrated at 3.0 L/min. The endotoxin content of the aqueous extracts of the filtered dust was determined by using a modification of the Limulus Amebocyte Lysate test.

On November 13, 1998, twelve area airborne fungal spore samples were collected; one outdoor location (1st floor loading dock, location "I" Figure 1) and one each from eleven indoor plant locations (1st floor locations "J" to "N" Figure 1, 1st floor office location "O" Figure 1, and 3rd floor locations "F" to "H" Figure 2). Spores were collected for approximately 150 minutes with short-cowl open face cassettes onto 25 mm methyl cellulose ester (MCE) 0.8 µm filters attached to air pumps calibrated at 20 liters per minute (L/min). Spores were identified and enumerated.

From November 11 to 13, 1998, four area airborne dust mite and roach antigen samples were collected; two from the first floor (location "L" Figure 1) and two from the third floor (location "G" Figure 2). Antigen was collected for approximately 26.5 hours with open face cassettes onto 37 mm PVC 0.45 µm filters attached to air pumps calibrated at 30 L/min in order to collect sufficient dust mass for antigen analysis. Dust samples were analyzed by enzyme immunoassay for roach (*Blattella germanica*) and mite antigens (*Dermataphagoides pteronyssinus* and *Dermataphagoides farinae*).

Medical

Prior to the walkthrough survey on October 6 - 7, 1998, NIOSH investigators arranged to have a message posted on employee bulletin boards that announced the NIOSH visit and encouraged workers to contact NIOSH investigators through the union if the workers had experienced respiratory symptoms associated with dust exposure. During the walkthrough, a similar message was announced three times over the public address system. Workers who had previously identified themselves to the union as having work-related health complaints were contacted by the APWU and informed of the interviewer's availability. Fifty-six workers responded to the call for interviews.

During December 1998 confidential interviews were conducted of 38 postal workers who could be reached by telephone. A structured questionnaire was used to determine the respiratory symptoms and job descriptions of the interviewees (see Appendix).

EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects even though their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy). In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: (1) NIOSH Recommended Exposure Limits (RELs),[4] (2) the American Conference of Governmental Industrial Hygienists' (ACGIH®) Threshold Limit Values (TLVs®),[5] and (3) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs).[6] NIOSH encourages employers to follow the OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever are the more protective criterion. The OSHA PELs reflect the feasibility of controlling exposures in various industries where the agents are used, whereas NIOSH RELs are based primarily on concerns relating to the prevention of occupational disease. It should be noted when reviewing this report that employers are legally required to meet those levels specified by an OSHA standard.

OSHA requires an employer to furnish employees a place of employment that is free from recognized hazards that are causing or are likely to cause death or serious physical harm.[7] Thus, employers should understand that not all hazardous chemicals have specific OSHA exposure limits such as PEL's and STEL's. An employer is still required by OSHA to protect their employees from hazards, even in the absence of a specific OSHA PEL.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8-to-10-hour workday. Some substances have recommended short-term exposure limits (STEL) or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from higher exposures over the short-term.

Paper Dust

Paper dust generated by mail processing is a complex and uncontrolled mixture of papers of unknown origin. The aggregate dust generated by mail sorters and aerosolized by maintenance procedures is difficult to characterize. It is likely that exposures to chemicals used in the manufacture of paper, in association with paper dust, would be well below any applicable occupational exposure limits for paper dyes, bleaching agents, and other chemicals associated with paper manufacturing. Paper dust can be categorized as an organic dust because it is of vegetable origin. Some types of organic dusts have been associated with acute responses (irritation or toxic pneumonitis), long-term responses (chronic bronchitis), or hypersensitivity responses.[8]

Prior to 1986, paper dust exposure had been regulated under the OSHA "nuisance dust" or particulate not otherwise regulated (PNOR) PEL. In 1986, OSHAs Occupational Health Review Commission ruled that paper dust is an organic dust; therefore the nuisance dust standard did not apply to paper dust.[9] In 1993, OSHA issued a notice that all inert, nuisance, and organic particulate would be covered under the PNOR standard if no other exposure limit was applicable. Presently, paper dust exposures are limited under the OSHA PNOR standard (15 mg/m^3 total dust, 5 mg/m^3 respirable dust).[10,11] The PNOR criteria were established to minimize mechanical irritation of the eyes and nasal passages, and to prevent visual interference. Since wood contains about 50 to 70% cellulose[12], the cellulose content of paper could plausibly limit an 8-hour TWA exposure to paper dust by the OSHA PEL (15 mg/m^3 total dust, 5 mg/m^3 respirable dust), NIOSH REL (10 mg/m^3 total dust, 5 mg/m^3 respirable dust) or ACGIH TLV (10 mg/m^3 total dust) exposure limits for cellulose.

Formerly referred to as nuisance dust, the preferred ACGIH TLV terminology for non-specific particulate is particulates not otherwise classified (PNOC).[7] The criteria for the classification of a substance as a PNOC include the following lung pathology: 1) the architecture of the air spaces remains intact; 2) collagen (scar tissue) is not formed to a significant extent; and 3) the tissue reaction is potentially reversible.[12] The ACGIH recommended TLV for exposure to a PNOC is 10.0 mg/m^3 inhalable particulate, 3 mg/m^3 respirable particulate, 8-hour TWA. NIOSH has not developed specific evaluation criteria for PNOR/C exposures.

Microbiological Contaminants

Microorganisms

Microorganisms (including fungi and bacteria) are normal inhabitants of the environment. The saprophytic varieties (those utilizing non-living organic matter as a food source) inhabit soil, vegetation, water, or any reservoir that can provide an ample supply of a nutrient substrate. Under the appropriate conditions (optimum temperature and pH, and with sufficient moisture and available nutrients) saprophytic microorganism populations can be amplified. Through various mechanisms, these organisms can then be disseminated as individual cells or in association with soil, dust, or water. In the outdoor environment, the levels of microbial aerosols will vary according to the geographic location, climatic conditions, and surrounding activity. Indoors, the concentration of certain microorganisms may vary somewhat as a function of the cleanliness of the HVAC system and the numbers and activity level of the occupants. With the exception of certain human-shed bacteria, indoor levels are expected to be below outdoor levels (depending on HVAC system filter efficiency) with consistently similar ranking among the microbial species.[13,14]

Some individuals manifest increased immunologic responses to antigenic agents encountered in the environment. These responses and the subsequent expression of allergic disease is based, partly, on a genetic predisposition.[15] Allergic diseases typically associated with exposures in indoor environments include allergic rhinitis (nasal allergy), allergic asthma, and extrinsic allergic alveolitis (hypersensitivity pneumonitis).[16] Allergic respiratory diseases resulting from exposures to microbial agents have been documented in agricultural, biotechnology, office, and home environments.[17,18,19,20,21,22,23,24]

Individual symptoms vary according to disease. Allergic rhinitis is characterized by paroxysms of sneezing; itching of the nose, eyes, palate, or pharynx; nasal stuffiness with partial or total airflow obstruction; and rhinorrhea (runny nose) with postnasal drainage. Allergic asthma is characterized by episodic or prolonged wheezing and shortness of breath in response to bronchial (airways) narrowing. Heavy exposures to airborne microorganisms can cause an acute form of extrinsic allergic alveolitis which is characterized by chills, fever, malaise, cough, and dyspnea (shortness of breath) appearing four to eight hours after exposure. In the chronic form, thought to be induced by continuous low-level exposure, onset occurs without chills, fever, or malaise and is characterized by progressive shortness of breath with weight loss.[25]

Acceptable levels of airborne microorganisms have not been established, primarily because allergic reactions can occur even with relatively low air concentrations of allergens and individuals differ with respect to immunogenic susceptibilities. The current strategy for on-site evaluation of environmental microbial contamination involves an inspection to identify sources (reservoirs) of microbial growth and potential routes of dissemination. In those locations where contamination is visibly evident or suspected, bulk samples may be collected to identify the predominant species. In limited situations, air samples may be collected to document the presence of a suspected microbial contaminant. A significantly higher concentration of airborne microorganisms (about 10 times or greater) in the area of interest compared to outdoor or control areas indicates that growth may have occurred.

Bacterial Endotoxin

A bacterial endotoxin is a lipopolysaccharide compound from the outer cell wall of gram-negative bacteria, which occurs abundantly in organic dusts.[26] It has been shown that the biological properties of endotoxin vary depending upon the bacterial species from which they are derived, as well as upon the state of the growth cycle of the bacteria.[27] Endotoxins have a wide range of biological activities involving inflammatory, hemodynamic, and immunological responses. Of most importance to occupational exposures are the activities of endotoxin in the lung.[28] The primary target cell for endotoxin-induced damage by inhalation is the pulmonary macrophage. Human macrophages in particular have been shown to be extremely sensitive to the effects of endotoxin in vitro.[29] Endotoxin, either soluble or associated with particulate matter, will activate the macrophage, causing the cell to produce a host of mediators.[28]

Exposure of previously unexposed persons to airborne endotoxin can result in acute fever, dyspnea, coughing, and small reductions in forced expiratory volume in one second (FEV_1), although some investigators have not been able to demonstrate acute changes in FEV_1.[28] The effects of repeated exposure to aerosols of endotoxins in humans are not known. Some animal studies have demonstrated a chronic inflammatory response characterized by goblet cell hyperplasia and increased mucous production. This suggests that repeated exposure may cause a syndrome similar, if not identical, to chronic bronchitis.[28]

Occupational exposure criteria have not been established for bacterial endotoxin by either OSHA, NIOSH, or ACGIH. However, Jacobs has reported that a sufficient toxicological data base is believed to exist for establishing an occupational limit for endotoxin based on cute changes in pulmonary function.[28] Eight-hour TWA concentrations have been suggested for over-shift decline in FEV_1 (100 - 200 nanograms per cubic meter of air (ng/m^3), for chest tightness (300 - 500 ng/m^3), and for fever (500 - 1,000 ng/m^3).[27] An 8 hour TWA threshold for airborne endotoxin of 10 ng/m^3 has also been suggested based on a decline in FEV_1 for individuals sensitized to cotton dust.[30] In addition, a recommended endotoxin exposure limit of 50 EU/m^3 based on inhalable dust sampling has recently been adopted in the Netherlands. This limit was established as about half of the 90 EU/m^3 level that induces measurable airways obstruction.[31] The mass conversion from EU units for the aqueous sample is based on a standard of approximately 50 EU units/ml corresponding to roughly 5 ng/ml on a mass basis.

Dust Mite Antigen

Dust mites are eight-legged sightless arthropods about 0.3 millimeters (mm) in length. They feed on skin scales, fungi, and other debris. They absorb water. Therefore, mites are dependent on ambient humidity and thrive in high humidity environments. Mites excrete digested food and enzymes as fecal pellets which range in size from about 10 to 35 µm, similar in size to pollen grains.[32,33]

Sensitivity to mite proteins is associated with inhalation of mite body parts or proteins associated with mite fecal pellets.[32] Exposure to these antigens can result in rhinitis and immediate or delayed asthma upon exposure in sensitized individuals. Typical symptoms range from nasal and ocular itching, rhinorrhea, sneezing, shortness of breath, wheezing, and productive cough.[33] Commercially available allergen extracts of mite proteins are available to determine sensitivity to the proteins either by skin testing or for *in vitro* assays of Ige antibodies.[32,34]

Typically, mite antigen is sampled from surface dust and analyzed by enzyme immunoassay. This is because epidemiological studies of mite exposure in domestic environments involve small quantities of airborne dust in undisturbed environments. Sufficient dust mass cannot be obtained to measure what are considered to be typical airborne mite antigen concentrations (commonly 0.005 to 0.050 µg/m^3). In addition, these studies typically do not report the relevance of the particle size of antigenic material. It has been common practice to assess exposure based on the measurement of a allergen in a reservoir of dust with the assumption that the allergen content of the dust is positively correlated with inhaled exposure.[32,34]

The threshold concentration (in micrograms of antigen per gram of dust, µg/g) for sensitization to the mite antigen Der p I (from *D. pteronyssinus*) and Der f I (from *D. farinae*) is 2 µg/g; the dose for symptoms is 10 µg/g. These thresholds are based on epidemiologic studies designed to estimate what level of antigen was likely to result in sensitization in patients with atopic tendencies, and the dose that elicited symptoms in clinically sensitive individuals. These thresholds should be applied as a basis for advising sensitized individuals to take steps to reduce exposure. They are not meant to establish permissible exposure limits, since certain individuals may have a response at a lower exposure.[34]

Certain studies have determined that fecal particles are the major form in which Der p I becomes airborne, and that less than 0.001 µg/m^3 is airborne in undisturbed rooms. During disturbance, aerosolized Der p I has been measured from 0.005 to 0.2 µg/m^3.[32,34] It is likely that mite antigen is associated with larger particulate which settles rapidly after disturbance.

Roach Antigen

Roach antigen can originate from shedded and dried exoskeletons and scales, fecal and saliva excretions, hairs, and other fragments from the cockroach. Exposure to these antigens can result in sensitivity symptoms such as eye irritation, rhinitis, nasal congestion, urticaria, and often cough, wheezing, and shortness of breath. Cockroach antigens can produce allergic rhinitis and asthma, and are generally associated with dust surrounding kitchens. Commercially available allergen extracts of cockroach proteins are available to determine sensitivity to the proteins either by skin testing or for invitro assays of Ige antibodies.[32,34]

Typically, roach antigen is sampled from surface dust and analyzed by enzyme immunoassay. As with mite antigen, roach antigen exposure is based on the measurement of roach antigen in a reservoir of dust with the assumption that the allergen content of the dust is positively correlated with inhaled exposure.[32,34]

The roach of interest in this study is *Blattella germanica*, a German cockroach associated with crowded cities, the southern United States, and tropical climates. The low threshold concentration for sensitization to cockroach antigen from *B. germanica* or *Periplaneta americana* is 5 µg/g. This threshold is derived from studies using an arbitrary classification scheme which classified allergen concentrations as low, medium, or high.[34]

The threshold concentration for sensitization to the roach antigen Bla g I (from *B. germanica*, the German cockroach) is 2 units/g. This threshold is based on epidemiologic studies designed to estimate what level of antigen was likely to result in sensitization in patients with atopic tendencies. Neither the low nor the sensitization thresholds are meant to establish a permissible exposure limit, since certain individuals may have a response at a lower exposure.[34]

RESULTS

Environmental

During the walkthrough survey, a musty odor associated with fungal contamination was strong on the third floor and inside the stairwell leading to the rooftop. The odor was not detected on the third floor at the time of the environmental survey. However, the same musty odor persisted inside the air handlers servicing the third floor.

Dust Concentrations

No personal respirable airborne paper dust concentrations collected from maintenance workers during blowout exceeded OSHA or ACGIH exposure limits for PNOR/C. Concentrations are based on 8-hour TWA exposures (in mg/m^3) since exposures during sampled periods were judged to representative of exposures during unsampled periods. Personal respirable dust concentrations ranged from 0.052 to 0.056 mg/m^3 respirable dust.

A qualitative aerosol concentration was measured with a real-time aerosol monitor operated parallel in time to vacuuming and blowout of delivery point bar code sorters 6 and 7 in area 4 (Figure 1). The monitor was not calibrated to accurately measure paper dust concentration. Therefore, the concentration measurement is strictly qualitative, meaning that the measurements give a relative sense of concentration but are not quantitative measurements of concentration. The monitor was positioned approximately 10 feet from, and in-between the delivery point bar code sorter machines at a height of five feet. A time versus qualitative concentration graph indicates that paper dusts aerosolized by compressed air increase in concentration rapidly and settle rapidly in about 15 minutes (Figure 6). Dust concentrations in close proximity to blowout increased at least 100 times above dust concentrations prior to blowout.

Airborne Microbial Sampling

Indoor spore counts inside the plant areas were not significantly elevated relative those detected outdoors. Fungi concentrations in the third floor and office areas ranged from 386 to 1157 spores per cubic meter of air (spores/m^3); first floor counts ranged from 771 to 3470 spores/m^3. The outdoor concentration was 6169 spores/m^3. *Cladosporium* dominated the outdoor sample (56% of total spores), *Cladosporium* and *Aspergillus/Penicillium* were dominant indoors (70% of total spores).

Airborne mite antigen (Der p I) was detected on the third floor (Figure 2, Location "G") at a concentration of 11.75 µg/g of dust collected. This concentration is above the concentration in bulk (non-airborne dust) that is associated with sensitization in patients with atopic tendencies (2 µg/g) and symptoms in clinically sensitive individuals (10 µg/g).[34] Mite antigen was not detected in airborne dust collected from the first floor. No roach antigen was detected in air samples.

Endotoxin concentrations in airborne dust samples in third floor, first floor, and office areas averaged 4.4, 6.5, and 5.6 endotoxin units per cubic meter of air (EU/m^3) respectively. These endotoxin concentrations were below the outdoor concentration of 8.8 EU/m^3. All measurements were well below that which could elicit an over-shift decline in FEV_1 or symptoms.[30]

Bulk Microbial Sampling

Bulk dust collected from 3 air handlers servicing the 3rd floor had concentrations of viable fungi (colony forming units per gram of dust, CFU/g) which averaged 18.5×10^6 CFU/g (range 14.0 - 26.8×10^6 CFU/g). The average fungi concentration for 7 air handlers that service the 1st floor was 1.2×10^6 CFU/g (range 0.021 - 3.3×10^6 CFU/g). The average for 2 air handlers that service office areas was 1.0×10^6 CFU/g (range 0.67 - 1.3×10^6 CFU/g). By average concentration, fungi were about 15 times more concentrated in 3rd floor air handlers than air handlers that service offices and the 1st floor.

Bulk dust samples from the three air handlers that service the third floor were dominated by *Tritirachium (*80 - 86%) and Acremonium (69 - 93%). Of the bulk dust samples collected from seven air handlers that service the first floor, one was dominated by *Exophalia* (92 - 93%), five by *Cladosporium* (30 - 99%) and *Penicillium* (10 - 43%), and one by *Aspergillus niger* (21 - 29%) and *Penicillium* (49 - 53%).

Of 12 bulk dust samples collected from each of 12 HVAC systems (7 systems servicing the first floor, 3 servicing the third floor, and 2 servicing office areas) mite antigen (Der p I) was detected in air handlers that service the first floor; units 1A (at a concentration of 2.86 µg/g) and 4 (2.72 µg/g). These concentrations are above the concentration in bulk dust that is associated with sensitization in patients with atopic tendencies (2 µg/g).[34] No mite antigen was detected in the other 10 air handlers.

Air Handler Inspections In The Plant

The results of the HVAC inspections performed on October 6 and 7, 1998, are presented in Table 1.

Overall, most outdoor air dampers were nearly closed and condensate drain pans were not effective. The return and supply ducts of many air handlers were excessively dusty. Many drain pans contained a thick (up to 1 inch) layer of grey or black slime which was not analyzed, but likely contains an accumulation of paper dust. All drain pans contained multiple chemical pads designed to leach biocide into the drain pan water. Many were covered in a layer of slime. Roll-type air filters were of low efficiency (estimated less than 30%); none were clogged to the point of filter break-through. Maintenance crews clean air handlers annually and semi-annually, and perform scheduled maintenance checks on at least a weekly basis. The maintenance personnel are not trained to recognize poor HVAC hygiene.

Particle Size Distributions (Gravimetric)

All samples had sufficient mass for size distribution calculations. Dust concentrations and estimates of respirable and thoracic dust concentrations by location are presented in Table 2. Graphs of mass fraction per diameter interval versus particle diameter illustrate the particle size distribution by location (Figures 3 and 4). The particle size distribution graphs indicate that in most areas of the plant, particles are somewhat evenly distributed through the submicron to 50 µm range. As the dust measurements are closer to blowout operations (samples from locations 1, 2 and 5), the distributions show a distinct increase in thoracic (about 10 to 30 µm in aerodynamic diameter) and larger inhalable aerosols (30 µm and larger).

Medical

Worker Interviews

During and after the site visit, symptomatic workers were given the opportunity to participate in a brief telephone questionnaire (see Appendix) documenting relative frequencies and work-relatedness of upper respiratory, lower respiratory, and systemic symptoms. Out of a work force of approximately 1700 mailhandlers, clerks, maintenance, and other workers, 56 expressed an interest in completing the questionnaire. Of these, 38 were reached by telephone and completed the questionnaire in December, 1998. This population represented about 2.2% of the total work force and was not randomly selected, so it cannot be considered representative of the work force as a whole. However, the survey was informative in documenting patterns of symptoms in certain symptomatic individuals.

The telephone questionnaire was administered by a single interviewer. It was designed to elicit information about current upper and lower respiratory symptoms, systemic symptoms, work-relatedness of symptoms, smoking history, and past illnesses. Questions about department, job, and machine assignments were open-ended.

Ages of the 38 respondents ranged from 30-61, with a mean age of 45. Fifty-seven percent (57%) were female. Five percent were current smokers; 34 % of respondents had smoked for at least a year during their lifetime. The majority of respondents (25/38) worked on the first floor of the plant. Respondents represented various job tasks such as mail handler, clerk, mail sorter, technician, manual sorter, maintenance mechanic, manual casing, and mail processor.

Workers were questioned with regard to the presence of symptoms occurring more than once a week during working hours at the Postal Service. Nearly all interviewed workers reported that they experienced nasal symptoms: irritated, stuffy, or runny nose (97%); sinus fullness or post nasal drip (89%). Seventy-nine percent (79%) reported eye problems; 74% reported irritated throat; 66% had headaches; and about 60% reported cough. Sixty-eight percent (68%) reported flu-like symptoms [fevers, aches, tiredness]; 34% reported wheezing; 39% were bothered by tightness in the chest; and 35% reported that they were short of breath more than once a week while at work.

Among the respondents, 89% felt that symptoms were worse at work. Eighty-seven percent (87%) felt better after getting home from work, and 97% felt better when away from work on days off or on vacations. Seventy-six percent (76%) felt that symptoms got worse over the course of the work week and 58% felt that symptoms on the first day back to work after days off were not worse compared to other days. One hundred percent (100%) felt that symptoms worsened during blowout of machines with compressed air.

Twenty-six percent (26%) of the respondents had physician-diagnosed asthma, 66% had hay fever, 79% had sinus symptoms, 55% had bronchitis, and 42% had some physician-diagnosed allergy.

Accident and Illness Reports

A review of the accident log from 1995-1999 showed a few entries coded as "dust/foreign particle" (17) and "inhalation" (2) out of 1170 entries. "Dust/foreign particle" could well refer to injuries other than respiratory, such as to the eyes. The District Office also performed a search of the Human Resources Information System for occupational illness cases where a CA-2 (Federal Employee's Notice of Occupational Disease and Claim for Compensation) was submitted to the Office of Workers' Compensation Programs. The data was searchable from 1997-1999. The TMPDC had 40 CA-2 cases during that period. Among the 40 cases, a search for case codes "disease of the lung" or "respiratory agents" found one case of "disease of the lung" during that period.

DISCUSSION

Environmental

Cellulose is a major component of paper. It is considered to be a biologically non-toxic natural polysaccharide which is widely distributed in nature. Airborne cellulose dust has been described as both non-irritating and non-toxic with little adverse effects on the lung at concentrations of less than 10 mg/m^3.[12]

There is some evidence that sinusitis can be induced or exacerbated by occupational exposures to dusts. A possible mechanism is the impaired clearance of mucous from the nasal passages as a result of swelling of the nasal mucosa secondary to allergic or irritant rhinitis.[35] One study revealed an association between an increased rate of upper respiratory symptoms and exposures to various types of non-specific occupational dusts. Interestingly, this study also showed a higher prevalence of upper respiratory symptoms in never-smokers than in current smokers.[36] It has been suggested in other studies that this phenomenon is probably due to impaired mechanisms of mucosal clearance in smokers, so that they do not exhibit upper respiratory symptoms as seen in non-smokers.[35]

Mill workers exposed to paper dust had more upper respiratory symptoms (throat irritation, nasal crusts), more cough with phlegm, and increased prevalence of asthma compared to non-exposed workers.[37] In another comparison of paper dust exposed versus non-exposed, there was increased risk for wheezing, breathlessness, chronic cough, and chronic phlegm.[38]

Studies of total paper dust exposures in soft paper mills indicate adverse health effects occur where concentrations of airborne dust range from 15 to 20 mg/m^3.[37,39] One study performed in a soft paper mill in British Columbia with paper dust levels under 10 mg/m^3, showed no increase in the prevalence of lower or upper respiratory symptoms among 1932 workers.[40]

In general, studies of lower levels of total paper dust exposure (1 to 3 mg/m^3) in soft paper mills showed an increase in complaints of nasal irritation and nasal crusts, but no increase in coughing, chronic bronchitis, asthma, dyspnea or sinusitis. There was no decline in respiratory function noted after low levels of exposure. In relatively high (> 5 mg/m^3) versus low (< 1 mg/m^3) exposure groups at one plant, the high exposure groups exhibited more upper respiratory symptoms (throat dryness, throat irritation, and nasal crusts), but no difference between the groups in terms of cough or cough with phlegm, and no increase in cross-shift change in pulmonary function. However, decrements in FEV_1 and forced vital capacity (FVC) were associated with at least 10 years of high-exposure work.[41] In another study, pulmonary function tests did not show any changes in lung function for workers exposed to total dust levels less than 5 mg/m^3 for greater than ten years. Though there was an increase in the prevalence of upper respiratory symptoms with dust exposure, no dose-response relationship could be found.[42] At least three studies suggest that higher levels of total paper dust exposure (> 5 mg/m^3) in pulp and paper mills seem to be associated with an increase in respiratory symptoms.[43] However, it is not clear whether or not exposures to processing chemicals or the paper dust itself is clearly the cause for certain symptoms.

Before processing, wood may contain wood preservatives, fungal spores, and terpenes. In the process of creating paper products, wood fibers are freed by digesting the fibers, a process that removes lignin and hemicellulose from the fibers. This is accomplished by the sulfite acidic process (using sulfite) or in recent decades, the sulfate alkaline process (associated with hydrogen disulfide, dimethyldisulfide, dimethylsulfide, and methylmercaptan). For printing paper, the bleaching process is used to increase the whiteness of the pulp to various degrees. This involves the addition of chlorine, and in recent decades, chlorine dioxide. Other methods have recently been favored in an effort to replace chlorine compounds, including the use of peroxides, oxygen, ozone, binders, enzymes, and peracetic acid. The pulp is mixed with water and certain additives which have included certain filling agents (asbestos, talc, titanium dioxide, clay, aluminum hydroxide, barium sulfate), wet strength agents (polyvinylamide resins), whitening agents, retention agents, antifoaming agents (waxes, tall oil rosin), dyes (Benzedrine-based dyes, titanium dioxide), dispersing agents, coating agents (melanin resins, casein, latexes, calcium carbonate, aluminum hydoxide, barium sulfate, colophony) and slime controlling agents or "slimicides" (organic bromic compounds, methyl-bisthiocyanate, fatty acids, pentachlorophenol, isothiazolinones, mercury compounds, and ethylenediamine).[43]

The repulping and deinking of paper waste for recycling involves further chemical treatment. Mixtures of used newspapers, magazines, and waste from the production of corrugated paper may be repulped without de-inking. The paper is mixed with water in a pulper and major impurities such as staples are removed. The paper pulp is refined, and slimicides, sizing agents, flocking chemicals, fillers, and other chemicals are added to the recycled pulp and paper. Deinking newspapers and magazines involves dissolving the waste paper in water, the addition of fatty acids and other chemicals to dissolve impurities, and the addition of bleaching chemicals to restore whiteness to the paper. Common chemicals used in the repulping and deinking include fatty acid derivatives, hydrogen peroxide, sodium bisulfite, sodium hydroxide, sodium silicate, sodium dithionate, hypochlorite, polyethylenimine, (diethylenetrinitrilo) pentaacetic acid, bentonite, kaolin, and acrylamide polymers, as well as slimicides, e.g., thiazole, bromine, and copper compounds. In addition to these chemicals, the pulp fibers likely contain biological contaminants including mycotoxin and endotoxin which could be concentrated to some extent as process water is recycled.[44]

A study of paper dust exposure in Croatian paper recycling workers compared exposed (9.1 mg/m^3 total dust mean concentration) and unexposed groups. Among the exposed group, more chronic respiratory symptoms (cough, phlegm, bronchitis, shortness of breath, sinusitis, and nasal inflammation) were observed, along with lower lung function measurements [FEV_1 and maximum expiratory flow rates at 25% and the last 50% of the FVC (FEV_{25} and FEV_{50})] compared to the unexposed group. Of 101 exposed workers, 15.8% had positive skin prick tests to at least one of two paper extracts in contrast to zero positives for unexposed workers. Increased serum Age levels were found in 21% of the exposed workers and in 5% of the controls. Exposures to paper dust in the recycling plant were higher than those recommended by Croatian standards (3 mg/m^3 total dust, 1 mg/m^3 respirable dust).[45] The allergic component explored in the Croatian recycling mill study raises interest in the allergic potential of paper dust exposures.

No epidemiological studies have been performed to assess exposure and response to paper dust created by the mail handling and sorting process. Exposure to certain chemical components of the dust, rather than the aggregate airborne mass of the dust, could be a factor in presenting or aggravating certain symptoms in sensitized workers. For example, respiratory and cutaneous sensitization to the enzymes cellulase and xylanase used in the bleaching process have been described in the literature. After four months to six years of exposure, four workers exposed to these enzymes in a laboratory setting developed contact urticaria followed by rhinitis and asthma. All four workers developed specific antibodies against the enzymes.[46] Since the origin of the paper dust to which workers are exposed is likely to be quite variable under mail sorting conditions, it is difficult to assess the full range of chemical and perhaps biological contaminants that are associated with inhalation of the dust.

As determined by a literature search for references on the subject, health effects associated with exposure to paper dust generated from mail handling are not well characterized. A basis for limiting exposure to the paper dust in mail handling environments is impeded by the variability in the sources of paper dust. Because paper dust is likely to vary widely in composition, the ACGIH PNOC standard cannot be applied with certainty to all types of paper dusts. It is not certain that the PNOR standard, the cellulose content of paper, or of any other substance and/or impurity is appropriate for limiting exposure to paper dust. Many types of dust exposures are without applicable exposure limits.

TMPDC management does not have a respiratory protection program and does not consider paper dust exposures at TMPDC to be sufficiently elevated to warrant the use of respiratory protection because paper dust exposures, even during mail sorter cleaning, are well below the PNOR standard. However, some employees have linked paper dust exposures to their own respiratory problems.

According to an OSHA interpretation letter on dust exposure of Postal employees dated September 25, 1990, "certain individuals who are allergic to non-specific dusts should be allowed to wear protective dust masks." If a worker's private physician "prescribes a dust mask" then "a letter from his/her private physician explaining the individual's susceptibility should be placed on file in the Health Unit." According to the interpretation letter, "OSHA policy is not to cite an employer for lack of a respiratory protection program unless there is a potential for employee over exposure or an adverse health condition occurs due to the respirator. Therefore, the use of disposable dust masks to limit exposure to low levels of nuisance dusts would not, in itself, necessitate the need for a respiratory protection program."[47] This exemption from a written respiratory protection program is repeated in the 1998 OSHA respiratory protection final rule with clarification that a disposable dust mask is a "filtering facepiece (dust mask)."[48]

According to the 1998 OSHA respiratory protection final rule, even if exposures do not require use of respirators because exposures are below applicable limits, employers may provide respirators or allow employees to use their own respirator. The employer must ensure that the respirators in use do not present a hazard to the health of employees. If only filtering facepiece respirators are voluntarily worn, the employer is not required to implement a written respiratory protection program. According to OSHA, it is the employer who must rely on "professional judgement and available data sources when selecting respirators for protection against hazardous chemicals that have no OSHA PEL." According to OSHA, it is prudent to select more rather than less protective respirators.[48,49]

Dust Mite

Given the dose-response relationship between dust mite antigen exposure and symptoms, sensitivity is a major risk factor for rhinitis and immediate or delayed asthma, and symptoms of nasal and ocular itching, rhinorrhea, sneezing, shortness of breath, wheezing, and productive cough. Certain studies have indicated that there are levels of exposure below which the risk of sensitization is decreased. It is equally likely that when levels of exposure are similar for individuals with and without allergic disease, that differences in individual responses are a function of individual susceptibility.[32,34] Mite sensitivity could be a factor in causing employee symptoms since environmental measurements of airborne mite antigen were elevated in the TMPDC, in terms of micrograms of mite antigen per gram of airborne dust.

Medical

Symptom data was not obtained from a random sample of the working population. The most prevalent symptoms noted were upper respiratory symptoms affecting nose, sinuses, eyes, and throat, which affected most of the symptomatic individuals. Symptoms localizing to the lower respiratory tract, chest tightness, wheeze, and shortness of breath, were prominent and affected approximately one third of the respondents.

It is not possible to definitively state the mechanisms underlying symptoms in these individuals. However, questionnaire data suggests work-relatedness. Association of symptoms with blowout suggests aerosolized particulate material as an etiologic factor. Symptoms appear to be mostly irritative in nature, with many workers experiencing relief from symptoms after leaving the work place.

Allergy, or the increased susceptibility to irritants that is often associated with allergy, appeared to be a predisposing factor for many individuals.

Frequency of systemic symptoms (headaches, fevers, achiness, fatigue, etc.) was unexpected. Although such symptoms are not specific for any particular disease process, they can be associated with inflammatory conditions such as endotoxin inhalation. However, environmental measurements did not suggest excessive endotoxin exposure, so the source of these symptoms remains unclear.

CONCLUSIONS

Paper dust blowout involves relatively short-term, elevated particulate exposures in the areas immediately surrounding blowout. Most of the particulate settles quickly and is inhalable. According to the particle size distribution data, most of the particulate aerosolized by blowout will deposit in the upper respiratory tract. Blowout aerosolizes contaminants that otherwise would not be inhaled, including paper dust containing the chemicals associated with paper manufacturing or recycling. If performed carelessly, blowout can aerosolize floor dust as well as paper dust.

Three personal respirable dust samples collected over 5.5 hours during blowout operations indicated that dust levels were about 0.05 mg/m^3 on a time-weighted average. This average dust level was considerably below any applicable standard or recommended standard applicable to paper dust. However, the peak exposures caused by blowout are likely to be much greater than 0.05 mg/m^3 for brief periods of time. Dust concentrations are not consistently high as measured in paper mills. Also, paper mill studies present certain confounding exposures when the health effects of paper dust exposure are examined; these include exposures to irritants (for example, sulfur dioxide and chlorine) and additives to paper.

Workers at this plant reported symptoms consistent with paper dust depositing in the upper airways (for example, rhinitis, sinus problems, and eye and throat irritation). Other reported symptoms, such as wheezing and shortness of breath may be associated with mite and fungi exposures (see below). The published literature on paper dust provides little, if any, guidance on the likely effects of post office paper dust since: 1) the exposures occurred in paper-making plants where the nature of the exposure was likely to be very different to that in mail handling facilities; and 2) the dust levels in paper-making plants were considerably higher than seen in this facility.

Paper dust has accumulated on surfaces within the plant, particularly within air ducts and the interior of air handlers. The cellulose content of paper dust provides a food source for fungi, and paper dust absorbs moisture from the air, thus supporting microbial growth. The accumulation of bulk paper dust will likely provide a matrix for microbial growth. In addition, fungi is a food source for dust mites.

Overall, air handlers were in good mechanical condition. However, the hygienic condition of the air handlers was poor due to the excessive dust in the air handlers (including roach debris in two units), the accumulated debris and slime layer in most drain pans and on some cooling coils, and drain pans that did not drain rapidly enough to prevent the accumulation of water. The air handler dustiness was likely due to the use of low filtration efficiency roll-type filters coupled with excessive blow-by of unfiltered air. Biocide packets used in the drain pans were not effective in preventing the accumulation of microbial materials in the pans.

The odor of fungi was detected when air handlers servicing the third floor were opened for the collection of bulk dust and water samples. Bulk dust samples collected from the interior of air handlers servicing the third floor contained fungi in concentrations about 15 times that of air handlers servicing the first floor offices and plant areas. The fungal genera that were dominant in the third floor air handlers (*Tritirachium* and *Acremonium*) were different than those found in air handlers servicing the first floor (mostly *Cladosporium*, *Exophalia*, *Penicillium*, and *Aspergillus niger*). Despite these findings, the concentration of airborne spores (including spores of dominant fungi in bulk samples) inside the facility were not elevated in relation to the concentration of spores measured outdoors at the time of the survey.

Mite antigen was detected in the dust inside two first floor air handlers and in the airborne dust of one sample collected centrally on the third floor. The concentrations were above the concentration in bulk (non-airborne dust) that is associated with sensitization in patients with atopic tendencies and symptoms in clinically sensitive individuals. The presence of airborne mite antigen indicates mite sensitive workers in this area are at risk for symptoms associated with mite antigen exposure (nasal or ocular itching, rhinorrhea, sneezing, shortness of breath, wheezing, and productive cough).

Mite antigen-containing particulate is typically of a relatively large aerodynamic diameter, which means that the antigen would have to be actively disturbed to become aerosolized, and would likely settle out of the air rapidly. The mechanism for aerosolization of the antigen on the third floor was not confirmed, and the location of dust containing mite antigen was not determined. Blowout could have aerosolized mite antigen at the TMPDC, but this has not been confirmed.

Endotoxin levels inside the building were less than those measured outside the building.

RECOMMENDATIONS

In a letter dated July 23, 1997, to Omaha Mail Processing and Distribution Center (OMPDC) management, Omaha, Nebraska, an OSHA area director observed that "employees with pre-existing respiratory ailments such as seasonal allergies, chronic asthma, [or] bronchitis are routinely exposed to paper dusts that initiate or aggravate these health conditions." In the letter, OSHA recommended controls that include respiratory protection, smoking cessation, administrative rotation, and/or engineering solutions which minimize dust generation at the optical character reader delivery point bar code sorter areas with air filtration or wet vacuuming of surfaces.[49]

The following NIOSH recommendations focus on the control of non-specific and paper dust exposures, control of paper dust accumulation within the plant, and maintenance of HVAC system components:

Non-specific Dust Exposures

NIOSH investigators agree with OSHA that concentrations of certain non-specific dusts or paper dust can be elevated at times such that dusts or components of the dusts might initiate or aggravate pre-existing respiratory conditions. We further agree with OSHA recommendations to provide respiratory protection for employees with chronic respiratory conditions, provide a smoking cessation program for affected individuals, and experiment with permanent administrative job rotations for affected workers.

Control of Non-specific Dust Exposures

According to OSHA, if the employer decides that voluntary respirator use is permissible and will not present a hazard to the health of the employee, the employer is responsible for selecting the type of respirator facepiece and filter. According to the latest OSHA Final Rule for Respiratory Protection, selection is determined by "informed professional judgement" and "available data sources."[48] Filter selection is straightforward, even if the mass median aerodynamic diameter (MMAD) of the particulate is not known; any Part 84 filter may be used. If a physician prescribes a "dust mask," then a respirator that uses a Part 84 filter is a good selection. A loose-fitting filtering facepiece respirator is a good first choice for respiratory protection against non-specific dust exposures that initiate or aggravate employee health conditions. Because of their higher efficiency against 0.3 micron particulate, Part 84 filters are a good choice for these respirators. Part 84 filters provide from 95 to 99.97% efficiency in the removal of 0.3 micrometer particles. After July 10, 1998, non-powered, air-purifying, particulate-filter respirators should be approved under Part 84.[50]

If respiratory symptoms are not controlled with a loose-fitting filtering facepiece respirator, then a tighter-fitting filtering facepiece respirator should be selected in the proper size for the worker's face. These respirators are specially molded to form a more complete seal with the face. If symptoms persist with a tight-fitting filtering facepiece respirator that has been fit tested for the worker, then respirators which progressively minimize facepiece penetration should be selected.

If any respirator other than a filtering facepiece respirator is used, the employer must implement a medical evaluation to ensure that the worker is medically able to wear the respirator, and ensure that the respirator is cleaned, stored, and maintained so that its use does not present a health hazard to the worker.[47,48]

It is important to note that when respirators are used voluntarily without fit testing (or other training) no level of protection is assured. The level of protection provided by a negative-pressure respirator will be more dependent on the quality of the fit testing than on the respirator.

Control of Paper Dust Exposures

Paper dust exposure from blowout operations is a source of concern for postal employees who relate exposure to the dust with health effects. Five HHE requests since October 1997 have been filed that relate exposures to paper dust with respiratory infections, cough, asthma, and allergic rhinitis in certain workers. Typically, the process associated with generating the dust is the use of compressed air to blow dust from sorting machines. At this time, it is not possible to definitively state the mechanisms underlying symptoms in certain individuals. The association of symptoms with blowout only suggests that aerosolized particulate material is an etiologic factor for symptoms.

Until the etiology can be assessed in a more definitive study, it should be reiterated that vacuuming is mandatory before blowout. The aerosolization of blowout dust should be minimized, perhaps by using the lowest velocity airsteam that is compatible with effective cleaning.

Respiratory protection should be used by employees performing blowout and by employees who experience symptoms associated with blowout. Ideally, employees who have symptoms triggered by blowout should not be exposed, or blowout should be timed such that affected workers are not in the vicinity of blowout.

According to the NIOSH Guide to the Selection and Use of Particulate Respirators Certified Under 42 Part 84, Part 11 dust/mist (DM) or dust/fume/mist (DFM) filters may be used for protection against dusts with a mass mean aerodynamic diameter (MMAD) of greater than 2 micrometers.[50] Therefore, DM or DFM filters under Part 11 may be used when necessary to protect employees from paper dust exposures at the TMPDC since the MMAD of paper dust at the facility is greater than 2 micrometers. In addition, any filtering facepiece Part 84 filter may be used. Other respirator selection logic should follow that of non-specific dusts as outlined above.

Control of Paper Dust Accumulation

In a letter to the OMPDC dated July 23, 1997, OSHA suggests engineering control of airborne paper dust in the form of auxiliary air filtration or wet vacuuming of floors or machines to remove paper dust. NIOSH investigators encourage the control of paper dust accumulation within the building on the grounds that paper dust provides a good matrix for microbial growth, and microbial growth, particularly within HVAC systems, should be minimized. Ideally, paper dust should be controlled at the source to prevent accumulation within the building. At a minimum, its accumulation should be controlled within HVAC return and supply airstreams. Control by prefilters, increased efficiency of primary filters, and prevention of filter blow-by are some options. NIOSH investigators do not encourage the application of water to collect paper dust unless moistened surfaces are dried within 24 hours.

HVAC Systems

For HVAC maintenance recommendations, third floor air handlers should be given priority for cleaning, since these systems exhibited fungal odors and fungi concentrations in bulk dust that were 15 times higher than concentrations measured in air handlers that service other parts of the building. For all air handlers, priority should be given to the removal of slime, the creation of free-flowing drain pans, the disinfection of surfaces, and the prevention of blow-by of unfiltered air from around roll-type filter media. It is recommended that the June 1998 Building Air Quality Action Plan (authored by the Environmental Protection Agency and NIOSH) be used as a guide for maintaining and improving HVAC operations. Specific recommendations follow:

1. Water should not be allowed to accumulate in drain pans or within porous surfaces in HVAC systems. Eliminate standing water in all air handling systems by providing free-flowing drains. Drain pans should not accumulate water, thus rendering the use of chemical pads impregnated with biocides unnecessary. Check insulation for moisture that is blowing off of cooling coils. Control of moisture is particularly important for the rooftop air handlers that service the third floor. Excessive humidity in these air handlers has likely contributed to mold growth within the porous lining of the air handlers and ducts.

2. Maintaining the proper balance of humidity is likely to be important in the mail handling environment due to concerns with allowing enough humidity to prevent accumulation of static electricity, and the dual concern of limiting humidity to prevent mite and other microbial growth. Controlling humidity below 50% relative humidity will help control dust mite populations and should be a target humidity level inside air handlers. It has not been determined whether or not controlling humidity in other areas of the plant is necessary in order to control mite populations.

3. To help minimize the accumulation of debris within air handlers, ensure all HVAC systems have outdoor air filters that are securely fastened into filter racks that minimize blow-by of unfiltered air. Ideally, filters should be 50 to 70% efficient (according to the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) dust spot efficiency test) in order to remove most microbial particulate from the airstream. Any increase in filter efficiency is desirable, but should be limited to account for the pressure drop the systems can handle.

4. Despite good drainage, it is likely that debris will accumulate on cooling coils and moist surfaces in drain pans, since highly efficient filtration of the air entering the interior of air handlers will be impossible to achieve. Monitor the accumulation of debris in air handlers and adjust maintenance schedules accordingly to maintain a dry, only slightly dusty interior for air handlers.

5. Routinely clean and disinfect surfaces (particularly wet surfaces) as recommended by equipment manufacturers and as on-site conditions require. Cleaning should be performed often enough to prevent the accumulation of dust and slime in drain pans and cooling coils. When cleaning and sanitizing HVAC components, never disinfect or use biocides in water or air in an operating HVAC system. Ensure that the HVAC system is not operating until it is cleaned, sanitized, and dried. Loosen and remove mold, slime, dirt, and

organic debris, then sanitize using a dilute aqueous household bleach solution (5% to 10% bleach in water). Bacterial endospores, produced by some thermophilic actinomycetes, may be slightly resistant to chlorine disinfectants; therefore, surfaces should be kept moist with the bleach solution for a sufficient contact time to allow for disinfection to occur (about 10 to 15 minutes). A clean water rinse should follow cleaning and sanitizing. If drain pans contain foam or other insulation, check with the air handler manufacturer for recommendations regarding cleaning and disinfection.

6. Do not wet porous insulation surfaces with water or attempt to disinfect visibly moldy insulation. Remove all traces of contaminated insulation and disinfect the underlying metal surfaces. When possible, insulate exterior surfaces instead of replacing interior insulation or sound lining. Ensure workers who clean or remove materials are adequately protected from cleaning solution exposures and dust exposures.

7. HVAC system maintenance workers should receive training in the recognition and control of contamination in air handlers and in other components of HVAC systems.

REFERENCES

1. Dillon H, Heinsohn P, Miller J eds. [1996]. Field guide for the determination of biological contaminants in environmental samples. Fairfax, Va: American Industrial Hygiene Association.

2. NIOSH [1994]. Particulates not otherwise regulated, respirable: Method 0600. In: Eller PM, ed. NIOSH manual of analytical methods. 4th ed. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 94-113.

3. Olenchock, S.A., Castellan, R.M., and Mull, J.C. 1984. Endotoxin contamination of cotton: Area of growth/varieties. Proc. 8th Cotton Dust Res Conf. P.J. Wakelyn and R.R. Jacobs (eds), National Cotton Council, Memphis, pp. 64-66.

4. NIOSH [1992]. Recommendations for occupational safety and health: compendium of policy documents and statements. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 92-100.

5. ACGIH [1998]. 1998 TLVs® and BEIs®: threshold limit values for chemical substances and physical agents. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

6. Code of Federal Regulations [1997]. 29 CFR 1910.1000. Washington, DC: U.S. Government Printing Office, Federal Register.

7. Public Law 91 - 596 (The OSH Act) 5(a)(1).

8. R Rylander, RR Jacobs eds. [1994]. Organic dusts: exposure, effects, and prevention. Ann Arbor, MI: Lewis Publishers, p. 45.

9. OSHA [1987]. Interpretation; OSHA currently has no enforceable standard for paper dust. U.S. Department of Labor, Occupational Safety and Health Administration.

10. OSHA [1993]. Interpretation; Compliance and enforcement activities affected by the PELs decision. U.S. Department of Labor, Occupational Safety and Health Administration.

11. Tingle R [1998]. Telephone conversation on March 23, 1998 between R. Tingle, Directorate of Health Standards Programs, Occupational Safety and Health Administration, Department of Labor, and D. Hewett, Division of Respiratory Disease Studies, National Institute for Occupational Safety and Health, Centers for Disease Control, Public Health Service, U.S. Department of Health and Human Services.

12. ACGIH [1991]. Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

13. Burge HA [1988]. Environmental allergy: definition, causes, control. Engineering Solutions to Indoor Air Problems. Atlanta, GA: American Society of Heating, Refrigeration and Air-Conditioning Engineers, 3-9.

14. Morey PR, Feeley JC [1990]. The landlord, tenant, and investigator: their needs, concerns and viewpoints. Biological Contaminants in Indoor Environments. Baltimore, MD: American Society for Testing and Materials, pp 1-20.

15. Pickering CA [1992]. Immune respiratory disease associated with the inadequate control of indoor air quality. Indoor Environment 1:157-161.

16. Molhave L, Bach B, Pedersen OF [1986]. Human reactions to low concentrations of volatile organic compounds. Environ Int 12:167-176.

17. Vinken W, Roels P [1984]. Hypersensitivity pneumonitis to Aspergillus fumigatus in compost. Thorax 39:74- 74.

18. Malmberg P, Rask-Andersen A, Palmgren U, Höglund S, Kolmodin-Hedman B, Stålenheim G [1985]. Exposure to microorganisms, febrile and airway-obstructive symptoms, immune status, and lung function of Swedish farmers. Scandinavian Journal of Work and Environmental Health 11:287-293.

19. Topping MD, Scarsbrick DA, Luczynska CM, Clarke EC, Seaton A [1985]. Clinical and immunological reactions to Aspergillus niger among workers at a biotechnology plant. British Journal of Industrial Medicine 42:312-318.

20. Edwards JH [1980]. Microbial and immunological investigations and remedial action after an outbreak of humidifier fever. British Journal of Industrial Medicine 37:55-62.

21. Weiss NS, Soleymani Y [1971]. Hypersensitivity lung disease caused by contamination of an air-conditioning system. Annals of Allergy 29:154-156.

22. Hodgson MJ, Morey PR, Attfield M, Sorenson W, Fink JN, Rhodes WW, Visvesvara GS [1985]. Pulmonary disease associated with cafeteria flooding. Archives of Environmental Health 40(2):96-101.

23. Fink JN, Banaszak EF, Thiede WH, Barboriak JJ [1971]. Interstitial pneumonitis due to hypersensitivity to an organism contaminating a heating system. Annals of Internal Medicine 74:80-83.

24. Banazak EF, Barboriak J, Fink J, Scanlon G, Schlueter EP, Sosman A, Thiede W, Unger G [1974]. Epidemiologic studies relating thermophilic fungi and hypersensitivity lung syndrome. American Review of Respiratory Disease 110:585-591.

25. Jordan FN, deShazo R [1987]. Immunologic aspects of granulomatous and interstitial lung diseases. Journal of the American Medical Association 258(20):2938-2944.

26. Hagmar L, Schütz A, Hallberg T, Sjöholm A [1990]. Health effects of exposure to endotoxins and organic dust in poultry slaughter-house workers. Int Arch Occup Environ Health 62:159-164.

27. Rylander R [1987]. The role of endotoxin for reactions after exposure to cotton dust. Am J Ind Med 12:687-697.

28. Jacobs RR [1989]. Airborne endotoxins: an association with occupational lung disease. Appl Occup Environ Hyg 4:50-56.

29. Olenchock SA [1985]. Endotoxins in occupationally related airborne dusts. Govern Lab 1:28-30.

30. Castellan RM, Olenchock SA, Kinsley KB, Hankinson JL [1987]. Inhaled endotoxin and decreased spirometric values, an exposure-response relation for cotton dust. N Engl J Med 317:605-610.

31. Dutch Expert Committee on Occupational Standards [1998]. Endotoxins: health-based recommended occupational exposure limit. Health Council of the Netherlands, Publication No. 1998/03WGD

32. Pope A, Patterson R, Burge H eds. [1993]. Indoor allergens; assessing and controlling adverse health effects. Washington, D.C.: National Academy Press.

33. Wald P, Stave G [1994]. Physical and biological hazards of the workplace. New York, N.Y.: Van Nostrand Reinhold.

34. AIHA [1996]. Field guide for the determination of biological contaminants in environmental samples. Fairfax, Va: American Industrial Hygiene Association.

35. LaDou J, ed. [1997]. Occupational and environmental medicine. 2nd ed. Stamford, Conn.: Appleton & Lange.

36. Korn RJ, Dockery DW, Speizer FE, Ware JH, Ferris BG [1987]. Occupational exposures and chronic respiratory symptoms; a population-based study. Am Rev Respir Dis 136:298-304.

37. Thoren K, Jarvholm B, Morgan U [1989]. Mortality from asthma and chronic obstructive pulmonary disease among workers in a soft paper mill: a case-referent study. British Journal of Industrial Medicine 46:192-195.

38. Toren K, Jarvholm B, Sallsten G, Thiringer G [1994]. Respiratory symptoms and asthma among workers exposed to paper dust: a cohort study. Am J Indust Med 26:489-496.

39. Toren K, Sallsten G, Jarvholm B [1991]. Mortality from asthma, chronic obstructive pulmonary disease, respiratory system cancer, and stomach cancer among paper mill workers: a case-referent study. American Journal of Industrial Medicine 19:729-737.

40. Chan-Yeung M, Wong R, Maclean L, Tan F, Dorken E, Schulzer M, Dennis R, Grzybowski S [1980]. Respiratory survey of workers in a pulp and paper mill in Powell River, British Columbia. 122:249-257.

41. Ericsson J, Jarvholm B, Norin F [1988]. Respiratory symptoms and lung function following exposure in workers exposed to soft paper tissue dust. 60:341-345.

42. Toren K, Sallsten G, Bake B, Drake U, Jarvholm B, Sahle W [1989]. Lung function and respiratory symptoms among workers in a soft paper mill. Am J Indust Med 61:467-471.

43. Toren K, Hagberg S, Westberg H [1996]. Health effects of working in pulp and paper mills: exposure, obstructive airways diseases, hypersensitivity reactions, and cardiovascular diseases. Am J Indust Med 29:111-122.

44. Andreassen R, Lynge E [1996]. Industrial hygiene measurements in a new industry: the repulping and deinking of paper waste. Am J Indust Med 30:142-147.

45. Zuskin E, Mustajbegovic J, Schachter E, Kanceljak B, Kern J, Macan J, Ebling Z [1998]. Respiratory function and immunological status in paper-recycling workers. J Occ Envir Med 40:986-993.

46. Gaertner M, Brunstein C, Busetto A [1992]. Lung function and respiratory symptoms in paper industry workers exposed to soft paper tissue (bathroom tissue) dust. Archives des maladies professionnelles. 53(7):639-644.

47. OSHA [1990]. Interpretation; Dust exposure for postal employees. U.S. Department of Labor, Occupational Safety and Health Administration.

48. 63 Fed. Reg. 5 [1998]. Occupational Safety and Health Administration: respiratory protection; final rule. (Codified at 29 CFR 1910 and 1926).

49. Office of OSHA Area Director Lodama Delinger [1997]. Letter to David J. Hayek, Acting Senior Manager, U.S. Postal Service, Omaha, Nebraska. Des Moines, Iowa. Photocopy.

50. NIOSH [1996]. NIOSH guide to the selection and use of particulate respirators certified under 42 CFR 84. Washington, DC: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 96-101.

TABLE 1

Observations of Air Handler Conditions

Tampa Mail Handling and Distribution Center, Tampa, Florida
HETA 98-0307

Air Handler Number	Zone	Comments
AH 1A	Offices	Slight visible mold growth on interior insulation of air handler, slime on cooling coil, drain and P-traps.
AH 1B	1st floor	Slime on cooling coils
AH 2	1st floor	No comments
AH 3	1st floor	Dusty, slight visible mold and slime in drain pan
AH 4	1st floor	Grey/brown slime accumulation in drain pan
AH 5	1st floor	Slight clear slime on cooling coil
AH 6	1st floor	Black and white slime on cooling coil, white mold growth on interior insulation, filter blow-by
AH 7	1st floor	No comments
AH 8	1st floor	Very dusty return air duct surfaces
AH 9	Offices	Visible white mold growth, slime in coil drain pans, standing water, dusty return duct
AH 10	1st floor	Very thick grey slime in both coil drain pans
AH 11A	1st floor	No comments
AH 12	1st floor	Poor drainage, slime in drain pan
AH 14	1st floor	Slime in drain pan and light dust

Air Handler Number	Zone	Comments
AH 17	Offices	Thick slime accumulation on cooling coils, poor drain pan drainage, slime in drain pans
AH 19	1st floor	Standing water in drain pan, visible white mold encased in dust downstream of coils
AH 20	1st floor	Dry friable white mold in air handler insulation
AH 32	3rd floor	White mold on insulation, thick black slime in drain pan, poor drainage, coils clean, strong musty odor
AH 33	3rd floor	Visible fungi, thick slime in drain pan, musty odor
AH 34	3rd floor	Poor drainage, slime and sludge in drain pan, no odor
AH 35	3rd floor	Visible fungi, thick slime in drain pan, musty odor
AH 36	3rd floor	Visible white fungi, musty odor, poor drainage, slime accumulation in drain pan
AH 37	3rd floor	Heavy dust, strong musty odor, standing water in drain pan
AH 47	1st floor	no comments

TABLE 2

Airborne Dust Concentrations and Estimates of Respirable and Thoracic Concentrations Based On Dust Collection by Marple 8-Stage Impactors

Tampa Mail Handling and Distribution Center, Tampa, Florida
HETA 98-0307

Location # (See Figures 3, 4 and 5)	Sampling Period	Sample Volume (liters)	Concentration (mg/m^3) Based on Total Mass Collected	Estimated Respirable Concentration (mg/m^3) Based on Application of Lung Deposition Curves[1]	Estimated Thoracic Concentration (mg/m^3) Based on Application of Lung Deposition Curves[1]
1	0713 - 1504	932.2	0.93	0.10	0.22
2	0719 - 1506	899.0	2.32	0.16	0.41
3	0723 - 1508	908.6	0.56	0.14	0.25
4	0732 - 1515	904.2	0.52	0.23	0.30
5	0736 - 1517	889.7	1.26	0.11	0.23
6	0740 - 1520	897.5	0.22	0.11	0.15
7	0745 - 1524	896.9	0.27	0.11	0.17
8	0752 - 1531	906.1	0.12	0.05	0.07
9	0757 - 1534	916.7	0.26	0.10	0.15
10	0801 - 1538	894.0	0.28	0.11	0.17

1 = Deposition curve source: ACGIH [1995] Air sampling instruments for evaluation of atmospheric contaminants, 8th ed., American Conference of Governmental Industrial Hygienists, Table 5-5, Inhalable, Thoracic, and Respirable Dust Criteria of ACGIH-ISO-CEN, p. 102.

FIGURE 1

1st Floor Plant Airborne Dust Sampling Locations 'I' Through 'P'

Tampa Mail Handling and Distribution Center, Tampa, Florida
HETA 98-0307

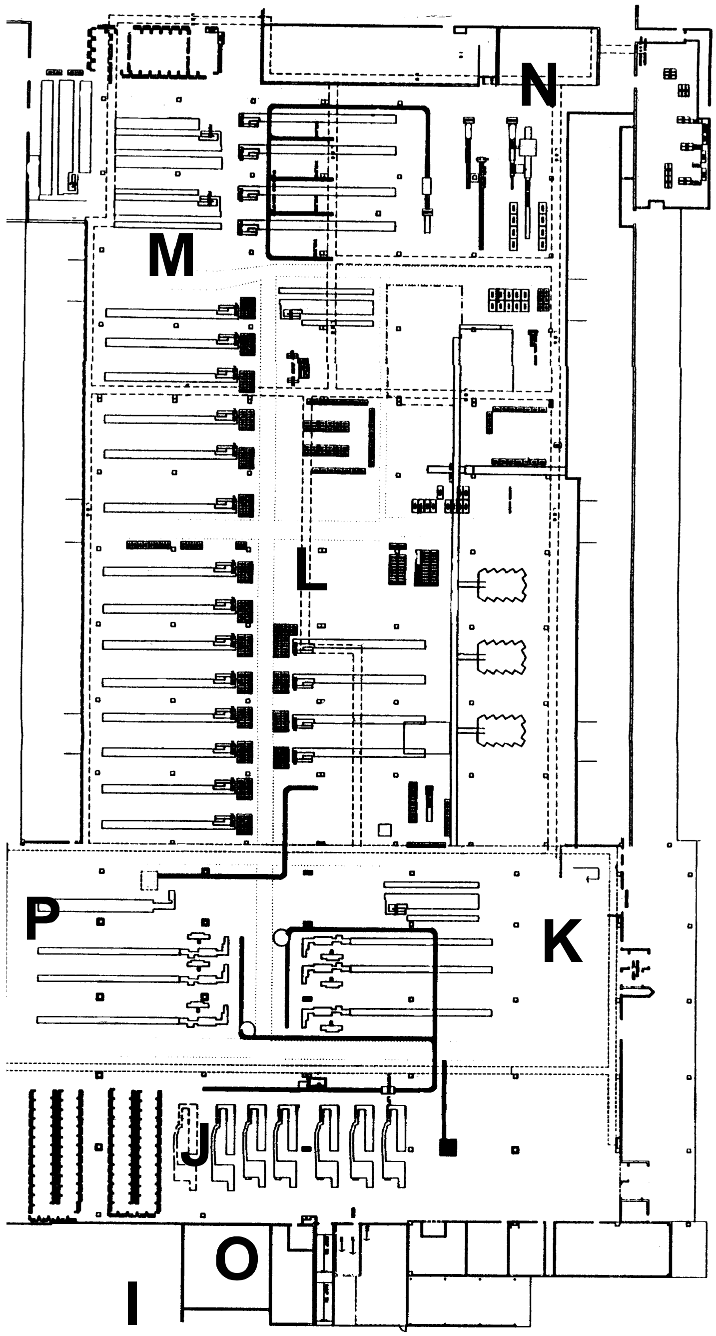


FIGURE 2

3RD Floor Plant Airborne Dust Sampling Locations 'A' Through 'H' and 'Q'

Tampa Mail Handling and Distribution Center, Tampa, Florida
HETA 98-0307

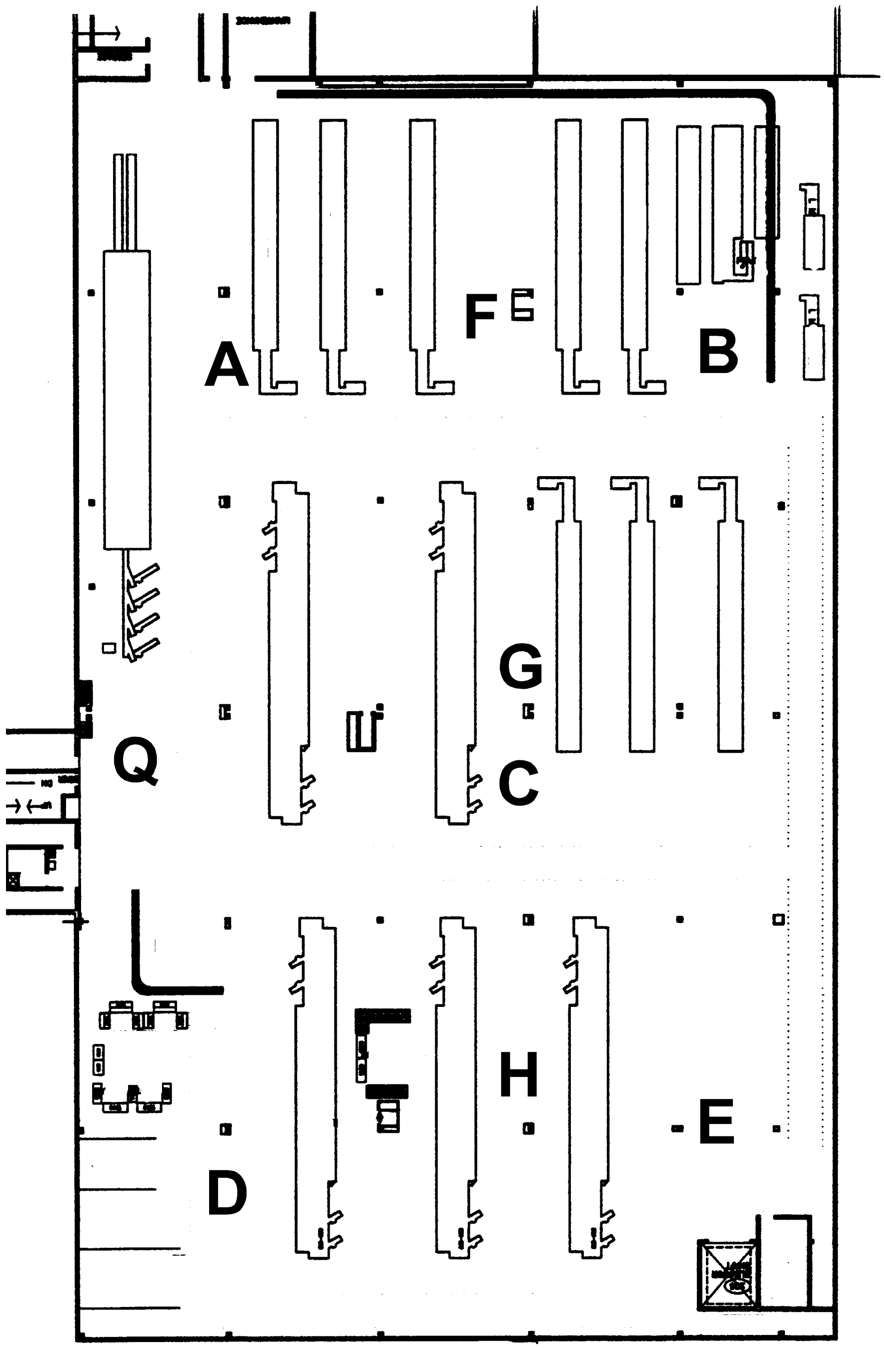


FIGURE 3

1st Floor Plant Particle Size Selective Dust Sampling Locations 1 Through 4

Tampa Mail Handling and Distribution Center, Tampa, Florida
HETA 98-0307

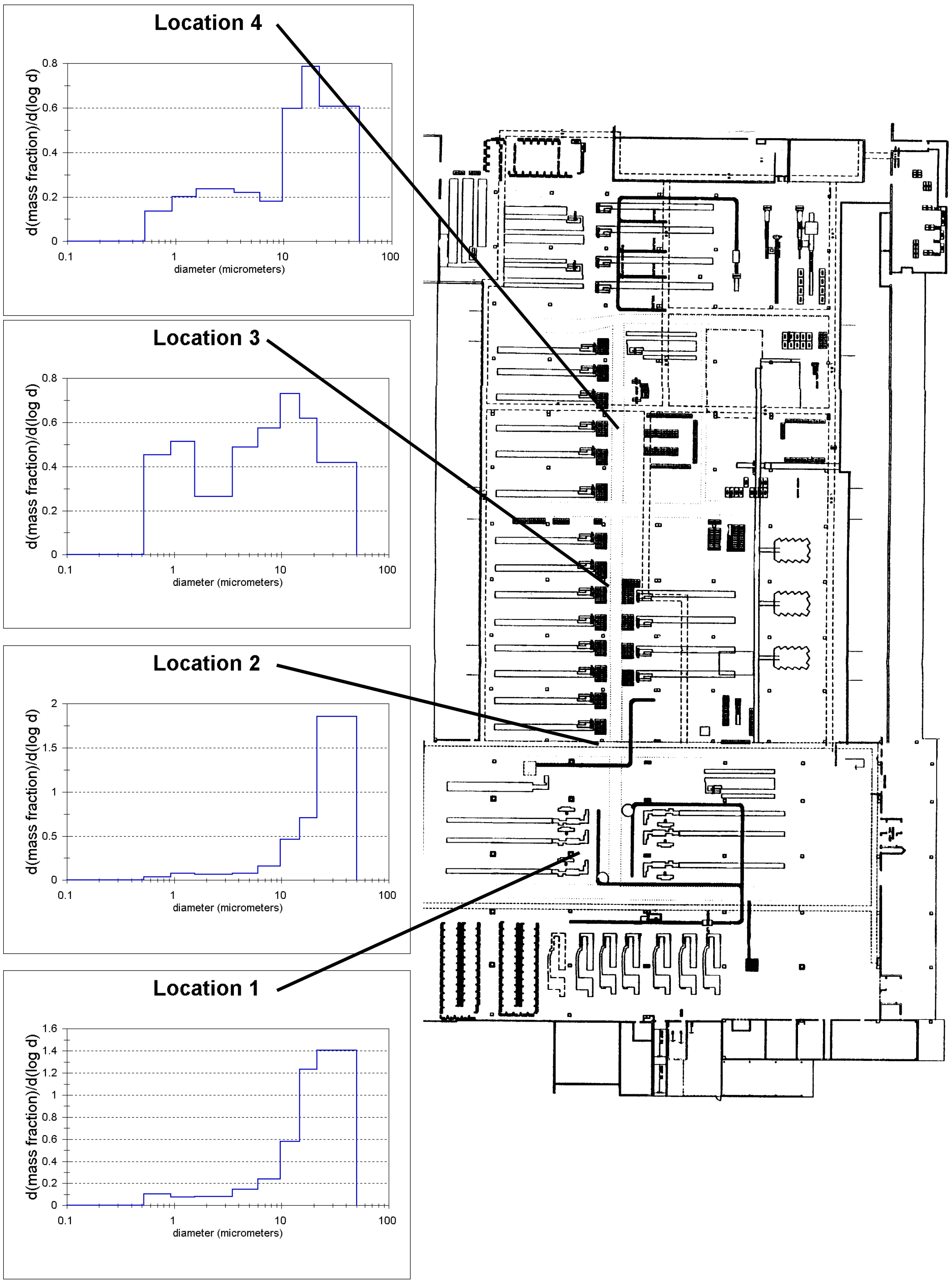


FIGURE 4

1st Floor Plant Particle Size Selective Dust Sampling Locations 5 Through 7

Tampa Mail Handling and Distribution Center, Tampa, Florida
HETA 98-0307

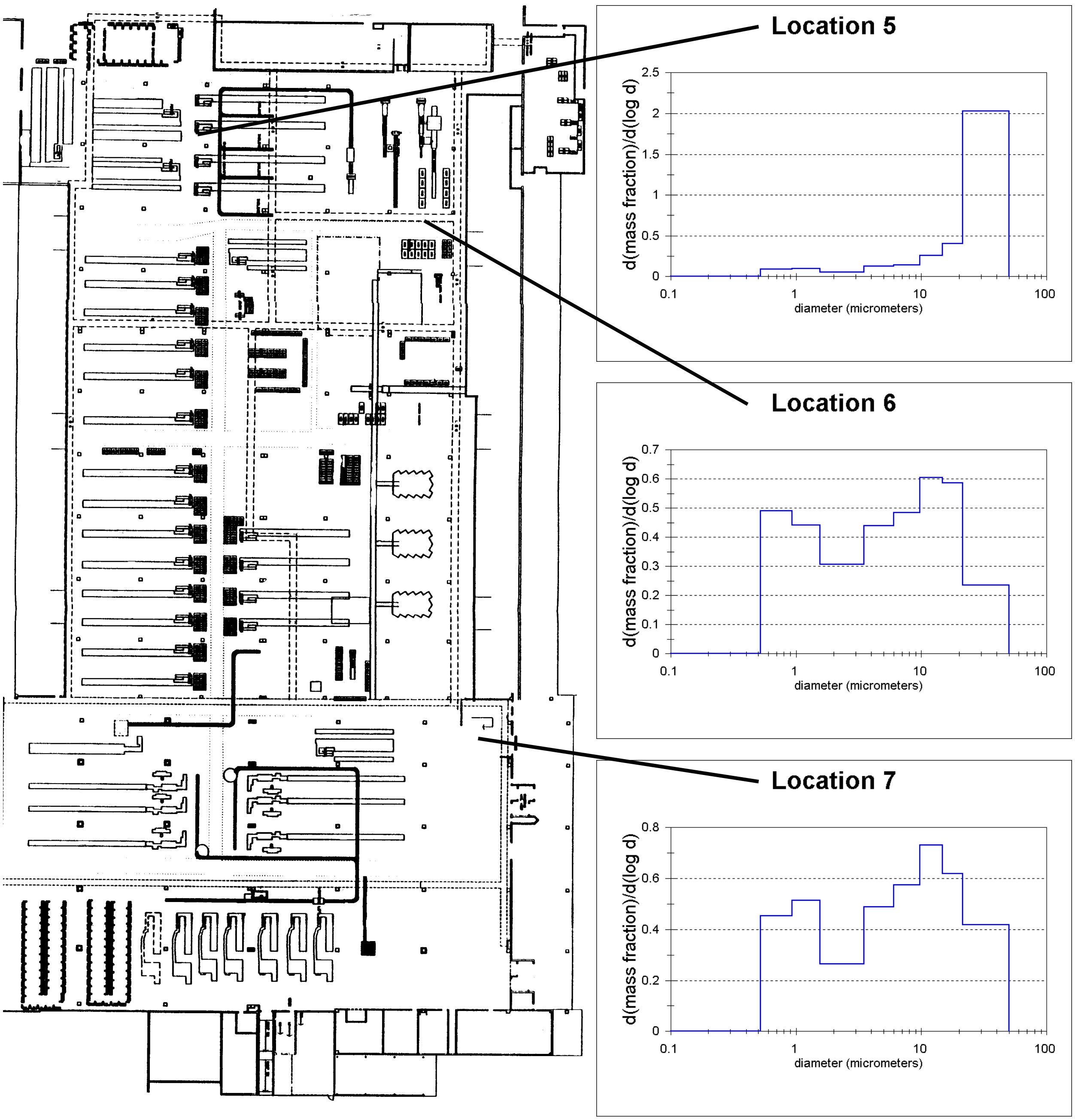


FIGURE 5

3rd Floor Plant Particle Size Selective Dust Sampling Locations 8 Through 10

Tampa Mail Handling and Distribution Center, Tampa, Florida
HETA 98-0307

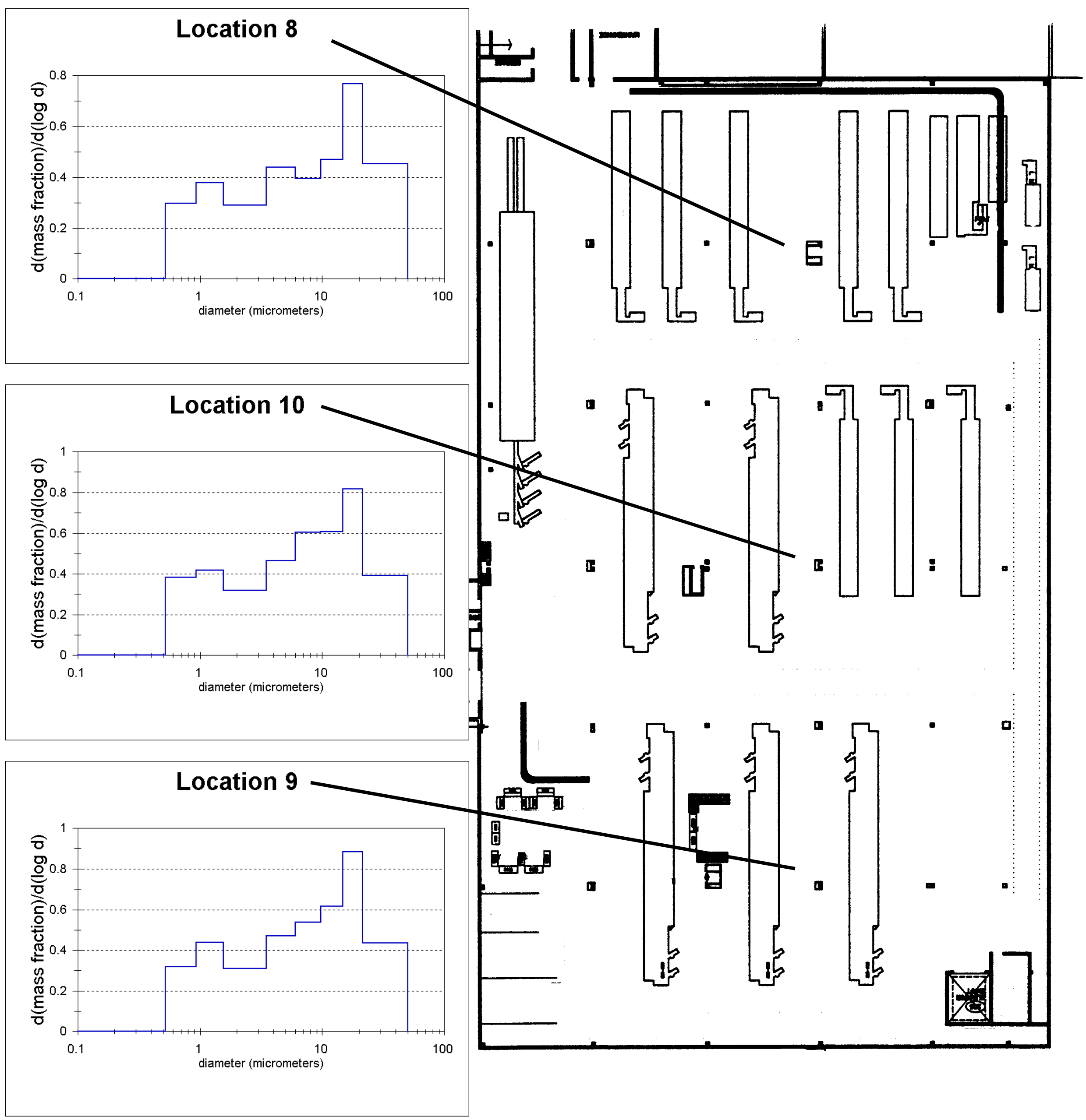
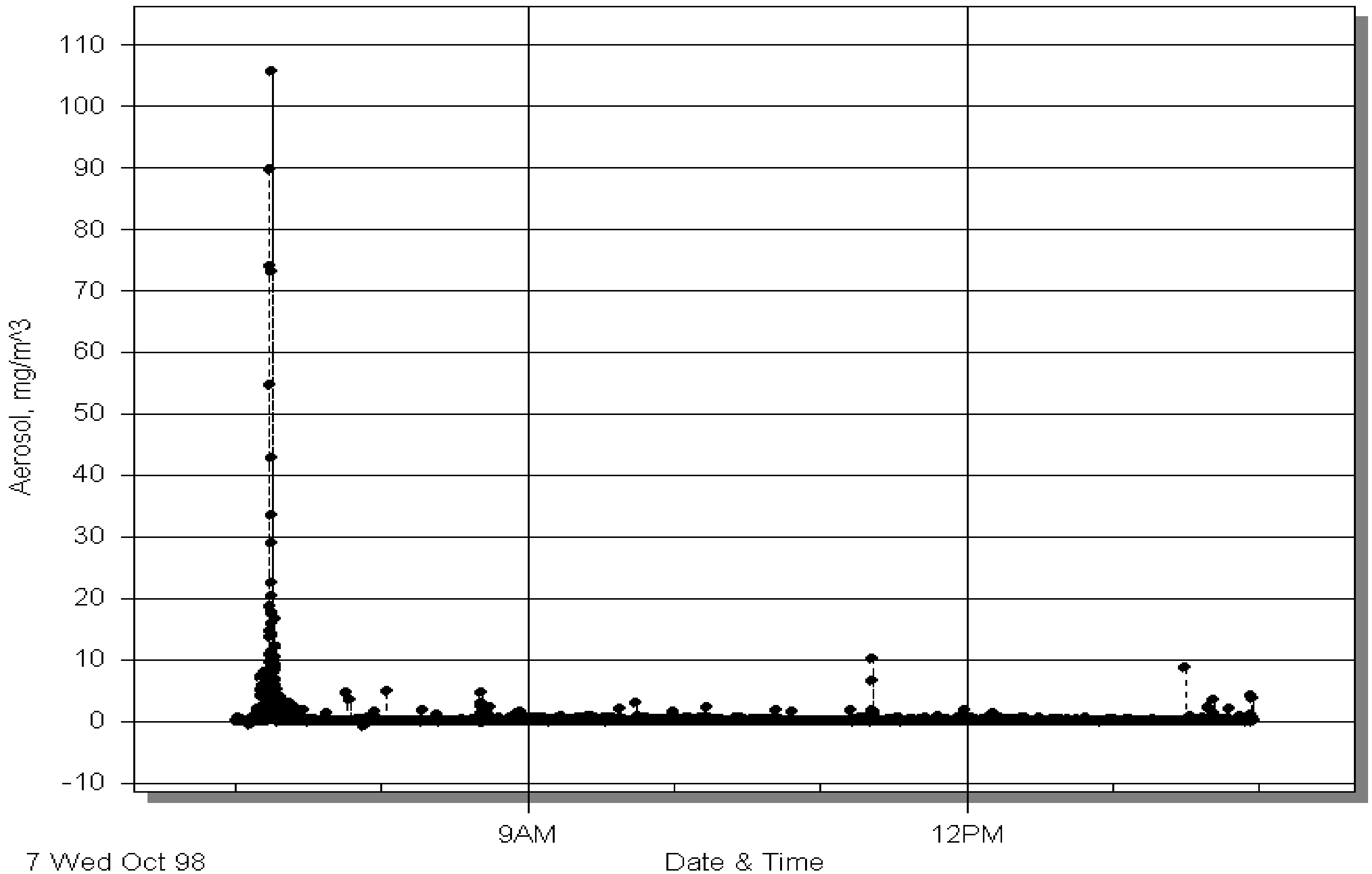


FIGURE 6

Graph of Qualitative Aerosol Concentrations During
Vacuum / Blowout of Delivery Point Bar Code Sorters #6 and #7, October 7, 1998

Tampa Mail Handling and Distribution Center, Tampa, Florida HETA 98-0307



Appendix

<u>Telephone</u> <u>Questionnaire</u>: HHE 98-0307, US Postal Service, Tampa, FL

1) Name:________________________________ 2) Survey ID#_______________

3) Telephone #:___________________________ 4) Date:_______________

5) I am from the National Institute for Occupational Safety and Health. We are currently doing an evaluation of indoor air quality at the US Postal Service facility in Tampa. Your name was provided as someone who works in the facility and would be willing to talk on the telephone about it. Would you be willing to answer some questions now - it would take about 10 minutes of your time?

1. Yes____ 2. No____

If no, thank the worker and hang up. If yes, proceed to questions:
First, I would like to ask you a few questions about your job:

6) What is your department?_________________________________

7) What is your job title?____________________________________

8) What do you do at work (what is your job description)?___________________________
____

9) What floor do you work on?_______________________________

Next, I would like to ask you some questions about your health:

10) During your working hours at the Postal Service do you have any of the following symptoms **more than once a week**?

A. Irritated, stuffy, or runny nose? 1. Yes___ 2. No___
B. Irritated, red, or watery eyes? 1. Yes___ 2. No___
C. Sinus fullness or post-nasal drip? 1. Yes___ 2. No___
D. Headache? 1. Yes___ 2. No___
E. Irritated, scratchy, or sore throat? 1. Yes___ 2. No___
F. Wheezing or whistling in your chest? 1. Yes___ 2. No___
G. Tightness in your chest? 1. Yes 2. No
H. Dry cough? 1. Yes___ 2. No___
I. Cough with phlegm? 1. Yes___ 2. No___
J. Shortness of breath when you are **not** doing hard physical work? 1.Yes___ 2. No___
K. Flu-like symptoms such as fevers, achiness, or unusual tiredness? 1.Yes___2. No___

ASK QUESTIONS 11 - 16 ONLY IF THE PERSON REPORTS ANY OF THE SYMPTOMS LISTED IN #10 ABOVE; OTHERWISE, SKIP TO #17, PAST ILLNESSES.

11) While you are at work, are your symptoms:
1. Better __
2. Worse __
3. Unchanged __

12) After getting home from work, are your symptoms:
1. Better __
2. Worse
3. Unchanged __

13) Over the course of the work week are your symptoms:
1. Better __
2. Worse __
3. Unchanged __

14) When you are away from work on days-off or vacations, are your symptoms:
1. Better
2. Worse __
3. Unchanged__

15) Are the symptoms worst on the first day back to work [after days-off] compared to other work days?
1. Yes__
2. No__
3. Don't Know

16) During blow-downs of machines with compressed air are your symptoms:
1. Better___
2. Worse___
3. Unchanged___

PAST ILLNESSES

17A) Have you ever had asthma? 1. Yes 2. No

IF NO TO 17A GO TO 18.

17B) Was it confirmed by a doctor? 1. Yes___ 2. No___

18) Have you ever smoked cigarettes for as long as a year? 1. Yes___ 2. No___
('YES' means at least 20 packs of cigarettes in your lifetime, or at least one cigarette per day for one year)

19) Do you currently smoke cigarettes (as of 1 month ago)? 1. Yes___ 2. No___

20) Have you ever had any of the following illnesses?

A. Attacks of Bronchitis? 1. Yes 2. No
B. Hay-fever or nasal allergies? 1. Yes___ 2. No___
C. Sinus trouble? 1. Yes___ 2. No___
D. Any type of allergy diagnosed by a doctor? 1. Yes___ 2. No___
D. Emphysema? 1. Yes___ 2. No___
E. Cardiac Problems? 1. Yes___ 2. No___

For Information on Other
Occupational Safety and Health Concerns

Call NIOSH at:
1–800–35–NIOSH (356–4674)
or visit the NIOSH Homepage at:
http://www.cdc.gov/niosh/homepage.html

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