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ANCLOTE ELEMENTARY SCHOOL
NEW PORT RICHEY, FLORIDA

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SUMMARY

On August 5, 1992, the National Institute for Occupational Safety and Health (NIOSH), received a confidential request for a health hazard evaluation (HHE) at the Anclote Elementary School in New Port Richey, Florida. The request asked NIOSH to investigate health problems experienced by some building occupants that were thought to be related to their work environment. These health concerns included lung problems the requestors associated with the presence of mold in the facility. In response to this request, NIOSH investigators conducted a site visit on November 12-13, 1992. The objectives for this visit were to inspect the school, interview building occupants, and review the building's heating, ventilating and air-conditioning (HVAC) system. Environmental monitoring for standard indoor environmental parameters (temperature, relative humidity [RH], carbon dioxide [CO_2]) was conducted, and the results were compared with guidelines developed by the American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE). Measurements were taken to estimate the quantity of outside air provided to occupied areas. Janitorial and pesticide application practices were assessed, as well as management protocols for responding to indoor environmental quality (IEQ) concerns.

On November 12, 1992, NIOSH investigators interviewed 25 employees (24 teachers, 1 cafeteria worker) of Anclote Elementary School using an indoor air quality and work environment symptoms survey. Teachers from each of the pods, as well as the art and music rooms, the kindergarten, and first-grade areas, were included.

Visual inspection indicated, in general, that all air-handling units (AHUs) were in good condition, draining properly, and had clean filters. Outside-air (OA) dampers were open on all systems except two units supporting the K-1/K-2 addition. The units supporting K-1/K-2 are totally-recirculating residential type units with no provision for OA. Moldy odors were detected in several of the classroom pods, and the source was apparently the wall-board ("Beaver Board") on the interior side of the outside walls. Removal of wall-paper in selected areas showed considerable mold-growth and water damage.

Temperatures were within an acceptable range (69°-75°F); there were, however, fluctuations of up to 4 degrees throughout the day in the same area. RH levels were at the high end, or higher, than those generally considered acceptable (30-60%) for occupant comfort. The highest RH level, 68%, was detected in the classroom serviced by AHU #8.

CO_2 measurements indicated that insufficient outside air was provided to occupied areas. The CO_2 levels ranged widely, but in most areas exceeded the 1000 parts per million (ppm) guideline recommended by ASHRAE Standard 62-1989, suggesting OA ventilation rates of less than the ASHRAE recommended 15 cubic feet per minute per person (cfm/p). The highest levels found were in excess of 3300 ppm in the K-1/K-2 classrooms. Air flow measurements confirmed that OA rates are less than 15 cfm/p in all areas except for the office/administrative area.

No unusual janitorial or pesticide use practices were noted during the investigation. A proactive system to prevent IEQ problems from occurring, or resolving existing problems in a timely fashion, has not been implemented. Activities which may affect IEQ (e.g., roofing, painting, etc.) are allowed to proceed without prior review with school management (e.g., principal) or consideration of their impact on occupants.

The employee interviews indicated that health concerns centered around the presence of mold on the walls and visible dirt on ventilation louvers. Other concerns included temperature (too

hot or cold) and excessively high humidity levels. The most common symptom reported was stuffy or runny nose, or sinus congestion.

Ongoing health concerns and complaints associated with the working environment have been experienced by some employees at the Anclote Elementary School. The presence of mold-contaminated wall board and ceiling tile is a potential source of microbiological contaminants. Environmental measurements indicate insufficient outside air is provided to occupied areas, and relative humidity levels exceed those generally considered comfortable. No chemical explanation for the employee symptoms was identified. Recommendations to address the IEQ issues at this school include modifying the ventilation system to ensure sufficient outside air is provided to occupied areas, identifying and removing all water-damaged or mold-contaminated material, improving humidity control, modifying HVAC cycle times, employee education, and establishing a pro-active IEQ management program.

KEYWORDS: SIC 8211 (Elementary and Secondary Schools): indoor environmental quality, IEQ, IAQ, mold, ventilation, carbon dioxide, relative humidity, temperature, respiratory illness.

INTRODUCTION

On August 5, 1992, NIOSH received a confidential request from employees of the Anclote Elementary School to investigate ongoing health complaints thought to be related to their work environment. The reported complaints were chronic respiratory illness and the presence of mold in the building.

An initial site visit to evaluate the Anclote Elementary School was conducted on November 12-13, 1992. During the survey, NIOSH investigators met with school and employee representatives, inspected the facility and heating, ventilating and air-conditioning (HVAC) system, conducted environmental monitoring, and interviewed building occupants.

An initial response letter describing the actions taken by NIOSH, as well as preliminary findings and recommendations, was sent to school officials and the requestor on January 26, 1993.

BACKGROUND

Anclote Elementary, constructed in 1973-1974, is a windowless school serving grades K-6, with classrooms arranged in pods. There are 806 children currently enrolled in the 53,000 ft^2 school (the building was designed for 817 students). The pod design (also referred to as a Kelley school) was popular in Florida during this time period, and there are 6-7 other similarly constructed schools in Pasco County. The pod design (figure 1) consists of placing 4-5 classrooms in a single room (pod), or open arrangement. The pods are separated by firewalls and face a media center in the center of the building. At Anclote Elementary, each pod is designated by the name of a continent (e.g., North America). The classrooms were carpeted at one time, but it has since been removed. At the time of the site visit, only the media center, main hallway, and the walls in certain areas were carpeted. There are 69 teachers, custodians, administrative staff, and cafeteria employees working at the school. School faculty is on duty from 7:45 AM - 3:15 PM. School is in session from 8:30 AM - 2:30 PM. Average student attendance (annual) for school year 1991-1992 was 93.8%.

Periodic indoor environmental quality (IEQ) concerns have been an ongoing employee issue at Anclote Elementary for a number of years. Many of these concerns involved the presence of mold and mildew associated with moisture from a chronically leaking roof. The specific health issue identified in the HHE request was respiratory illness and its hypothesized relationship to the presence of mold in the building. Prior to the NIOSH visit, no health or environmental investigations had been conducted at the school. In response to employee concerns, the HVAC system was recently inspected, and a project to completely replace the roof to resolve the leakage problems was initiated. Smoking is not allowed in the school.

HVAC System

The Anclote Elementary school is serviced by eleven roof-mounted, constant-volume (CV) air-handling units (AHUs) with fixed outside air (OA) intakes (no economizers). Two residential-type air conditioners, with no OA provision, support two add-on classrooms (K1, K2). The school was designed to comply with Florida Mechanical Code Regulations 6A-2, Educational Facilities. These regulations specify that a minimum OA rate of 5 cfm/p be provided through the air handling system, and that the system must be capable of maintaining a temperature of 78°F and 65% RH.

For energy conservation purposes, the HVAC system is cycled, with off-times between 4:00 PM and 7:00 AM. Temperature control is electric for heating and a 2-stage compressor

Freon® system for cooling. Supply and return air grilles are located in the ceiling. Return air ducts (no common plenum) convey return air to the AHUs. Each pod has a thermostat, accessible only to maintenance personnel, with the sensor located in the return air duct. The units are operated in the continuous fan-on mode, as opposed to the automatic mode (in the automatic mode the AHU shuts down when the thermostat is satisfied).

EVALUATION PROCEDURES

The NIOSH evaluation consisted of the following: (1) a review of background information regarding the problems experienced and suspected causes; (2) a review of information regarding design and operation of the school's HVAC system, prior IEQ assessments, and current plans regarding IEQ by the District School Board of Pasco County; (3) an on-site evaluation at the Anclote Elementary School.

During the site visit, NIOSH investigators conducted a visual inspection of the facility to identify potential IEQ issues in the main building. The ventilation systems supplying the main building (AHUs 1-11) and the K-1/K-2 additions were also inspected. The cafeteria HVAC system was not evaluated. Air volumes entering the OA intakes were measured on AHUs 1-11 and serial measurements for temperature, RH, and CO_2 were collected throughout the facility. Pesticide application and janitorial practices were reviewed with the school facilities manager, and management protocols for responding to IEQ issues were assessed. Confidential medical interviews were conducted with 25 school employees to obtain information regarding potentially work-related health concerns.

Environmental

Sampling and analytical methodology used during the survey was as follows:

A. Carbon Dioxide (CO_2)

Instantaneous measurements of CO_2 concentrations were obtained using a Gastech Model RI-411A Portable (direct reading) CO_2 monitor. The principle of detection is non-dispersive infrared absorption. The instrument was zeroed (zero CO_2 gas source) and calibrated prior to use with a known CO_2 source (span gas). The monitor provides CO_2 concentrations in 25 parts per million (ppm) increments with a range of 0 - 4975 ppm. Measurements were obtained at various intervals and locations throughout the building. Outdoor readings were taken to determine baseline CO_2 levels.

B. Temperature and Relative Humidity (RH)

Dry bulb temperature and RH levels throughout the building were determined at various intervals. Outdoor readings were obtained for comparison purposes. Instrumentation consisted of a TSI, Inc. model 8360 VelociCalc® meter with a digital readout. This unit is battery operated and has humidity and temperature sensors on an extendable probe. The temperature range of the meter is 14 to 140°F and the humidity range is 20 - 95%. Temperature and RH, as determined via standard dry bulb, wet bulb, and psychrometric chart correlated well with levels determined via the VelociCalc® meter.

C. Ventilation Monitoring

The TSI, Inc. model 8360 VelociCalc® meter was used to measure air velocity at the outside air intake vent for subsequent determination of outside air volume. This is an electronic meter with a digital readout. Velocity is measured by the cooling effect of air as it passes over a

heated (hot-wire) sensor at the end of the probe. Relative building pressure was determined using an Alnor Jr. Velometer. The outside door was opened about 1 inch and the velometer was placed between the door and the door frame. Needle deflection on the analog meter was used to determine air flow direction, an indicator of relative pressure. The Alnor Jr. Velometer is a mechanical, swinging vane air velocity meter with two range settings (0-200 fpm, 0-800 fpm).

Medical

Confidential medical interviews were conducted with 25 school employees. Most of these were randomly selected from each area of the building. A few who had not been selected but wished to be interviewed were included. Workers were interviewed one at a time in a private conference room. An indoor air quality and work environment symptoms survey was used as a guideline for conducting the medical interviews. Questions involved medical history and current symptoms.

EVALUATION CRITERIA

NIOSH investigators have completed over 1100 investigations of the occupational indoor environment in a wide variety of non-industrial settings. The majority of these investigations have been conducted since 1979.

The symptoms and health complaints reported to NIOSH by building occupants have been diverse and usually not suggestive of any particular medical diagnosis or readily associated with a causative agent. A typical spectrum of symptoms has included headaches, unusual fatigue, varying degrees of itching or burning eyes, irritations of the skin, nasal congestion, dry or irritated throats and other respiratory irritations. Typically, the workplace environment has been implicated because workers report that their symptoms lessen or resolve when they leave the building.

A number of published studies have reported a high prevalence of symptoms among occupants of office buildings.[1-5] Scientists investigating indoor environmental problems believe that there are multiple factors contributing to building-related occupant complaints.[6,7] Among these factors are imprecisely defined characteristics of HVAC systems, cumulative effects of exposure to low concentrations of multiple chemical pollutants, odors, elevated concentrations of particulate matter, microbiological contamination, and physical factors such as thermal comfort, lighting, and noise.[8-13] Indoor environmental pollutants can arise from either outdoor sources or indoor sources.[14]

There are also reports describing results which show that occupant perceptions of the indoor environment are more closely related than any measured indoor contaminant or condition to the occurrence of symptoms.[15-17] Some studies have shown relationships between psychological, social, and organizational factors in the workplace and the occurrence of symptoms and comfort complaints.[17-20]

Less often, an illness may be found to be specifically related to something in the building environment. Some examples of potentially building-related illnesses are allergic rhinitis, allergic asthma, hypersensitivity pneumonitis, Legionnaires' disease, Pontiac fever, carbon monoxide poisoning, and reaction to boiler corrosion inhibitors. The first three conditions can be caused by various microorganisms or other organic material. Legionnaires' disease and Pontiac fever are caused by Legionella bacteria. Sources of carbon monoxide include vehicle exhaust and inadequately ventilated kerosene heaters or other fuel-burning appliances. Exposure to boiler additives can occur if boiler steam is used for humidification or is released

by accident.

Problems NIOSH investigators have found in the non-industrial indoor environment have included poor air quality due to ventilation system deficiencies, overcrowding, volatile organic chemicals from office furnishings, machines, structural components of the building and contents, tobacco smoke, microbiological contamination, and outside air pollutants; comfort problems due to improper temperature and relative humidity conditions, poor lighting, and unacceptable noise levels; adverse ergonomic conditions; and job-related psychosocial stressors. In most cases, however, these problems could not be directly linked to the reported health effects.

Standards specifically for the non-industrial indoor environment do not exist. NIOSH, the Occupational Safety and Health Administration (OSHA) and the American Conference of Governmental Industrial Hygienists (ACGIH) have published regulatory standards or recommended limits for occupational exposures.[21-23] With few exceptions, pollutant concentrations observed in the office work environment fall well below these published occupational standards or recommended exposure limits. The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) has published recommended building ventilation design criteria and thermal comfort guidelines.[24,25] The ACGIH has also developed a manual of guidelines for approaching investigations of building-related complaints that might be caused by airborne living organisms or their effluent.[26]

Measurement of indoor environmental contaminants has rarely proved to be helpful in determining the cause of symptoms and complaints except where there are strong or unusual sources, or a proved relationship between a contaminant and a building-related illness. The usual low-level concentrations of particles and variable mixtures of organic materials found are troublesome to understand. However, measuring ventilation and comfort indicators such as carbon dioxide (CO_2), temperature and relative humidity, is useful in the early stages of an investigation in providing information relative to the proper functioning and control of HVAC systems.

A. Carbon Dioxide (CO_2)

CO_2 is a normal constituent of exhaled breath and, if monitored, can be used as a screening technique to evaluate whether adequate quantities of fresh air are being introduced into an occupied space. The ASHRAE Standard 62-1989, Ventilation for Acceptable Indoor Air Quality, recommends outdoor air supply rates of 20 cubic feet per minute per person (cfm/person) for office spaces and conference rooms, 15 cfm/person for reception areas, and 60 CFM/person for smoking lounges, and provides estimated maximum occupancy figures for each area.[24]

Indoor CO_2 concentrations are normally higher than the generally constant ambient CO_2 concentration (range 300-400 ppm). When indoor CO_2 concentrations exceed 1000 ppm in areas where the only known source is exhaled breath, inadequate ventilation is suspected. Elevated CO_2 concentrations suggest that other indoor contaminants may also be increased.

B. Temperature and Relative Humidity

The perception of comfort is related to one's metabolic heat production, the transfer of heat to the environment, physiological adjustments, and body temperatures. Heat transfer from the body to the environment is influenced by factors such as temperature, humidity, air movement, personal activities, and clothing. ANSI/ASHRAE Standard 55-1981 specifies conditions in which 80% or more of the occupants will find the environment thermally comfortable.[25]

ASHRAE has developed a chart which includes a "comfort zone" considered to be comfortable for the majority of building occupants. This zone lies between 68° and 77° F and 20% to 60% relative humidity. Note, however, that some scientists feel that RH levels below 30% may produce discomfort from dryness.[27] The range is wide because the feeling of comfort is a subjective, individual perception.

C. Bioaerosols

Bioaerosols are airborne particles, that are living or were released from a living organism.[26] Exposure limits have not been established for bioaerosols. However, in some cases, this type of contamination can cause or contribute to adverse health outcomes. These outcomes include allergic rhinitis, asthma, and hypersensitivity pneumonitis (a potentially severe disease), which can be caused by bacteria, fungi, protozoa and other bioaerosols. Microbial organisms will be found throughout the environment (including buildings that are not experiencing indoor air quality problems) and their presence should not be construed as proof of the cause of worker health problems. However, obvious signs of bioaerosol reservoirs, amplifiers and disseminators should be corrected to reduce the potential for these sources to create health problems.

Potential sites of microbial contamination include the building HVAC system (stagnant water in condensate pans, filters that become moist, porous acoustical liner in ducts), and water damaged carpet, ceiling tile and other furnishings. Odor can be another indicator of microbial contamination. If the work area smells moldy, fungi are probably present, and their reservoirs should be identified and removed.[26]

Air sampling is generally considered to be an environmental evaluation method of last resort as their are few criteria available to interpret the data, dose-response relationship information is scant, and the presence of organisms does not prove a causal relationship with complaints.[26] Air sampling may be useful, however, in properly designed studies to compare bioaerosol levels in complaint, non-complaint and outdoor environments, and thereby help determine their relationship to the health effects of interest.

RESULTS AND DISCUSSION

Environmental

HVAC/Facility Inspection

A visual inspection of all thirteen AHUs showed that, in general, all appeared to be in good condition. All filters had been recently changed. Condensate drain pans were free of standing water or evidence of mold, indicating proper drainage. Outside air dampers were open on all systems inspected. A limited inspection of supply duct in selected areas did not show the presence of residue build-up or microbiological growth. Supply ducts are flexible and are not internally insulated. The main supply manifold was inaccessible and therefore not inspected. Building exhaust consists of approximately 20 bathroom ventilators and the cafeteria exhaust. Inspection of these systems showed that roof-top bathroom exhaust fans #8 and #11 were not operational. No sources of contaminants were noted near the OA intake vents. According to school officials, filters (2-inch coarse) are changed on a monthly basis.

The building was under negative pressure with respect to outside. This may be due to the large number of exhaust fans, (bathrooms, cafeteria) as well as insufficient OA provisions. Under these parameters, unconditioned OA will infiltrate into the building through doors and other leakage points. A common design goal is to operate a building under positive pressure to

allow for better control of temperature and humidity, conserve energy, and minimize the introduction of unfiltered air into the building.

A musty/mold-like odor was detected in the South America, Antarctica, and Africa-B Pods. The source of the odor is apparently from the wall-board (referred to as "beaver-board") on the interior side of the outside walls. Visual evidence of mold was observed in several areas. Removal of wall paper in the South America Pod showed considerable mold/water-damaged wall-board. No evidence of mold growth (visual or odor) was detected from an inspection in spot locations above the false ceiling. A comprehensive inspection above the false ceiling was not conducted. Some water-damaged ceiling tile was noted in the music room.

Environmental Monitoring Results

The environmental monitoring results are shown in Table 1. The CO_2 measurements ranged widely, but in most areas exceeded the 1000 ppm guideline. The highest readings, detected in the K-1/K-2 classrooms, were in excess of 3000 ppm. As previously noted, these classrooms have no OA source. Serial measurements obtained at 9:00 AM, 11:00 AM, and 1:45 PM, also showed a general increase in CO_2 levels throughout the day for most areas (this buildup of CO_2 is not an unusual finding in facilities with inadequate OA provisions).

Temperature measurements indicated levels to be within acceptable ranges. There were, however, fluctuations of up to four degrees F° throughout the day in some areas. The differences in temperature between pods are primarily due to occupant preference.

Relative humidity levels exceeded 60% in most areas. In some areas, RH levels in the afternoon dropped to the upper 50% range. The highest level found was 69%, detected in the kindergarten classroom at 9:00 AM. A contributing factor to these high RH levels, in addition to insufficient dehumidification capacity, may be the infiltration of unconditioned outside air through leakage points.

OA quantities were determined at each AHU and are shown in the following table. These figures are "point-in-time" measurements and may vary depending on system operation. Also, these measurements represent only the volume of OA delivered to the AHUs, and not the volume delivered to specific locations within the areas served. At least six velocity measurements were obtained at the face of each OA intake louvre. These measurements were used to calculate an average flow rate in cubic feet per minute (cfm) for each AHU. Because each OA intake was equipped with a square-punch grille, an area correction factor of 0.88 was used to adjust the final result.[28]

AHU#	Area Served	# Occupants[1]	OA Rate (CFM)	CFM OA/P
1	Europe Pod	127	898	7
2	South America Pod	117	840	7.2
3	Antarctica Pod	104	849	8.2
4	Music/Art/Phys. Ed.	77[2]	377	5
5[3]	Africa B Pod	107	748	7
6[3]	Africa A Pod	107	238	2.2
7[3]	North America Pod	110	1047	9.5
8	Kindergarten	49	660	13.5
9/10	Cafeteria	Variable	1540	NA

12/13	K1/K2	46	0	0
11	Office/Administ.	15	54	57

1. Number of occupants is approximate
2. Number of occupants varies throughout the day
3. These units also serve the media center (variable occupancy)

CFM OA/p = Cubic-feet per minute of outside air per person

A total OA rate of 8051 cfm was calculated. With 859 building occupants, this equates to approximately 9.4 cfm OA/p. However, there is considerable variability in outside air rates between the areas served. With the exception of the administration office, all areas were receiving less than the ASHRAE recommended 15 cfm OA/p. These results correspond with the CO_2 monitoring results, which also suggest insufficient OA is being provided to the building.

Janitorial/Pesticide/Management Protocols

No unusual janitorial practices that would contribute to IEQ problems were identified. Routine janitorial activities include floor mopping and buffing (2-3 times per week) and daily cleaning of bathrooms with an ordinary commercial disinfectant. Floor stripping and sealing is only conducted during the summer, and carpet shampooing consists of spot cleaning on an as-needed basis. Prior to May, 1992, building pesticide application consisted of a monthly (Saturday) fogging with ULD BP-100®, a pyrethrin/piperonyl-butoxide based insecticide intended for indoor use. Currently, the Pasco County School District contracts with a licensed pesticide applicator who treats the building monthly. Fogging is only used on a limited basis and is restricted to the kitchen area. Crevice treatment is the primary means of application. According to school officials, HVAC system filters are sprayed with a disinfecting deodorant (Klenz®, Momar Inc.) upon installation. This disinfectant is primarily intended for bacterial and odor control via spot or space application. The product has a solvent-carrier (65% ethanol/methanol) and an active ingredient (0.2% o-phenyl phenol) which has no long-lasting residual disinfectant capability.

A proactive system to prevent IEQ issues from occurring has not been implemented at the school. Activities that may impact IEQ (e.g., painting) are allowed to proceed without consideration of their impact on building occupants. These activities are coordinated through the Pasco County School's Maintenance and Engineering group, and may not involve Anclote School officials. During the NIOSH site visit, a project to replace the roof to resolve leakage and drainage problems was reviewed. The roofing tasks involved the use of heated tar/asphalt, which can generate considerable emissions. Activities that entailed these contaminant-generating processes were occurring during school-occupied hours, with no provisions in place to control or prevent infiltration of contaminants into the building. Odors from these activities were noted inside the building.

At the local level, there is a work-order system employees can use to request improvements. A review of work-orders submitted since 1991 showed that four requests had been filed to remove or repair mold/water damaged ceiling tile or walls.

Medical

Initial health concerns centered around the presence of mold on the walls and dirt visible on the vents throughout the building. The interviews revealed that many of the teachers found the building to be too cold, some attributing this to too much air movement. Others found the

building to be too hot with too little air movement. Some complained of excessive humidity; few thought the building was too dry. Many of the teachers complained of unpleasant odors, particularly from the "roofing tar" and the "glue on the pipes". The most common symptom reported was stuffy or runny nose, or sinus congestion; this affected 18 people. Other common complaints included headache; dry, itching, or irritated eyes; tired or strained eyes; and dry throat. Less common complaints included sneezing, coughing, and sore throat. The symptoms were noted by workers throughout the building.

CONCLUSIONS

Health concerns and complaints about the working environment have been reported by some employees of the Anclote Elementary School. School employees associate the primary health concerns with the presence of mold in the building. Evidence of mold (visible and odor) was detected in various areas in the school. Until recently, attempts to resolve the mold problems (replace damaged tile, cover walls with wallpaper) did not address the underlying causes - excessive moisture from a chronic leaking roof and high humidity levels. The presence of the water/mold damaged wall board and ceiling tile is the single most obvious potential source of microbiological contaminants.

The measured ventilation parameters show that, although rates vary, insufficient outside air is provided to occupied spaces. There is currently no outside air being provided to classrooms K-1 and K-2. Additionally, humidity levels were consistently higher than recommended levels. Although the original design of the HVAC system may have met the Florida Mechanical Code 6A-2 in some areas, there is consensus among ventilation and IEQ experts that this criterion (5 cfm OA/p) is no longer acceptable.[24,27] Temperature swings of up to 4°F were also noted in some areas. Excessive variations in temperature may cause more discomfort than maintenance of higher or lower temperatures with less variation.[29] Comfort is a necessity for efficient teaching, and odors or other IEQ problems may interfere with learning.[29] The temperature swings may be due, in part, to the HVAC system cycling program. It is possible that this practice of cycling the HVAC system heightened the awareness of environmental shortcomings among employees already uncomfortable in their work environment. The negative pressure of the building, allowing unconditioned outside air to flow into the school, may also be a contributing factor.

No chemical explanations for the reported symptoms were identified during this survey. This is typical of most non-industrial IEQ investigations. Janitorial and pesticide practices were consistent with those found in many facilities and did not suggest any inappropriate chemical use.

An IEQ management plan has not been implemented. There is no system to ensure IEQ-impacting activities are reviewed and properly addressed and that IEQ problems are resolved in a timely fashion. This was evidenced by the contaminant-generating roofing activities taking place during school hours without controls to prevent infiltration of emissions (this appears to be a county-wide issue, and not specific to the Anclote Elementary School).

The results of the medical interviews suggested no evidence of an infectious etiology for the symptoms reported. There was little to suggest work-related asthma. The constellation of symptoms was consistent with that found in other IEQ investigations.

RECOMMENDATIONS

1. Upgrade the ventilation systems to ensure that sufficient conditioned OA is provided to building occupants. Use the ASHRAE 1989-62 criteria (15 cfm OA/p) as the design goal.

Add-on classrooms K-1 and K-2 should be the top priority for modifications or upgrades. A qualified mechanical engineering firm or original HVAC system designers should be consulted. Ensure that sufficient dehumidification capacity is provided. The upgrades should ensure that the building is operated under positive pressure to improve zonal control and decrease temperature fluctuations. Conduct a complete test and balance of the HVAC system after modifications to ensure that the system operates as intended and that design goals are met.

2. Conduct a comprehensive inspection of building wallboard, ceiling tile, and remaining carpet to identify water-damaged or mold-contaminated material. The inspection will require the removal of some wallpaper and carpeting. All water/mold damaged material should be removed. Attempts to clean or decontaminate mold-contaminated porous material are generally unsuccessful.

3. Implement an IEQ Management Plan for the Anclote Elementary School. An IEQ manager or administrator with clearly defined responsibilities, authority, and resources should be selected. This individual should have a good understanding of the building's structure and function, and should be able to effectively communicate with occupants. The elements of a good plan include the following:

   -- Proper operation and maintenance of HVAC equipment.

   -- Overseeing the activities of occupants and contractors that affect IEQ (e.g., housekeeping, pest control, maintenance, food preparation).

   -- Maintaining and ensuring effective and timely communication with occupants regarding IEQ.

   -- Educating building occupants and contractors about their responsibilities in relation to IEQ.

   -- Pro-active identification and management of projects that may affect IEQ (e.g., redecoration, renovation, relocation of personnel, etc.).

   The NIOSH/EPA building air quality guidance manual should be consulted for details on developing and implementing IEQ management plans.[27]

4. Implement a less stringent cycle time for the HVAC system (e.g., start the systems earlier) to decrease fluctuations in temperature and to improve humidity control.

5. Eliminate the use of the deodorant/disinfectant filter spray. Filter spraying is not an intended use for this product.

6. Educate employees regarding the proper function and limitations of the HVAC system. Inform occupants how to obtain resolution for their concerns regarding IEQ and the actions Anclote Elementary and Pasco County District School Board are taking to address IEQ.

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For the purpose of informing affected employees, copies of this report shall be posted by the

employer in a prominent place accessible to the employees for a period of 30 calendar days.

Table 1
Temperature, Relative Humidity (RH) and Carbon Dioxide (CO_2) Monitoring
Anclote Elementary School: New Port Richey, FL
HETA 92-347: November 12, 1992

Location	CO_2 (ppm)			RH %			Temperature		
	9:00	11:00	1:45	9:00	11:00	1:45	9:00	11:00	1:45
Outside	400	400	400	65	60	60	76.5	81.0	82.9
T. Lounge	600	600	925	66	61	52	74.2	73.8	70.2
Cafeteria	450	500	825	63	62	56	72.4	72.5	69.6
Office	725	800	1025	65	63	58	73.4	72.1	70.5
Europe 1	450	1300	1300	63	63	59	69.5	69.2	69.7
Europe 2	450	1325	1300	62	61	57	69.1	69.1	68.8
S. America 1	450	1300	1300	63	62	59	69.5	69.2	69.7
S. America 2	550	1275	1275	63	63	61	71.2	70.1	71.4
Media Cent.	550	1125	1075	64	64	59	71.8	71.2	72.0
Antarctica 1	600	1275	825[1]	66	62	60	73.0	70.5	70.9
Antarctica 2	625	1200	950	68	61	60	73.7	69.9	71.5
Art Room	500	1125	1125	64	61	59	70.7	69.3	70.5
Music Room	450	1650	1175	65	64	61	71.3	72.2	71.5
Africa B-1	650	1325	1275	66	63	59	71.0	71.9	70.7
Africa B-2	675	1325	1300	65	63	58	70.7	71.9	69.6
Africa A-1	775	1225	1600	64	63	57	69.9	71.1	68.5
Africa A-2	750	1275	1550	64	63	57	69.5	70.2	67.7
N. America 1	1050	1475	1550	66	64	58	72.0	71.3	69.1
N. America 2	1000	1475	1600	67	64	59	73.6	71.7	69.6

Kindergarten	825	1025	1300	69	63	60	73.4	72.8	73.4
K-1	1075	3000	3325	64	60	56	73.6	72.3	73.8
K-2	1075	3000	3275	66	58	58	73.4	72.8	73.4

1. no children present

ppm = parts of gas or vapor per million parts air