in-situ moisture detection because it can be used to rapidly scan a surface to determine if moisture is present and detect a moisture problem in the formative stages, before it becomes serious.

This investigation involved a newly-constructed health care facility. It was prompted by owner concerns of potential areas of moisture intrusion through the envelope and resultant microbial colonization in the interstitial wall space. Infrared thermography was used to identify areas of probable moisture anomalies in the building envelope (walls and roof). Thermal images were made using a FLIR ThermaCAM® E series camera. Based on the qualitative interpretation of the thermal scans, wall areas were selected for invasive examination. At each location the brick veneer was removed to expose the method of brick installation and the composition of the envelope. Exterior sheathing was removed to expose the framework, batt insulation, vapor barrier, and backside of the gypsum wallboard for visual examination. Observations were photographed and the free water content of building components was measured. Microbial colonization was observed and in some cases with deteriorating building components. Air sampling for culturable fungi was conducted throughout the building to determine if the mold present in "visually inaccessible spaces" migrated into the tenant space.

This investigation demonstrates that qualitative thermography coupled with quantitative substantiation is the most powerful method of moisture analysis in building envelopes.

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INFRARED IMAGING IN RAPID RESPONSE EVALUATIONS: AKA FOUR HURRICANES IN SIX WEEKS, AN ASSESSMENT RETROSPECTIVE.
L. Rogers, M. Hodgson, S. Donham, Clayton Group Services, Tampa, FL.

When faced with excessive water intrusion in large facilities, time is of the essence to identify water impacted materials before they become fungally impacted materials. Rapid identification of wet materials can also accelerate the effective drying process of the building and ultimately can help contain insurance claim costs. Moisture meters have been the benchmark tool for moisture evaluations. However, the meters are limited since they only provide location specific data, may be confounded by finish material treatments, and are influenced by environmental conditions. The use of infrared imaging can provide a big picture image of a space that can be calibrated to the conditions in the space for a rapid identification of suspect wet materials. This technique, combined with moisture meter confirmation can provide qualitative and quantifiable information about the extent of damage. This presentation will discuss the advantages and disadvantages of each method and present a case study of the implementation in response to the 2004 hurricane season in Florida.

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METHODS FOR ASSESSING MOISTURE AND REMEDIATING MOLD CONTAMINATION IN HVAC SYSTEMS. P. Haas, D. Zehnter, A. Grdina, M. Snyder, Morse Zehnter Associates, West Palm Beach, FL; R. Morse, AIA, Morse Zehnter Associates, Poestenkill, NY.

Mold does not ordinarily grow on surfaces inside HVAC units and ductwork despite the fact that the air inside these units is at essentially 100% relative humidity. This is because the wall of the unit is warmer than the airstream and above the dew point of the air in the airstream. This session will present measurements and observations taken in operating air-conditioning equipment that demonstrate these conditions. Water can be stripped off of coils by a rapidly moving airstream. Measurement methods to determine if this is happening will be described. Data will also be presented on conditions that cause mold growth in ductwork. The causes of these conditions will be described. Methods of measuring environmental conditions (temperature, relative humidity, dew point, equilibrium relative humidity, aerosolized water) inside ductwork using simple hand-held devices will be described. This paper also reports on testing to determine feasibility of the treatment of mold contaminated fibrous glass lined ductwork, the remediation methods used, clearance testing methods, and long-term success of the project.

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A COMPARISON OF HVAC AGE AND CONDITION WITH IEQ COMPLAINTS. P. Haas, D. Zehnter, Morse Zehnter Associates, West Palm Beach, FL; R. Morse, AIA, Morse Zehnter Associates, Poestenkill, NY.

This paper summarizes occupant complaints of humidity, temperature, moisture intrusion, and mold compared to HVAC equipment age and condition in approximately 500 buildings. The study parameters included datalogging of complaint areas followed by maintenance and mechanical assessments. An engineering evaluation from as-built conditions, mechanical take-off information, supply configuration, and dehumidification enhancement was compared to complaints. In each case the causes of the complaints were validated using the datalogging information, maintenance assessments, and the engineering evaluation. Corrective action was described by a condition assessment of the functional components of the equipment, redesign considerations, or equipment replacement in accordance with ASHRAE guidelines.

The assessments will be described by categorizing the complaints and equipment as multivariable and weighting them in a linear model. A comparison of the age and actual mechanical conditions to the sets of weighted complaint values will be made. Correlation using the data set of complaints with the marginal condition found in some of the HVAC equipment inspected will illustrate a number of valuable lessons. Occupant values of comfort using temperature and relative humidity as the primary source of negative complaints will be compared to the actual capability of the HVAC to adequately dehumidify occupied spaces. Complaints made about temperature fluctuations and humidity was often correlated negatively with datalogging values. Occupants were generally less capable of describing a higher temperature and lower relative humidity as more comfortable than lower temperatures coupled with excess relative humidity during occupied hours, even when datalogging values showed this condition. Moisture intrusion and mold infestation complaints were often linked to building envelope conditions and less likely correlated to HVAC equipment ability to treat high humidity. Complaints made of musty odors or visible mold in the absence of building envelope problems existed were often the only way occupants noted high humidity caused by HVAC equipment.

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POST REMEDIATION AIRBORNE MOULD CONCENTRATIONS IN BUILDINGS FORMERLY USED AS MARIJUANA GROW OPERATIONS. J. Rygnestad, Levelton Consultants Ltd., Nanaimo, BC, Canada; G. Krstic, Hemerra Envirochem Inc., Vancouver, BC, Canada.

The effectiveness of correct remedial methods in reducing the level of airborne mould spores in buildings formerly used as marijuana grow operations was explored in this analysis of 126 indoor and 66 outdoor air samples collected at 27 different sites. The data collected was statistically analyzed to determine the probable form of the relationship between indoor and outdoor airborne mould spore concentrations. Post remediation air samples collected from indoor and outdoor environments were similar in both composition and relative frequency. The lack of statistically significant differences in composition or relative frequency between indoor and outdoor samples indicates that correct remedial methods are effective in reducing the level of airborne mould spores in buildings formerly used as marijuana grow operations.

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FIRST RESPONDERS' PROTECTION DURING RESPONSE TO A TALL BUILDING COLLAPSE. N. El-Ayouby, NIOSH, Pittsburgh, PA.

Following the tragic event of the World Trade Center (WTC) of 9/11, the National Institute for Occupational Safety and Health (NIOSH) contracted with the Rand Science and Technology Policy Institute (STI) to determine the problems faced by the first responders (fire-

fighters, law enforcement, emergency medical services, and trade services) during this event. Several problems were identified that hindered the performance of the search and rescue operations. Among the identified problems were the deficiencies in personal protective equipment (PPE) needed, identification of hazards the first responders faced, information on the short- and long-term effects of exposure, the geographic location of the tasks performed by various responders, and the logistic problems associated with supplying during extended efforts.

The NIOSH and Rand STI efforts resulted in an extensive report based on workshops conducted with emergency responders. This report was used to create guidelines and fact sheets tailored to each group of emergency responders' operational tasks. The objective of the guidelines and fact sheets is to have information useable by incident commanders and documents that are easily carried on site providing information addressing anticipated hazards. These documents address chemical, physical, and biological hazards. The hazards were identified based on the finding in the Rand STI report, existing NIOSH policy, and on the monitoring results that were performed by local, state, and government organizations during the WTC event. Each guideline and fact sheet uses an integrated approach to a different environment (zone) on the collapse site and addresses the types of hazards and their concentration in the different zones, the length of acceptable exposures, the selection PPE under unknown as well as known exposures, and the level of protection required for each zone in the presence or absence of monitoring. The fact sheets and guidelines emphasize training, cautions, limitations, and restrictions of PPE use.

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ACRYLONITRILE CONTENT AS A PREDICTOR OF CAPTAN PERMEATION RESISTANCE FOR DISPOSABLE NITRILE GLOVES. R. Phalen, S. Que Hee, UCLA, Los Angeles, CA.

The aim of this study was to determine if acrylonitrile content was related to permeation resistance of nitrile gloves to the pesticide captan. Powder-free, disposable nitrile glove samples of similar thickness and standard reference materials were conditioned overnight at 55 ± 1% relative humidity. Attenuated total reflectance-Fourier transform infrared (ATR-FTIR) spectrometry measured the acrylonitrile content on the inner surfaces of six different brands. ATR-FTIR analysis focused on 2236 ± 5 cm^{-1}, the characteristic nitrile minimum, using 32 scans, resolution 4 cm^{-1}, and a uniform pressure of 24 lb/ft^2. Permeation of an aqueous emulsion (217 mg/mL) of captan, as a wettable powder (48.9% captan), was conducted using the American Society for Testing and Materials (ASTM)-type I-PTC-600 permeation cell, according to the ASTM F739 closed-loop method. Analysis of the hexane collection solvent was by gas chromatography-mass spectrometry. One glove brand was excluded on the basis of variable acrylonitrile content indicating poor manufacturer or lot quality (24% coefficient of variation (CV) versus less than 5% CV for other brands). The steady-state permeation rate (SSPR) was also highest for this excluded brand. Glove acrylonitrile content (12.7 to 29.9%) was significantly correlated ($p \leq 0.05$) with the ASTM normalized breakthrough time (BT) at 0.25 $\mu g/cm^2$ ($r = 0.9905$) and the logarithm of the SSPR ($r = 0.9730$). On average, BT increased 90 min for every 5% increase in acrylonitrile content. The average SSPR ranged from 0.002 to 0.310 $\mu g/cm^2/min$, a 150-fold difference. The logarithm of the SSPR was also significantly correlated ($p \leq 0.05$) with the BT ($r = 0.9747$). Increasing acrylonitrile content results in longer BT protection and decreased SSPR. ATR-FTIR is useful to determine nitrile polymer uniformity and potential glove chemical resistance.

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MANAGING PPE SUPPLY-CHAIN INTERRUPTIONS WITHOUT COMPROMISING SAFETY OR IMPACTING OPERATIONS. C. Torres, Intel Corporation, Colorado Springs, CO; C. Albaugh, Intel Corporation, Chandler, AZ.

This presentation will outline the approaches taken to manage supply-chain interruptions of critical PPE (chemical resistant gloves) without compromising safety or impacting on-going operations. Due to manufacturing changes made by the PPE manufacturer, chemical resistant gloves used in our fabrication facilities were materially different than previous versions of the same glove. The gloves began to react differently to typical uses in our operations due to the manufacturing changes that were made and not previously communicated. As a result the gloves were no longer approved for use in any of our facilities until changes in the manufacturing process could be made and a new product was fully tested and certified. In the course of the presentation the following topics will be addressed. The situation: the means of discovery, initial responses to EHS and operational concerns, interim solutions to provide acceptable PPE to protect workers and allow on-going operations, and long-term plans to identify and implement a new chemical resistant glove from a previous or new glove manufacturer. The problems: how to bridge the PPE gap during a supply-chain interruption while upholding safety and operations, how to communicate interim and long-term PPE changes to users and management, how to leverage vendor relationships and contractual agreements to fulfill needs in a timely fashion, and how to accomplish all of the above while achieving cost-control goals of the organization. The resolutions: explanation of our interim solution to use a previously approved chemical resistant glove to bridge the supply gap, a review of overall communications strategies employed, presentation of how vendors were leveraged to implement interim and long-term solutions, and a look at cost considerations throughout the process. Finally, the presentation will address benefits to others such as forming a strategy to anticipate and handle potential supply-chain interruptions and effectively responding to multisite situations requiring cross-site coordination.

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APPLICATION OF PHOTOCHROMIC DYES IN AUTOMATIC WELDING FILTERS. A. Poscik, Central Institut for Labour Protection–National Research Institute, Warszawa, Poland.

An intensive emission of UV, visible, and infrared radiation during welding and the needs of good visibility of a welding object causes use of active optical filters.

These active welding filters should change transmittance in 0,1 ms, after the lighting of the welding arch. Presently, used automatic welding filters are furnished with liquid crystals screens and electronic modules. Most of these filters are very expensive. In this case, the possibility to create a new contruction of active welding filters with photochromic dyes was analyzed.

Photochromnic organic dyes are characterized by a very fast intermolecular reaction of ring opening, caused by UV radiation. This reaction of ring opening is accompanied by a change absorption of dyes. Maximum absorption shifts from UV to visible region. This phenomenon takes advantage to create active welding filters.

Because of the neccessity of modification of optical properties of active filters, the interference thin layers filters were used. These filters are responsible for absorption of visible radiation which is not absorbed by photochromic dyes. Additionally, the passive filter was used to absorb infrared radiation. As a result, the fast welding filters were obtained, changing luminous transmittance in time below 0,1 ms. High efficiency of received filters and the low price in comparison with presently used automatic welding filters with liquid crystals and electronics modules present advantages of presented photochromic welding filters.

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IMPROVEMENT OF ADSORPTION APPLICATIONS USING HIGH CONTACTING EFFICIENCY MICROFIBROUS ENTRAPPED MATERIALS. E. Luna, R. Kalluri, D. Cahela, B. Tatarchuk, Center for Microfibrous Materials Manufacturing, Auburn, AL.

Personal protective equipment (PPE) and collective protection equipment (CPE) currently rely on packed bed heterogeneous contacting. Although well developed and largely understood, packed bed performance is limited by the physical relationships between pressure drop, particle size, and, e.g., intraparticle transport.

In this work new materials have been specifically created to improve CPE and PPE applications and to overcome the above noted contacting efficiency relationships. These materials

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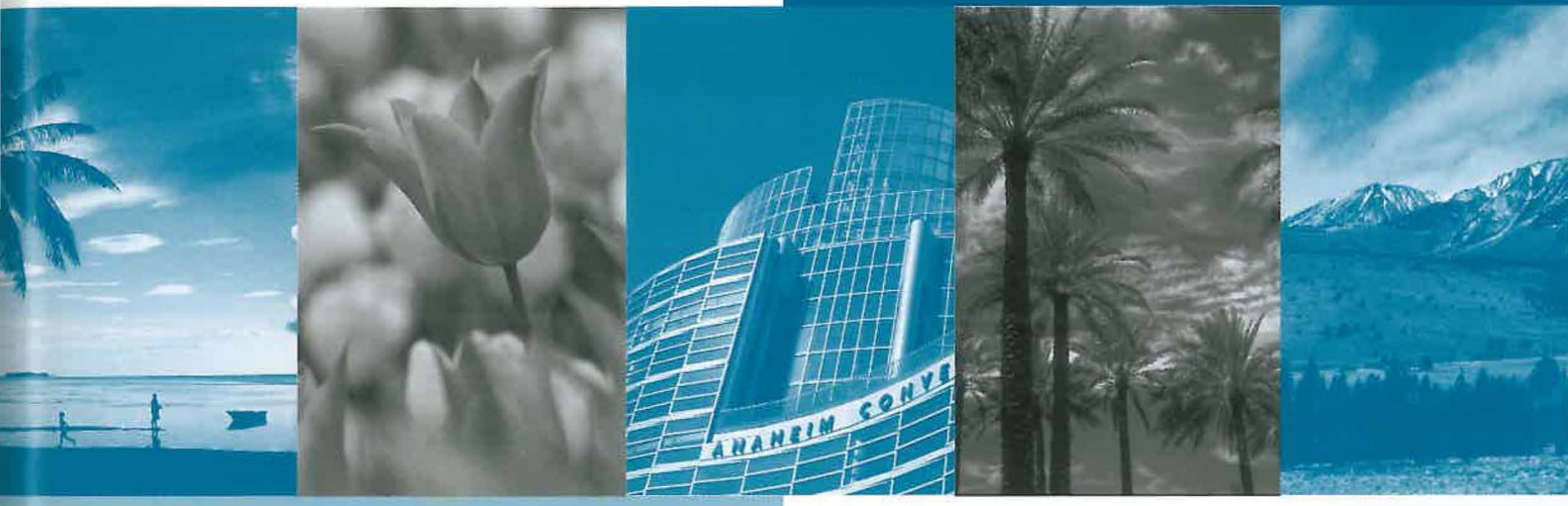

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