

4.8-10 HVAC inspection and maintenance, an important industry standard

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For many years, the aftermarket maintenance of HVAC systems has been a much-discussed subject. Many investigations of IAQ problems suggest that dirty or improperly operating HVAC systems are a contributing cause. Numerous articles and speeches cite deferred or neglected maintenance as leading to premature system failure and inefficient operation. Many over the years have suggested that ASHRAE should develop a standard practice to address proper maintenance. Some ASHRAE members have resisted, noting that as a design oriented society, operations and maintenance falls outside of ASHRAE scope. At the winter ASHRAE meeting in Anaheim, California, the Board of Directors of the society approved the establishment of a project committee to develop such a standard. Since this will be an ANSI Standard, rigorous and well-defined procedures will govern the conduct of the committee and the entire developmental process. Twenty eight committee members have been approved, a formal work plan has been approved by the ASHRAE Technical Council, five meetings have been held and a public review draft will have been released by the time of the conference. This presentation will explain the work plan which includes the title, purpose and scope of the proposed Standard. In addition, it will provide an overview of the latest version of the draft Standard document.

4.8-11 Education programme related to healthy buildings

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A multi-scientific adult education programme (30 credit units) was planned in 1996 for the persons who inspect or design buildings either for the reason that buildings are suspected to be damaged and need to be repaired or for the building trade. Common people, authorities and insurance companies considered that consultants or various authorities performing the building inspections needed more thorough knowledge. Expert inspection was believed to save costs and to increase credibility. In addition, legislation concerning building inspections should be developed. Thus, the fifth programme was launched in August 2004. The students of the latest programme are from various educational backgrounds: construction or air conditioning engineering, microbiology or environmental hygiene. In addition to the whole programme 'Expert of Healthy Buildings' (30 credit units), the students can also accomplish minor grades such as Indoor Air Surveyor (16 credit units) or Moisture and Mould Damage Investigator (20 credit units). Experts of Healthy Buildings can apply for personnel certification from VTT in Finland. The board of the certification includes members representing authorities, municipalities, educational and research institutes, societies, companies and VTT.

4.8-12 Modeling the IAQ impact of HHI interventions in inner-city housing

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The U.S. Department of Housing and Urban Development's Healthy Homes Initiative is addressing a wide range of indoor air quality (IAQ) concerns to improve urban housing conditions and protect the health of children. To evaluate the impact of potential interventions on indoor contaminant concentrations and occupant exposures, a simulation study was conducted using the multi-zone IAQ model CONTAM. The model was used to predict ventilation rates, contaminant concentrations of carbon dioxide, carbon monoxide, nitrogen dioxide, water vapor, particles, radon, and volatile organic compounds and occupant exposures for a baseline case and for eight different interventions, which included source control, filtration, local exhaust ventilation and dilution ventilation. While source control interventions were always the most effective on an individual contaminant basis, not all sources of indoor contaminants can be removed. On the other hand, interventions impacting air change rates, such as ventilation and envelope tightening, can either increase or decrease contaminant concentrations depending on the origin of the contaminants.

4.8-13 Causes and prevention of symptom complaints in office buildings: distilling the experience of indoor environmental quality investigators

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The goal of this project was to recommend empirically based strategies to prevent building-related symptoms in office buildings, for owners and managers. Ideas from six experienced building investigators were gathered and prioritized in a multi-day workshop. The top ranked problems identified were, in priority order: excessive building moisture, inadequate outdoor air, excessive dust, pollutant gases and odors, inadequate thermal control, and inadequate attention by management to indoor environments. Available findings in the scientific literature were generally consistent with these recommendations. The highest priority strategies recommended for preventing building-related symptoms were: managing water at building exteriors, operating ventilation systems per design intent, providing at least minimum ventilation rates, and maintaining indoor temperatures at 22°C ± 1° (72°F ± 2°). Despite the range of climates in which they worked, IEQ investigators showed considerable agreement, including top-ranking managing of water at building exteriors as a prevention strategy. Efficacy of these empirically based strategies generally has not been confirmed.

4 Contaminant Control

4.1 Air cleaners

4.1-1 Photocatalytic oxidation for aircraft cabin and indoor pollutant control

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Few acceptable methods exist for the removal of low concentration VOC pollutants in aircraft cabin and indoor environments. Photocatalytic oxidation (PCO) is a novel approach which chemically destroys pollutants rather than adsorbing them into a matrix. The PCO approach is light weight, maintenance-free, and avoids issues related to desorption of contaminants from saturated media. Experimental studies have shown that high conversion of organic pollutants can be obtained in a 0.1 m³ PCO unit and an air flow of 236 L/s. Conversion is not accompanied by production of ozone; the air cleaner removes background ozone effectively. Lab scale studies show that a broad range of pollutants can be removed, and that the major oxidation product is carbon dioxide. Low concentrations of aldehydes can be generated if high concentrations of specific pollutants are present. The PCO unit also effectively disinfects the air. Experimental studies with *Serratia marcescens*, *Bacillus globigii*, and *Micrococcus roseus* indicate that a range of bacteria can be eliminated. The implications for improvement of comfort in indoor environments will be discussed.

4.1-2 The study in the indoor air purification of a new type of lamp-house of photo-catalyse

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It has been found in this paper, by experiment, that blue rays along the surface of the cold plasma reacting piece contains the ultraviolet rays wave band that Titanium dioxide rays catalyzing needs, the regular relation and conclusion of the capacity of the cold plasma reacting, the wavelength of ultraviolet rays and relative light intensity. Then this paper analyzes the application of UV/O₃/TiO₂ synergize in indoor air purification.

4.1-3 Sorptive effects of volatile organic compounds (VOCs) on activated carbon fibers (ACF) and indoor sink materials – a test chamber study

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Detailed studies on sorption properties of VOCs on ACF evaluated the effectiveness of ACF for removal of indoor VOCs in the passive mode. Sorptive properties of selected indoor sink materials were also investigated. Three VOCs: toluene, acetone and limonene were examined in this study, and four indoor sorptive materials: carpet, cotton, polyester and gypsum board were tested. The experimental data for indoor materials and empty test chamber surfaces was found to be in good agreement in fitting the linear sink model based on the Langmuir adsorption process, while the experimental data for ACF was found to be accept-

able in fitting the non-linear sink model based on the Freundlich adsorption process. These experimental results on sorption kinetics of ACF in the passive mode appear to be promising for control of indoor VOCs, even considering the potential competition from indoor sorptive materials.

4.1-4 Function research of plasma air cleaner

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To research the function of plasma air cleaner the paper combined with the finished product test which was entrusted by some business enterprises, completely discussed and analyzed indoor air cleaner in all sides. In addition the application of electronic filter in split-floor type air-conditioner's indoor unit was stated in detail, its cleaning principle consists of utilizing static electricity function to gather dust, uniting low temperature plasma with titanium dioxide photocatalytic technique to remove dust, germ and other pollutant in indoor air. With these standards, the type of air cleaner was tested to evaluate the performance of removing dust and germ, function parameters were analyzed and calculation model was verified. Through these tests, the conclusion is drawn that uniting low temperature plasma with titanium dioxide photocatalytic technique can availablely remove dust and germ in indoor air, so the popularization and application of this theory progressively promote air cleaning technique development.

4.1-5 Some innovative considerations in modelling indoor formaldehyde concentration

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Indoor concentrations of air pollutants are higher than outdoors and therefore people nowadays spending the largest part of their time indoors is exposed to high risk of indoor air pollution. The concentration of the indoor air pollutants as formaldehyde, ammonia, benzene, NO_x and other Volatile organic compounds are usually not acceptable with respect to human health aspects. In present work, some innovative considerations in modeling formaldehyde concentration are considered. The result indicates as to the circumstances mentioned below, i.e., air leakage, nature ventilation, plants, plants combined with air ventilation, about 20 hours later, the formaldehyde concentrations are 208, 5, 178 and 5 µg/m³, respectively. Nature Ventilation has the excellent effect in eliminating formaldehyde. Plant also has an effect on the purification, but its effect is not as good as nature ventilation.