Environmental Health Committee (EHC) Emerging Issue Report:

Ozone and Indoor Chemistry

What is the issue?

Recent research has found that outdoor ozone levels far lower than the current outdoor standard of 75 ppb (EPA, 2008) contribute to increased mortality as well as an increase in Building Related Illness (Bell et.al. 2006, Levy 2007, Apte et.al. 2007/2008). Levels as low as 20 ppb have been shown to increase mortality and statistical approaches suggest that "safe O_3 levels would be lower than 10 ppb" (Bell et.al. 2006). Both ozone and ozone reaction products have been implicated in adverse health impacts from exposure indoors (Weschler 2006, Wisthaler & Weschler 2007). Indoor ozone levels are typically 0.2-0.7 times outdoor levels (Weschler 2000) and vary roughly proportionally to air change rates from 0.5 to 10 per hour respectively and are even higher at high air change rates not uncommon in naturally ventilated residences and other buildings where indoor O_3 levels approach outdoor levels. People spend more than 90% of their time indoors where more than 50% of their exposure to ozone occurs, but the exposure to reaction products indoors may be an even more important health concern (Weschler, 2006). This research suggests that the introduction of ozone to indoor spaces should be reduced to ALARA (as low as reasonably achievable) levels.

Methods to decrease the concentration of ozone and its indoor by-products involve steps to limit the introduction of ozone into an occupied space, whether by internal emission, or entry from outdoors, as well as steps to reduce ozone reactants (such as terpenes) and by-products of ozone indoor chemistry, such as carbonyls, secondary organic aerosols (SOA), and ultrafine particles (UFP) (Singer et al, 2006; Morrison, 2008). The selection of surface materials for air-handling equipment, ductwork and interior surfaces can significantly influence ozone and ozone reaction product concentrations (Morrison et al, 1998; Kunkel 2010; Wang and Morrison, 2006).

What action should be considered?

To minimize health impacts of ozone and associated by-products, the following actions should be considered (particularly for individuals and populations at high-risk for adverse consequences, such as infants, the elderly and those with chronic respiratory illnesses):

1. Remove ozone from outdoor air at the outdoor air intake, or as early in introduction to the occupied space as possible, using ozone removal technologies that do not result in by-product formation.
2. Minimize indoor ozone emissions by reducing the use of equipment that produces ozone (e.g. laser-based printers, and photocopiers, and some air cleaning technologies).
3. Minimize indoor ozone by filtering or exhausting the ozone produced by pertinent equipment.
4. Reduce concentrations of terpenes and other reactive organic compounds as well as carbonyls and other products of indoor ozone chemistry in indoor spaces through source reduction and gas phase removal equipment.
5. Use high efficiency particulate filters (*e.g.* MERV 13 or greater) to remove ozone reaction products in the form of SOA and UFP from outdoor and recirculated air (Fadeyi 2009)

Note: Emerging Issue Reports are developed and approved by the ASHRAE Environmental Health Committee (EHC). The Ozone and Indoor Chemistry Emerging Issue Report was approved by EHC in January 2011.

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