**Summary**

**Issue:**
Volatile organic compounds (VOCs) are emitted from building materials, glues, adhesives, paints and lacquers. These compounds are respiratory irritants that adversely affect the health of workers and occupants.

**Recommendation:**
Reduce indoor air contaminants by limiting VOCs in adhesives, sealants, paints and coatings.

**Proposed Legislation, Rule or Study**

**Amendments to the New York City Building Code:**

1. Add a new section 801.1.3 as follows:
   
   **801.1.3 Volatile organic compounds.** These provisions shall limit the volatile organic compounds of interior finishes, adhesives and sealants.

2. Add a new section 803.10 as follows:
   
   **803.10 Volatile organic compounds.** No interior wall or ceiling finish shall contain any volatile organic compound in any concentration exceeding that permitted under Rule 1113 of the South Coast Air Quality Management District.

3. Add a new section 804.6 as follows:
   
   **804.6 Volatile organic compounds.** No interior floor finish shall contain any volatile organic compound in any concentration exceeding that permitted under Rule 1113 of the South Coast Air Quality Management District.

4. Add a new section BC 806 as follows:
   
   **SECTION BC 806 - ADHESIVES & SEALANTS**
   
   **806.1 Volatile organic compounds.** No interior adhesive or sealant shall contain any volatile organic compound in any concentration exceeding that permitted under Rule 1168 of the South Coast Air Quality Management District.

**Supporting Information**

**Issue – Expanded**
Volatile organic compounds (VOCs) are common chemical contaminants that can easily evaporate into the air and are found in homes and offices. Their presence can be noticed as an odor, such as paint and "new car smell." Many building materials and indoor furnishings release VOCs, contributing to "sick building syndrome." Even if a building’s ventilation system is properly designed and well maintained, VOCs and other chemical contaminants must be controlled to ensure healthy indoor air.

EPA studies have found that levels of common VOCs are consistently higher indoors than outdoors. VOC levels in homes can be 2 to 5 times higher inside than outside, with some indoor air levels over 1,000 times higher following certain activities such as paint stripping. Paint emits numerous chemicals that the California EPA has deemed as toxic air compounds (TACs) and emissions can continue for extended periods of time. One study found that less than 50% of the VOCs in latex paint are emitted in the first year.

Exposure to VOCs can cause short and long-term health problems. Some VOCs are known carcinogens; several studies have found a link between exposure to formaldehyde and increased incidence of nasal cancer, nasopharyngeal cancer, and leukemia. VOCs can also cause eye, nose, and throat irritation; headaches, loss of coordination, and nausea; and
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damage to liver, kidney, and the central nervous system.9

VOCs also contribute to ground-level ozone formation (smog).10 When VOCs are released into the air, the organic compounds react with nitrogen oxides to form ozone.11 High concentrations of ground-level ozone can cause respiratory problems and exacerbate asthma, emphysema, and bronchitis.12 Ground-level ozone also adversely affects the local ecosystem, damaging or weakening trees and plans, and reducing forest growth and crop yield.13

Environmental & Health Benefits
Limiting VOC levels in adhesives, paints, coatings and sealants will reduce human exposure and avoid potential health risks associated with indoor air exposure. According to the California Air Resources Board, scientific study has only touched the ‘tip of the iceberg’ in understanding all VOCs in indoor air. Because the link between indoor air pollutants and health impacts is so complex, researchers are also investigating the reaction of VOCs with other compounds present in indoor air and are discovering new areas for future study.14

Limiting VOCs will also help lower ground-level ozone concentrations in outdoor urban air, and alleviate the health and environmental risks associated with ground-level ozone.15

This proposal was found to have a positive, indirect environmental impact.

This proposal was found to have a low positive health impact per building and to impact a large number of buildings. It was thus given a health score of 2.

Cost & Savings
This proposal is not expected to have any impact on capital costs.

Precedents
These limits are more stringent and comprehensive (in terms of the number of materials addressed) than the limits established in current New York State Department of Environmental Conservation (DEC) Regulations.16

These VOC limits are consistent with the South Coast Air Quality Management District’s (SCAQMD) Rules 1113 and 1168, which have been incorporated into the 2008 California Green Building Standards Code17 and adopted by numerous municipalities throughout the country.18 Regionally, the Bay Area Air Quality Management District also established VOC limits for adhesive and sealant products.19

Additionally, the Green Seal® has set guidelines for VOC levels in paints that manufacturers must follow to obtain a certification.20 A variety of industry associations have also implemented guidelines addressing VOC levels for their respective products, including the Carpet and Rug Institute21 and Resilient Flooring Institute.22

In 2005, the City of New York enacted laws creating an environmentally preferable purchasing program, which establishes VOC limits for coatings purchased by the city.23 Within New York City, the Battery Park City Authority has requirements for sealants, adhesives, paints and coatings in all new construction to abide by the South Coast Air Quality Management District’s Rule 1168.24 25

A number of states, including California, New Jersey, Texas and Arizona, have enacted laws limiting VOC content in paints and coatings. EPA laws in effect since September 13, 1999 establish limits of VOC’s contained in the Architectural and Industry Maintenance (AIM) industry. All of the states in the northeast region have enacted regulations on the content of VOC’s in consumer products including cleaning products and products used in architectural and interior applications (NY, PA, NJ, MD, DE, DC, ME, CT, MA, NH, RI, VT, VA).

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) is developing Proposed Standard 189.1 - Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings. Section 8.4.2 of the standard calls for the use of low emitting building materials including adhesives, sealants, paints and coatings that are in compliance with SCAQMD Rules 1113 and 1168, and Green Seal Standards GS-36 (aerosol adhesives) and GS-11 (paints, coatings and primers). The Standard is expected to be finalized in early 2010.26

LEED
These recommendations correspond with many requirements of

- LEED-CI credit EQ4.1 Low-Emitting Materials: Adhesives & Sealants;
- LEED-CI credit EQ4.2 Low-Emitting Materials: Paints & Coatings;
- LEED-NC credit EQ.1 Low-Emitting Materials: Adhesives & Sealants;
- LEED-NC credit EQ4.2 Low-Emitting Materials: Paints & Coatings; and
- LEED for Homes credit MR2, Environmentally Preferable Products.

It should be noted that the reference standards vary significantly depending upon the type of application for the product. For example; topcoat paints, primers and sealers all have differing requirements. Adherence to these
recommendations will likely assist in achieving LEED credits, though each material must be researched independently under the selected rating system.

This recommendation will also facilitate achieving LEED-NC and LEED-CI credit EQ3.2 Construction IAQ Management Plan, Before Occupancy and LEED EB credit EQ3, Construction IAQ Management Plan and LEED for Homes credit EQ8, Contaminant Control. These points are concerned with reducing overall Indoor Air Quality problems throughout the building or space.

Adhesives for carpet and laminate adhesive are addressed separately by LEED, and do not apply to these recommendations.

Implementation & Market Availability

There are no known implementation issues for this proposal. Low VOC and VOC-free products are readily available.

Notes

Researchers have investigated VOCs in buildings for many years. There are many thousands of different types of compounds that are considered VOCs. Given this fact, research on the human health effects of VOCs is limited. Below is a summary of the current information related to VOCs, exposure, and health effects.

Human Exposure Standards:

The following information is taken from the Health Canada technical guide on indoor air quality in office buildings:

The threshold limit values (TLVs) for individual chemical substances that have been adopted by the American Conference of Governmental Industrial Hygienists (ACGIH) are not appropriate for office environments, for several reasons. For example, ACGIH TLVs apply to industrial workers who may be exposed to a few known contaminants at high concentrations over a 40-hour work week. Industrial workers are usually provided with adequate protective equipment (e.g., source ventilation, protective clothing or face masks, breathing equipment). In addition, the industrial workforce is generally made up of young, healthy, adult males.

Office workers, on the other hand, are exposed, without protective equipment, to a broad spectrum of contaminants at low concentrations over periods often longer than 40 hours per week. The synergistic effect of these compounds on occupant comfort is not known. As well, the population composition of the office workforce covers a much broader spectrum than that of the industrial workforce. It would therefore seem that individual limits much lower than ACGIH TLVs are more appropriate.

ASHRAE Standard 62-2007 observes that one approach has been to assume that some fraction of TLV is applicable and would not lead to adverse health effects or complaints in general populations; however, ASHRAE cautions that this approach should not be used without first assessing its suitability for the contaminant of concern. ASHRAE indicates that concentrations of concern range from less than one part per billion (ppb) for some very toxic compounds or for compounds having very low odor thresholds up to concentrations several orders of magnitude higher. “Not all compounds can be identified, and toxicological data are incomplete for many compounds.” Although there are at present no U.S. standards for Total VOC, the U.S. Green Building Council Leadership in Energy and Environmental Design target is 500 micrograms per cubic meter. The European Community has prepared a target guideline value for TVOC of 300 micrograms per cubic meter, where no individual VOC should exceed 10% of the TVOC concentration.

ASHRAE 62-2007 states that precise guidance on TOC concentrations cannot be given, and that setting target concentrations for TVOCs is not recommended.

Health Effects:

Of the VOCs typically found indoors, only a few, such as formaldehyde and acrolein, are irritants at levels typically measured. A few of the VOCs commonly found in indoor environments are known carcinogens (e.g., benzene), although evidence for carcinogenicity is extrapolated from high-level exposures in industrial environments. Others (e.g., carbon tetrachloride, chloroform) have produced cancer in laboratory animals, but no direct evidence exists for human effects. Most VOCs are lipid soluble, readily cross the blood-brain barrier, and are easily absorbed through the lungs. Most are neurotoxic and, in levels in excess of occupationally acceptable limits, may cause central nervous system depression, vertigo, visual disorders, and occasionally tremors, fatigue, anorexia, and weakness. Potential genotoxic effects are still under investigation. Effects of low-level exposures to VOC mixtures over long periods of time are still being researched.

The following information is taken from the Health Canada technical guide on indoor air quality in office buildings:

Research in North America and Europe has demonstrated that VOCs at concentrations much lower than the ACGIH TLVs can cause discomfort. In an exposure range of 0.3-3 mg/m³, odors, irritation, and discomfort may appear in response to the presence of TVOC together with thermal comfort factors and stressors. Above about 3 mg/m³, one may expect complaints; above 25 mg/m³, temporary discomfort and respiratory irritation have been demonstrated for a common mix of chemicals in an office building.

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Hypersensitive individuals can have severe reactions to a variety of VOCs at very low concentrations. They can react to organic compounds that are released by building materials, carpets, and various consumer products, including plastics, soaps and dyes. These reactions can occur following exposure to a single sensitizing dose or sequence of doses, after which time a much lower dose can provoke symptoms. Chronic exposure to low doses can also cause reactions. Symptoms are usually non-specific and may be insufficient to permit identification of the appropriate compounds. Because the available knowledge of toxicological and sensory effects of VOCs and their mixtures is incomplete, reduction of overall exposure to VOCs is desirable.\(^3\)

ENDNOTES:

