Defining VOCs

The term volatile organic compound (VOC) is poorly defined because measuring volatility is subjective. In addition, there are numerous standardized tests designed to determine VOC content, Total VOCs (TVOC), and VOC Emissions each with an implied method to determine volatility. The parameters (time, temperature, reference material, column polarity, etc.) used in the definitions and the associated test methods were created without a significant evaluation of volatilization characteristics in real world settings. But let's review the most common types of VOC terms used in the construction industry: VOC Content, TVOC, and VOC Emissions.

VOC Content

Volatile Organic Compounds (VOC) Content is the emissions of a non-solid during manufacturing and while in that non-solid state. For example paint in the bucket can off-gas VOCs and that off-gas while it is still liquid is called Content. If the paint is applied to the wall the off-gassing is still content until it hardens then it is called Emissions as the material ages. Therefore the VOC Content is an occupational hazard for workers in the manufacturing, and installing the material. VOC Content is also classified as one of the main causes of smog, emitted from the manufacturing or burning of non-solid materials. LEED has been concerned with Content for some time and require reporting of VOC Content of non-solid materials per the following methods:

- All paints and coatings wet-applied on site must meet the applicable VOC limits of the California Air Resources Board (CARB) 2007, Suggested Control Measure (SCM) for Architectural Coatings, or the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective June 3, 2011.
- All adhesives and sealants wet-applied on site must meet the applicable chemical content requirements of SCAQMD Rule 1168, July 1, 2005, Adhesive and Sealant Applications, as analyzed by the methods specified in Rule 1168. The provisions of SCAQMD Rule 1168 do not apply to adhesives and sealants subject to state or federal consumer product VOC regulations.
- For projects outside the U.S., all paints, coatings, adhesives, and sealants wet-applied on site must either meet the technical requirements of the above regulations, or comply with applicable national VOC control regulations, such as the European Decopaint Directive (2004/42/EC), the Canadian VOC Concentration Limits for Architectural Coatings, or the Hong Kong Air Pollution Control (VOC) Regulation.
- If the applicable regulation requires subtraction of exempt compounds, any content of intentionally added exempt compounds larger than 1% weight by mass (total exempt compounds) must be disclosed.
- If a product cannot reasonably be tested as specified above, testing of VOC content must comply with ASTM D2369-10; ISO 11890, part 1; ASTM D6886-03; or ISO 11890-2.
- For projects in North America, methylene chloride and perchloroethylene may not be intentionally added in paints, coatings, adhesives, or sealants.

There are several current VOC test/calculation methodologies, including: SCAQMD Method 313 (M313), ASTM Standard Test Method E 1868-10 (E1868) and U.S. EPA Reference Method 24 (M24).

Total VOC

TVOCs are Total Volatile Organic Compounds that only include carbon based chemicals with 5-carbon atoms through 17-carbon atoms (C5-C17), good and bad. This is misleading and possibly liable or harmful to the public as it doesn't include many dangerous chemical emissions such as formaldehyde and other harmful chemicals with carbon (C) atoms outside this range. The establishment of any artificial TVOC limit such as 500 or 1000ug/m3 lacks scientific merit. No human health effects have been correlated to TVOC's; rather exposure limits to individual chemical emissions have been establish through science as defined in

CA/DHS/EHLB/R-174. The TVOC sum weights all chemicals (C5-C17) with equal severity regardless of their known individual human health impact.

Per LEED Manufacturers' claims of compliance with the above requirements must also state the range of total VOCs after 14 days (336 hours), measured as specified in the CDPH Standard Method v1.1:

0.5 mg/m3 or less;
between 0.5 and 5.0 mg/m3; or
5.0 mg/m3 or more.

Projects outside the U.S. may use products tested and deemed compliant in accordance with either (1) the CDPH standard method (2010) or (2) the German AgBB Testing and Evaluation Scheme (2010). Test products either with (1) the CDPH Standard Method (2010), (2) the German AgBB Testing and Evaluation Scheme (2010), (3) ISO 16000-3: 2010, ISO 16000-6: 2011, ISO 16000-9: 2006, ISO 16000-11:2006 either in conjunction with AgBB, or with French legislation on VOC emission class labeling, or (4) the DIBt testing method (2010). If the applied testing method does not specify testing details for a product group for which the CDPH standard method does provide details, use the specifications in the CDPH standard method. U.S. projects must follow the CDPH standard method.

VOC Emissions

VOC Emissions is the off-gassing during service life time of a material and is the concern for occupant health and wellbeing. Building products VOC Emissions claims must be tested and determined compliant in accordance with California Department of Public Health (CDPH) Standard Method v1.1–2010, using the applicable exposure scenario. The default scenario is the private office scenario. The manufacturers or third-party certification must state the exposure scenario used to determine compliance. Claims of compliance for wet-applied products must state the amount applied in mass per surface area.

USG has conducted third-party volatile organic compound (VOC) emissions tests on most of our products per ASTM D5116 -Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions From Indoor Materials/Products- and the California Department of Health Section 01350 (California Department of Department of Health ***Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers*, including 2010 addendum**).

The VOC emissions test results show the VOC emissions of most of our products are well below the levels established in the following standards:

- All **LEED** rating systems
- All **GREENGUARD™** standards (Both GreenGuard Certification and GOLD)
- **Collaborative for High Performance Schools** (CHPS) Best Practice Manual, 2006,Low Emitting Materials (LEM) Table
- **South Coast Air Quality Management District** (SCAQMD) Rules for VOC Limits.
- **FEMA** Procurement Specifications –Formaldehyde and VOC Levels
- **MAS** Certified Green
- **UL** Environment
- All **Scientific Certification Systems** (SCS) programs
- **ANSI/BIFMA** M7.1-2007 and X7.1-2007
- **CARB** Formaldehyde
- Environmental Technology Verification (**ETV**) Large Chamber Test Protocol for Measuring Emissions of VOCs and Aldehydes, effective September 1999.
- **CRI** Green Label Plus
- The **Blue Angel** low-emission materials.

In fact, in acknowledgement that Sheetrock® Brand Gypsum Panels are so low in emissions it is one of the approved substrates for test emissions of other building products, as demonstrated in the except below :

STANDARD METHOD FOR THE TESTING AND EVALUATION OF VOLATILE ORGANIC CHEMICAL EMISSIONS FROM INDOOR SOURCES USING ENVIRONMENTAL CHAMBERS VERSION 1.1

*(Emission testing method for **California Specification 01350.** Supersedes the previous version of STANDARD PRACTICE FOR THE TESTING OF VOLATILE ORGANIC EMISSIONS FROM VARIOUS SOURCESUSING SMALL-SCALE ENVIRONMENTAL CHAMBERS)*

3.2 Preparation of Paint Test Specimens

3.2.1 Apply “flat” and “eggshell” wall paints to conditioned standard 5/8" thick gypsum board (e.g., USG Sheetrock brand or equivalent). The substrate size shall be appropriate to achieve the specified loading factor (Table 3.1). Just prior to painting, accurately weigh (±0.1 g) substrate, mask borders ¼” on all sides with tape (e.g., 3M Scotch-Blue™ Painter's masking tape, or equivalent) to avoid paint dripping on edges. Accurately measure (±2 mm) the dimensions of the area to be painted. Alternative approaches for protecting the edges may be acceptable and shall be reported if used.

Inherently nonemitting sources. Products that are inherently nonemitting sources of VOCs (stone, ceramic, powder-coated metals, plated or anodized metal, glass, concrete, gypsum plaster, clay brick, and unfinished or untreated solid wood flooring) are considered fully compliant without any VOC emissions testing if they do not include integral organic-based surface coatings, binders, or sealants.