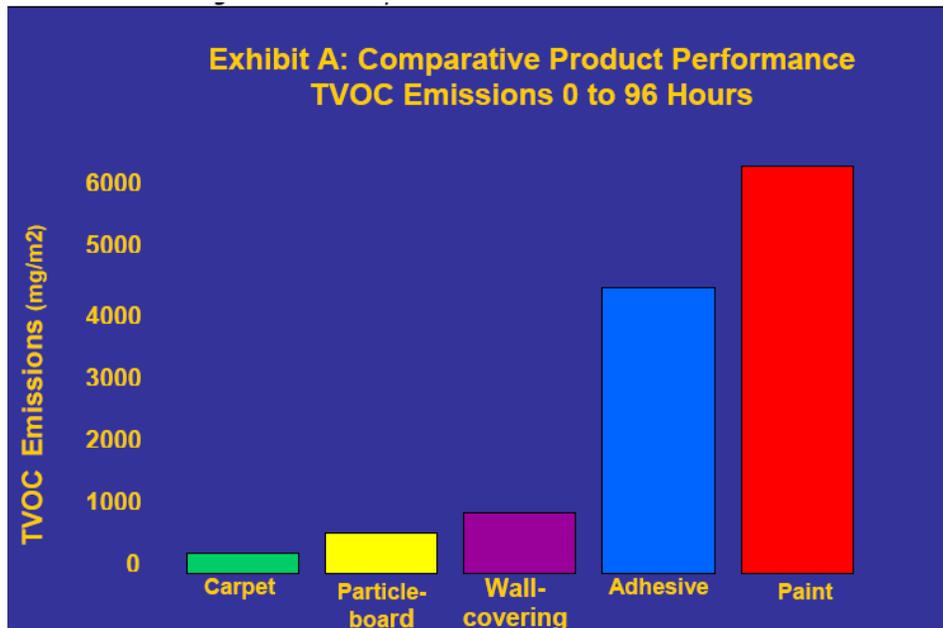


Beneath the Surface:
Managing indoor air quality issues for better products,
better business in the paint industry

Paints are some of the most commonly identified sources of volatile organic compounds (VOCs) in indoor environments. While most users do not understand the chemistry behind these materials, they can easily detect strong odors from paints, which trigger concerns about emissions and their effect on health and comfort. Odors do not necessarily indicate the presence of dangerous chemicals, nor does the absence of odor indicate the safety of the air we breathe. Strong odors aside, paints are some of the most powerful emitters of VOCs in indoor spaces.

Exhibit A: This chart compares total VOC (TVOC) levels from paints and other common finishings in indoor spaces.



Paint manufacturers have long been under scrutiny from environmental groups and public health agencies. Data of VOC emissions from users of surface coatings, as tabulated in the National Emission Inventory for 1999, is included in the Exhibit B.i According to this data, compiled by the US Environmental Protection Agency, VOCs from paints and coatings make up approximately 12% of all VOC emissions recorded. In this study, surface coating was second only to automobiles as a source of VOC emissions.ii

As pressure from these groups increases, the paint industry faces the unique challenge of balancing business objectives with efforts to address important environmental issues. However, this industry is not alone, and other producers of high emitting finishings and furnishings provide examples of how emissions issues can be tackled in a proactive, cost effective manner that benefits the business as a whole.

Exhibit B: National Emissions Inventory, 1999.

Source Category	VOC (thousand short tons)
Architectural	483
Industrial adhesives	148
Wood furniture	130
Metal cans	113
Autos and light trucks	106
Auto refinishing	104
Traffic markings	93
Maintenance coatings	85
Electronic, electrical	82
Metal furniture	58
Thinning solvents	54
Paper	51
Metal coil	49
All other	580
Total	2,136

The Chemistry of Paint

It is helpful to know a little bit about the basic chemistry of paint in order to understand why its emissions are so high. Consisting of pigments, binders, solvents, and additives, paint contains VOCs that are fundamental to its functionality and performance. While the pigment is obviously the essential component in paint, it also has to include binder so that color will adhere to a surface. Solvents hold the pigments and binders in a liquid state until they are spread on a surface in open air, at which point solvents dissolve, leaving behind the pigment adhering to the painted surface. A variety of additives are included to enhance the performance of the paint. For example, biocides may be added to prevent mold growth, or anti-skinning agents to maintain the texture of the paint in the packaging. Most, if not all of these components of paint release VOCs into the air during the application and drying process. Exhibit C contains a list of common VOCs emitted from both latex and oil-based paints. Further exacerbating the problem is the fact that paint is designed to be spread over a large surface area, increasing the area that emits VOCs.

Exhibit C: Common chemicals found in paints

Flat Latex	Gloss and Semi-Gloss
Formaldehyde	Formaldehyde
Toluene	Toluene
Propylene glycol	Benzenes
Ethylene glycol	Xylenes
Texanols	Naphtha
Butoxyethoxyethanol	Aliphatic hydrocarbons
Butyl propionate	Butyl acetate
Alcohols	Ethylene glycol ether
Aldehydes	Triethylamine

Potential Health Effects

Potential health effects from inhalation of VOCs range from uncomfortable to debilitating. Symptoms can be acute or chronic, acute problems manifesting themselves nearly immediately upon exposure to VOCs. Common symptoms include headache, nausea, fatigue, cough, dizziness, and eye, nose, and throat irritation. Chronic symptoms may manifest themselves over a long period of time, making it difficult to trace the cause to a specific exposure event. Serious long-term health consequences may develop, although further clinical studies are required to clearly link emissions limits with chronic conditions. Exposure may present greater problems for those sensitive individuals including the immuno-compromised, young children and the elderly.

Content Versus Emissions

Regulatory bodies and agencies have looked for ways to achieve a reduction in the VOCs used in and emitted from paints. In Section 183(e) of the Clean Air Act Amendments of 1990, the Environmental Protection Agency proposed to regulate paint content in hopes of reducing the pollutant emissions. While VOC content has a positive correlation with VOC emissions, emissions can not be predicted by content. USEPA Test Method 24, which determines a product's VOC content, is based on a gravimetric weight loss of the product upon heating. This method is generally not sensitive or reproducible for content levels less than 0.1 to 1%. Consequently, it is common to find VOC emissions from a product even though it has been reported to have a "No-VOC" content based on Method 24. Some VOCs such as formaldehyde, may be generated as byproducts or by chemical reactions during coating application; these VOCs cannot be measured in the content analysis.

Air Quality Sciences conducted some emissions studies designed to measure VOC emissions compared with VOC content labels on packaging of several different types and brands of paint. In this study, nine different interior paints including flat latex, semi gloss, and gloss paint were applied to wallboard and their emission releases were recorded over time in an environmental chamber. Using small chambers

according to the ASTM D 5116-97 method, these studies identified the chemicals being emitted and their levels, and predicted how long they would be emitted.

Dynamic environmental chamber testing involves the use of electropolished stainless steel chambers, which are operated at closely controlled experimental conditions of temperature, relative humidity and air exchange (the rate of introduction of fresh, outside air). Supply air to the chambers is filtered for both chemicals and particles. The use of only stainless steel, glass and Teflon ensures that the testing environment will be as chemically inert as possible. The chambers vary in size. The small-scale chamber provides a testing environment of about 50 liters or 1.75 cubic feet. The large environmental chamber is designed to simulate an office and is about 1,000 cubic feet. Analytically, the environmental chamber results are determined using sophisticated analytical chemistry techniques, such as gas chromatography/mass spectrometry for VOCs.

As indicated by Exhibit D, there are variations not only among different types of paint, but also within manufacturers of a single type. Paints labeled as VOC-free registered TVOCs in the product emissions testing. The data indicate there is a difference between content measurements and airborne emissions. Paint manufacturers that would like to ensure that their products are low emitting must test specifically for emissions in order to determine if their products are optimal for performance in indoor environments. Meeting content regulations does not guarantee performance, particularly above the “no-VOC” range.

Exhibit D: Results from VOC Content/ Emissions Comparative Study

	VOC Content per label (g/L)	VOC Content per ASTM (g/L)	TVOC emissions (mg/m ²)	Predicted air levels (24 hour) (mg/m ³)
Flat Latex 1	0	32	18	0.02
Flat Latex 2	118	201	19212	4
Flat Latex 3	<250	166	7179	1
Semi Gloss 1	0	22	26	0.06
Semi Gloss 2	121	169	581	6
Semi Gloss 3	<250	261	4843	34
Gloss 1	<250	245	3114	35
Gloss 2	<250	271	32594	721
Gloss 3	<250	103	2374	0.6

Testing Options

The bad news is that there is no way to predict emissions without emissions testing. The good news is that there is a range of different testing options available to meet the specific objectives, timeline, and budgets of each individual manufacturer. Below are just a few of the many testing options available. There are no regulated standards, and certification programs are currently voluntary, so managing product emissions is largely focused on corporate commitment to design products for today’s indoor environmental quality needs and to protect the health of all users.

Basic Protocol

Following a standardized protocol, testing involves measuring emissions following application on wallboard. The standard protocol follows ASTM 5116-97, as developed by the USEPA. Emissions of volatile organic compounds (VOCs) are measured and reported in emission rates, the amount of contaminant released per unit of time.

This is an excellent test for manufacturers during their product development process and for those who are just initiating product emissions testing. The basic test provides information about the types of emissions and their levels during the normal application process. Results provide a starting point for identifying potential problems and making adjustments. They also provide a standardized test platform for comparing emissions among different types and brands of paint, evaluating the impact of manufacturing changes aimed at reducing emissions, and evaluating “complaint” products from customers.

Odor Protocol

Users may complain about unusual or unacceptable odors originating from paints. Paint odors are obviously strongest during and immediately following application. However, strange or unacceptable odors may linger long after paint has dried. Paint is applied to a surface in the chamber and tested under normal application and usage. Measurements are made for aldehydes and VOCs, which are typical sources of odors. All chemicals identified are compared to AQS’ extensive database of odorants to identify the culprit.

Risk Assessment

A risk assessment evaluates a product’s potential to produce adverse human health effects. Emission data obtained from environmental chamber testing is used to predict human exposure concentrations of contaminants, and these concentrations are assessed for their potential to produce cancer and non-cancer risks. The data is reviewed according to standards and guidelines available from California’s Proposition 65, OSHA’s occupational exposure limits occupational levels, the EPA’s carcinogenic and non carcinogenic risk levels, and sensory irritation and odorant limits available from numerous scientific organizations. Risk assessment is a must for those manufacturers who want to understand potential health risks associated with use of their products.

Certification Protocol

Manufacturers can apply to voluntary certification programs like the GREENGUARD Certification Program for low emitting products. These programs offer third party verification that a product exceeds basic low emitting standards as currently being required of numerous government purchasing and green building programs. Testing can be done to prequalify products for the program, or official program testing can be completed for application submittals.

The case study that follows provides an example of how one manufacturer in the insulation industry have used product emissions testing and indoor air quality issues to create new opportunities, grow their business, and advance the industry as a whole.