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An Environmental Study of Interior Wall Paint

The topic of paint spans far and wide. It includes countless possible ingredients, applications, colors, and hundreds of other subcategories making a truly thorough survey thereof a very daunting task. The first man-made paints appeared 25,000 years ago on the walls of caves. At that time, they were composed of natural elements such as blood or colored minerals from the soil. The Egyptian culture provided the next major development in the history of paint from approximately 3000 to 600 BCE, introducing the color Egyptian blue. Some 5000 years ago, the first synthetic paint was introduced. From 600 BCE to 400 AD, the Greeks and Romans were the first to experiment with varnishes. In 1804 the first white lead paint appeared in the United States. 1865 marked the first US paint patent, and ready mixed paints began to be produced in the US two years later. In 1923, nitrocellulose lacquer was introduced.

(<http://www.eng.buffalo.edu/Courses/ce435/PaintsandCoatings/tsld003.htm>) In short, Paint is defined as follows: “*n: a substance used as a coating to protect or decorate a surface (especially a mixture of pigment suspended in a liquid); dries to form a hard coating.*” (WordNet® 1.6, 1997 Princeton University via www.dictionary.com)

In particular, this essay will focus on one of paint’s more common applications, interior wall paint. Wall paint serves to make walls look nice aesthetically. It covers up any construction work on the walls and can create a “mood” or “atmosphere” in the room based on its color and texture. Most wall paint consists of a white base to which color tinting is added when the paint is

purchased. Since it is so widely used in residential homes, it is important to make considerations about interior wall paint that lie deeper than its simple application and function. The second logical consideration, of course, is paint's human health effects. In the 20th century, one of the major problems surrounding interior paint was its lead content because of problems arising from small children eating paint chips

A 1996 statistic from the South Coast Air Quality Management District claims that paints used for homes and other structures account for 60 tons of VOC (volatile organic compound) emissions per year (see www.aqmd.gov/news1/Archives/paint.html). Volatile Organic Compounds make up one component of solvents—vehicles used in solvent-based paints to disperse the paint's pigment. According to AQMD, some specific dangers created by VOC's include their ability to combine with Nitrogen Oxides and form harmful ground level ozone, and their ability to cause premature aging of the lungs. They also contribute to the level of PM10, or particulate pollution in the air, which the AQMD linked to 8000 deaths per year in Southern California in 1996.

The AQMD report blaming paint for such great amounts of air pollution is nearly 8 years old, and in the meantime there have been significant developments in low VOC paints. Also, it refers only to VOC emissions in a single region of the USA where smog emissions have been comparatively high for a good part of the last hundred years. What's more, smog is popularly considered an outdoor problem where this essay is chiefly concerned with indoor air quality. Despite its weaknesses, this statistic shows that there is a need for new paints that do not harm the environment. Today, a great deal of progress has been made in the development of safer paints, but the paints that contributed to the pollution on the south coast of California are still in

wide use. Greater awareness of the dangers of most paints and the alternatives that are available is sorely needed. This paper will discuss precisely those issues.

While the South Coast AQMD report only covered outdoor air pollution, one can't simply consider indoor air and outdoor air in two separate categories. There is obviously an air exchange that takes place because without such a phenomenon the indoor air would gradually turn into CO₂ and become smothering. If so many VOC's attributed to paints are found in the outdoor air, then one can probably expect this to be reflected in the VOC concentration of the indoor air. Important to consider when making this assumption is that a significant portion of such VOC's are initially released *indoors* by interior paints and, though their concentration levels likely drop as air is filtered through the home, their presence in the indoor air has the potential to be very high immediately following painting. A pertinent question to ask of VOC's is if they are necessary to fulfill their function, and whether reducing the concentrations in paint would reduce the overall qualities of the paints in which they are used. It is clear from the sheer number of efficient low VOC paints existing today that a reduction in VOC levels would not necessarily result in lower quality paint.

In the remainder of this essay, we will examine some paints that are the basic industry standard, for which no steps have been taken to make them environmentally safe. We will see that there is a great deal more than the level of VOC's in a paint that can make it dangerous to human health and the environment. The release of ozone depleting chemicals and other gases that contribute to global warming during the combustion or decomposition of paint is one concern, as well as the non-renewable resources and energy used in its manufacture. Following our examination of two industry standard paints, we will look at two examples of low-VOC paints which will showcase some of the qualities these paints can have in spite of their low VOC

contents. Finally, we will look at two paints claiming to be zero-VOC and completely environmentally benign, to see if an ideal paint, one that is actually “good” and not “less bad,” really exists.

Industry Standard Paints:

Davis Paint Co. Professional Wall Paint

Pratt & Lambert Accolade Interior Semi-Gloss Enamel

To set up a basis or control for the low VOC and Green Paints, we first researched the industry standard or “status quo” of the industry. Two paints were chosen, one from Pratt & Lambert ® brand paints and the other from the Davis Paint Company. The information found about these paints is as follows.

The first paint researched is Davis Paint Co. #4000 Professional Line Wall Paint White. Its product code is 826-W-400. Both MSDS and other Data Sheets are readily available and easy to find for this product. (<http://www.davispaint.com/PDF/Cookpdf/826w400lwp.pdf>
<http://www.davispaint.com/PDF/Cookpdf/CMSDSpdf/826W400.pdf>)

Beginning with human health effects, the most important health issue that is repeated multiple times on labeling is to have an adequately ventilated area for use. Vapor or mist can cause headache, nausea, and irritation to the nose, throat, and lungs in poorly ventilated areas. If taken internally, this product can cause gastrointestinal irritation. This paint is made from Kaolinite, Calcium Carbonate, Nepheline Syenite, and Ethylene Glycol. Ethylene Glycol is known to be a toxic chemical. Due to this toxicity, human health risks are increased.

Air Pollution is a relevant issue to discuss for this product. Warning labels state that the paint must be completely sealed in its container when not in use. From this warning it can be inferred that it off-gases hazardous chemicals. Adequate ventilation is also mentioned in this

section of the data sheets. There are 101 grams per liter of VOC's. Thermal decomposition or combustion can produce fumes of carbon dioxide and carbon monoxide. Disposal of this product is not specifically mentioned. Instead, the company refers the consumer to their local waste management companies.

As for packaging, this product is sold in one-gallon metal containers. It is specifically mentioned on the package that the paint cannot be allowed to freeze. In order to function properly, the paint must be at a temperature of at least 50 degrees Fahrenheit. Its performance is graded and marketed as professional quality. The manufacturer also recommends at least two coats of paint for the best results.

The second industry standard paint researched is Pratt & Lambert Accolade Acrylic Latex Interior Semi-Gloss Enamel. Its product code is 555-11. No MSDS sheet could be found for this product online after extensive searches, however some data sheets were available.

http://intranet.risd.edu/envirohealth_msd/ID/PrattLambertAccoladeIntSemiGloss.pdf

Beginning with the effects on human health, this product contains both air pollutants and carcinogens. This product may cause irritation to the eyes, skin, and respiratory system. It may also cause nervous system depression. Extreme overexposure may cause unconsciousness and even death. This product contains cobalt and cobalt compounds, which are known to be carcinogens. Other effects of overexposure include headaches, dizziness, nausea, and loss of coordination.

For air quality, this product is quite poor. The product information repeatedly emphasizes that there must be good ventilation wherever the paint is in use, and that the can must be thoroughly sealed when not in use. There are actually 367 grams per liter of VOC's in this

Pratt & Lambert paint. Thermal decomposition or combustion will produce fumes of carbon dioxide and carbon monoxide.

In manufacturing, the items used to make this product are Titanium Dioxide, Calcium Carbonate, Talc, Quartz, and Mineral Spirits. This product is combustible; therefore, it must be kept away from heat and open flame.

For disposal, this product has been classified as hazardous material and must be disposed of in accordance with local, state, and federal laws. Both of these paints are made from non-renewable resources.

Low-VOC Emitting Paints:

Glidden Ultra Hide from ICI Paints and General Paint Co.'s Low-VOC Paint

Low VOC for flat paints was defined by the national park service in 1999 (<http://www.nps.gov/hfc/conservation/exhibit/pdf/ex-tech.pdf>) as non-flat paint having between 0-150 g/l or a flat paint having between 0-50g/l VOC content. Yet other sources have developed their own definitions for low VOC levels for paint, and there don't appear to be agreed-upon limits. An online publication from the University of Minnesota places the low VOC threshold for solvent-based paints at 380 g/l VOC content, and water based paints at 150 g/l VOC content (<http://www.facm.umn.edu/cons/2002/AppGG02.pdf>). One other chart (http://216.239.39.104/search?q=cache:jr2srDfgTqMJ:www.facm.umn.edu/cons/2000/APPA/G_APPA.pdf+50+voc+content+paint&hl=en&ie=UTF-8; 2002) confirms this definition and consequentially will be the one used to define this attribute during the following comparison.

The first sample paint is manufactured by the ICI Paints. The product itself is called Glidden Ultra Hide Acrylic Flat Paint, and has easy application, good hiding ability (i.e. opaqueness when coating a surface), and above all, a low VOC level. www.gliddenpro.com

reports this level to be 0.98g/l—well under the required voc content threshold. Ultra Hide is composed of vinyl acrylic resin, titanium dioxide and extender pigments. The manufacturer also claims it contains no lead or mercury.

The MSDS does mention a few negative issues involving the product when it comes to human health issues. First, there is the danger of severe lung irritation from excessive inhalation. Adequate ventilation and a respirator mask are therefore highly recommended in order to reduce the possibility of developing Silicosis, a non-cancerous lung disease. Also possible upon contact is skin irritation, which can be alleviated with soap and water, and eye irritation, which can be dealt with by flushing the eye with water. Ultra hide creates no Birth defects unless it is tinted in which case it has been known to cause birth defects in lab animals.

Another possible danger is flammability. While Ultra Hide has no flash point, the MSDS recommends under the Accidental Release Measures heading that the Paint be immediately removed from possible ignition sources. The paint has a class a flame spread rating, or the lowest possible flammability rating. Also noteworthy is that Ultra Hide contains combustible compounds Carbon Monoxide, Carbon Dioxide, Sulfur Monoxide, and Oxides of Calcium.

As far as environmental issues are concerned, Ultra Hide claims not to be harmful to the atmosphere and have no ozone depleting properties, though the manufacturer has done no other ecological testing. Due to the previous information about human health issues, it is difficult to determine what Ultra Hide's air related environmental impact actually is.

The main factors for most in choosing paint are function and price. Aside from easy application, good hiding ability, and low VOC concentration, Ultra hide is also non-yellowing, has low odor, is quick drying (30-60 minutes for touch up, 2-4 hours for recoat), and is washable

with soap and water. The bottom line, at least at Home Depot, is \$19.99 per gallon, covering 400 square feet.

The second of the low VOC paints surveyed comes from the Canada-based General Paint Company. As with the Ultra Hide, General Paint's 54-020 HP 3000 low VOC paint has a similar array of reasonable functional qualities contrasted with undesirable health factors. This one, however, costs \$42.99 in Canadian Dollars, which amounts to approximately \$32.53 a gallon, US Dollars.

HP stands for "high performance" and this product is designed for "high wear areas of the home where a low VOC product is needed." (<http://www.generalpaint.com/hp3000.htm>) Especial for HP 3000 is its ability to touch in 30 minutes and be recoated in 60 minutes. The paint cures within 7-10 days. Only one to two coats must be applied (3.78L covers 26-34m² or 275-370 ft²). The paint may also be thinned and cleaned up with water.

What, then, is the downside of this seemingly very effective paint? The human health implications of this paint were seemingly minimal according to its MSDS (www.generalpaint.com/msds/54-020.htm). Under "hazardous ingredients" the manufacturer listed Amorphous silica, making up 0.5-1.5% of the paint's total volume, which has been known to cause skin and eye irritation. Upon skin contact, the user is directed to remove any contaminated clothing and wash the exposed area of the body with soap and water, seeking medical attention if irritation persists. In the case of eye contact, the user is directed to flush the eye(s) with water for 20 minutes or until irritation persists. If ingested, the user is instructed not to induce vomiting unless directed.

The paint has a slight ammonia smell and General paint recommends that the user wear respiratory protection while painting and be removed to fresh air if irritation occurs. The product

does not have a flash point though CO₂, CO, nitrogen oxides, and sulfur oxides are mentioned as hazardous combustion PDT's and hazardous decomposition products might be CO₂, CO, or aldehydes.

As with the other paint example, no information directly concerning the environmental impact of the product was given and one must simply make assumptions based on the human health issues involved.

Zero-VOC Emitting Paints:

Safecoat from American Formulating and Manufacturing

Old-Fashioned Milk Paint from The Old-Fashioned Milk Paint Co.

We chose two paints that were advertised as zero-VOC, in the hopes of finding a more ideal indoor wall paint than the previous four. These two paints are American Formulating and Manufacturing's "Safecoat Zero VOC Semi-gloss" and The Old Fashioned Milk Paint Co.'s milk-based paint. They both present good alternatives to normal toxic paints and to low-VOC paints that can still be hazardous.

AMF Safecoat, whose MSDS information is available online at <http://www.afmsafecoat.com/2003msds/1412%20Semigl%20msds.pdf>, is an acrylic paint that meets the standards allowing it to be classified as a zero-VOC paint. It costs \$30.90 per gallon on the company website. It is made with alternative solvents that are safe for people who are sensitive to the chemicals in most paints. The smell is not offensive, only a very mild paint smell, so it is fine to be in the room where the paint has been applied while it is drying. It uses no cancer-causing chemicals. The only pollutant that this paint emits when decomposing is CO₂, which is a vast improvement over most paints, which emit ozone-depleting pollutants. Also, it is not as energy-intensive to produce, since it is not petroleum based.

The paint's main ingredients are Acrylic Emulsion Copolymer, water, and Titanium Dioxide. The Acrylic Copolymer is determined to be environmentally safe due to its large atomic weight that makes it unlikely to off-gas and is unable to enter biological systems, and which is completely benign once cured.

(<http://www.nicnas.gov.au/PUBLICATIONS/CAR/NEW/NA/NASUMMR/NA0300SR/na361.htm>) The Titanium Dioxide can be used to break down volatile organic compounds, and has been used as an air purifier, both outdoors and indoors. It's highly acclaimed environmental benefits are not completely free of controversy, however, for there are some who claim that while TiO_2 reacts with hazardous chemicals, it can break them down into substances that are even more volatile than they were originally. (<http://ehpnet1.niehs.nih.gov/docs/2001/109-4/innovations.html>)

In terms of performance, AFM Safecoat does as well as or better than standard paints. It is sold as a base, to which any color tint can be added. Most tints will increase the VOC content, but AFM also provides zero-VOC colorants that may be used. (www.afmsafecoat.com) When paint is called for, this is a perfectly environmentally friendly option that can be substituted for ordinary paints without much extra effort.

Going one step further in environmental sustainability is the Old-Fashioned Milk Paint Company's milk paint. (MSDS and Product Bulletins available at <http://www.milkpaint.com/info.htm>) This paint is sold as a powder to be mixed with water, and is mainly made up of powdered milk, lime, clay, and earth or mineral pigments. Its price when ordered directly is \$43.95 for a bag of powder that will make a gallon of paint when mixed with water. One gallon of this paint covers 300 square feet.

This milk paint recipe predates the introduction of petroleum and latex by thousands of years, extending back to ancient Egypt. Because of its completely natural design, with no need for solvents, this paint has absolutely no volatile organic compounds. It is completely biodegradable, emitting no pollutants at all into the air. While it is wet, this paint smells like milk, and has no odor once it has dried, which only takes about 30 minutes. It is safe to use on children's toys, which means it is safe enough to chew on. The health warnings on the MSD Sheet are associated with any powder, and once the paint is mixed with water, as it appears from the company's website, nothing could be safer.

The manufacture of this paint is not nearly as harming to the environment as most, for its main ingredient, milk, is easily obtained and very renewable. Lime, while it has to be mined, is praised as a renewable resource that has many uses in constructing environmentally friendly buildings. This paint also saves energy by being sold in bags as a powder. Thus, it comes to the consumer in a more concentrated form, and is much easier to ship than a heavy liquid in an aluminum can. It is not difficult to mix either, for one needs only to add water.

The only possible drawback to this paint is its unique look. Since the paint does not use any solvents at all, the color is slightly uneven after the first coating. Antique enthusiasts attempting authentic period restorations seek after this paint's uneven, matte appearance. In fact, it's greatest danger is its ability to pass off new furniture as antique, even fooling antique dealers. But a modern architect may not desire its antique look. Extra steps can be taken to apply the color more evenly, and it can be given a semi-gloss appearance by burnishing the surface to which the paint has been applied. It is not as simple a substitute as the more normal AFM Safecoat.

The extra work needed when it comes to applying this paint may be completely overshadowed, however, by its extreme durability. The Old-Fashioned Milk Paint Co.'s paint recipe was created by studying artifacts that were painted hundreds of years ago whose color have not faded at all, and the paint looks as good as new. No paint has gone through such a successful test of time as milk paint. This clearly saves energy in the long run, eliminating subsequent painting jobs that would be necessary with any normal paint. Milk paint's unique look is still quite beautiful, so its great environmental qualities combine with its historic nature to make the ideal paint.

Using a Zero-VOC paint is not necessarily more expensive, and it can function just as well as a low-VOC or normal, toxic paints. There should be no question for the environmentally conscious painter that zero-VOC is the way to go. The only question that remains, then, is which is the best zero-VOC paint? The paints described above are only two out of a myriad of fine products claiming to be Zero-VOC. There are other paints as good as these, but there are also ones that use odor masking chemicals in order to claim to be Zero-VOC. These can still be a hazard to human health, let alone the environment.

Old-Fashioned Milk Paint and AFM Safecoat are very different from each other, each one having its own strengths and weaknesses. Milk paint is the more expensive of the two, and the most unique. AFM Safecoat does not depart quite as far from the norm of modern paint, which may be desirable for some, but we would argue that it is also a weakness. The paint, while it doesn't smell as much as normal paints, still has a light chemical smell, which can't possibly be as benign as the milk odor of milk paint. Also, while it seems that there is no great danger presented by the chemicals used in its production, they have not gone through the great test of

time that milk paint has. Too often new, human synthesized substances that seem to be completely benign turn out to be detrimental to the earth.

This same risk is not present with the Old-Fashioned Milk Paint Co.'s paint. Perhaps the strongest point favoring milk paint over AFM Safecoat, is milk paint's extreme durability. It is clearly proven that this paint will last hundreds, if not thousands of years without fading. The slight difference in price that milk paint presents is far overshadowed by its durability. This, in combination with its completely safe composition, brings us to The Old-Fashioned Milk Paint as a clear winner. The sheer beauty of this paint is magnified when the beholder can gaze upon it without a trace of guilt surrounding its use.