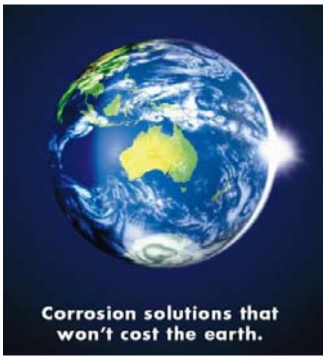
ESD - Coatings & VOC

2.3.2

Introduction



According to the Green Building Council of Australia, commercial buildings contribute 8.8% of the national greenhouse emissions in this country (which is high by world standards). Designing more **ecologically sustainable** commercial buildings is one way to **reduce** our **contribution to greenhouse emissions**.[i]

The issue of VOC is extremely complex; to illustrate this complexity, below are a few issues associated with VOC's, coatings and their impact on our environment.

What Is VOC?

VOC stands for **Volatile Organic Component**, or **Volatile Organic Compound**.
The term includes **both naturally occurring** and **man-made** compounds. The term "organic" means carbon-based.

The **definition of VOC**, when related to paints and coatings, is described in the **APAS** (Australian Paint Approval Scheme) Document No. 181[ii]. In that document, a **VOC** is an organic compound with a **boiling point** less than **250°C** at one standard atmosphere pressure (101325 Pa) or a **vapour pressure** less than **0.01mm Hg** at 21°C.

Is VOC The Same As HAP?

No, these are different. **HAP** stands for **Hazardous Air Pollutant**.

According to the US EPA, six common air pollutants (also known as "criteria pollutants") are found all over the United States. They are **particle pollution** (often referred to as particulate matter), **ground-level ozone**, **carbon monoxide**, **sulphur oxides**, **nitrogen oxides**, and **lead**. These pollutants can harm your health and the environment, and cause property damage. Of the six pollutants, **particle pollution** and **ground-level ozone** are the most widespread health threats.[iii]

Whilst HAPs do occur in nature, **most HAPs** are released into the environment by **industrial activity**.

Where Does VOC Originate?

Many VOC's in the atmosphere are **naturally occurring** – they evaporate from **vegetation**[iv], such as **monoterpenes** from pine trees and **isoprene** from deciduous trees. Mowing grass and harvesting hay release **VOC** into the air. The blue haze over the Blue Mountains is **eucalyptus oil**. **Ethanol**, present in the wine we drink is the fermentation product of fruit sugars, and **citrus oil** is a natural, and very effective cleaning agent.

A rising proportion of **VOC's** in the atmosphere are man-made, however. These **VOC's** are synthesized from fossil fuels (ie petroleum based), and certainly not limited to **paint** and **coatings**; they exist in a very broad range of products including but not limited to **food**, household **cleaning agents**, **glues**, **fabric linings**, **joint sealants**, **carpet backing**, **adhesives** for carpet and tiles and **plastics**.

VOC in Paint and Coatings

Most **conventional protective coatings** contain **VOC's**, which evaporate and are released into the air during application and as the paint dries. In **coatings**, **VOC** is also known as **solvent** or **thinner**.

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What Effect Does VOC Have?

The release of **VOC's** may affect the **paint applicator**, the **occupant** of the space in which the product was used, and the **environment**.

Effect of VOC on the Applicator (Occupational Health and Safety)

The **VOC's** released during application (and as the paint dries) may trigger respiratory reactions including asthma, and breathing discomfort, when inhaled and other symptoms such as dizziness and nausea.[v] They can also cause skin irritation on contact. Wearing **appropriate personal protection** and **engineering controls** during application can prevent such adverse reactions.[vi]

Effect of VOC on the Occupant (Indoor Air Quality)

Generally, improvements in building insulation and draft minimisation in building design have also created ventilation challenges. **VOC's** and other chemicals that "off-gas" may take some time to dissipate. According to the Australian Bureau of Statistics, "Newer buildings are particularly at risk of hazardous air pollution due to **low ventilation rates** and **'off-gassing'** of new building materials. 'Off gassing' refers to the releases of toxic fumes from **furniture**, **carpets**, **paints***, **glues** and **sealants** used in building products. These fumes are greatest in new buildings and may remain high for several months (EA 2001a)."[vii] (*It must be noted that water borne paint does not contain any of the chemicals listed as air pollutants therein.)

Effect of VOC on the Environment

Industries that had traditionally used large quantities of low-solids, high solvent paint, such as the automotive and furniture industries, had accounted for a significant proportion of total VOC emission. In the US, VOC emission from coating industries almost rivalled vehicle emission only 20 years ago. The US and particularly California lead the way on VOC limits, however the driver was based on low-level atmospheric pollution rather than the associated contribution to the green-house gas issue. Much of what has been used as a framework for ESD issues has been drawn from legislation in place to control low-level atmospheric pollution – a related issue, but not the same issue. Hence there are flaws in the translation.

For instance, acetone is an organic solvent and by definition a VOC. However, because it does not contribute to lower atmospheric pollution – it does not photo-reduce to ozone – it is exempt.

Nevertheless, on the whole, **reducing VOC** emissions where we can **reduces photochemical smog** and **reduces contribution to the Greenhouse Effect**.

Then Why Add VOC? The Traditional Role of Solvents in Paint

Solvents are normally included in conventional oil based coatings for a number of reasons, such as:

- **Solution medium** – the resin is dissolved or dispersed in the solvent.
- **Paint carrier** - pigment powders and other additives are dispersed in the solvent and hence "carried" by the solvent. The solvent also carries the paint from the can to the substrate via brush, roller or spray. Once the paint is applied, the solvent no longer has any use. It evaporates, leaving a thin, smooth film on the substrate.
- **Paint thinner** and/or flow modifier - if the paint is too thick to apply easily (temperature can cause this), solvent can be added to adjust the flow-out

Reformulation of protective coatings to reduce VOC levels must take these points into account to ensure that the reformulated product is not more difficult to apply.

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A small amount of **VOC** is normally included in water-borne paints to:

- improve "**wet edge**" by prolonging evaporation long enough to allow the paint to flow out,
- improve **coalescence** of the latex particles as the water dries.

Water-borne paints have a solvent level of around 8%, so using a water-borne paint seems to be a more environmentally responsible option, assuming performance properties are equal to those of the solvent-borne equivalent. Low VOC coatings, either water-borne, or solvent-free, are available.

Are all VOC's Bad?

All organic additives that evaporate from paint as it dries are classified as **VOC's**, regardless of relative potential for harm. In other words, a particular organic chemical may be found in a range of foodstuffs, face creams or household items, but as part of a paint formula, if it evaporates, it is considered a **VOC**.

VOC's differ widely with regard to their effect on the environment; whilst some do contribute to the greenhouse gas effect (or when not used in accordance with safety advice, pose occupational health and safety risks for the user), others are chemically identical to naturally occurring VOC's.

For example, the APAS no longer lists acetone as a VOC as there is no evidence at present that it has a negative photochemical effect in the atmosphere[viii].

Is Low VOC the same as Low Odour?

LOW VOC must not be confused with **LOW ODOUR**. Some low **VOC** paints have a strong, distinct odour, whilst some higher **VOC** paints have a low or pleasant odour. Certain solvent-free products (i.e. zero VOC) have a strong odour during application and drying but the odour dissipates fairly quickly as the product cures. Check data sheets and ask reliable technical consultants for VOC values.

ESD – Short Term VOC Savings versus Long Term Durability

Some types of low VOC coating technologies have enormous and obvious advantages over traditional coating systems in certain applications; a good example of this is **Dulux Luxafloor ECO$_2$**, which is a true waterborne epoxy floor coating. **Luxafloor® ECO$_2$** offers **equivalent performance** to traditional interior low film build epoxy coatings at **significantly lower VOC levels**.

A **water borne acrylic paint** might initially seem like a sound ecological choice until we consider the **long-term impact** this would have on the **life cycle** of the steelwork - it would probably last **months**, not years, in coastal environments, and attempting to control corrosion by **frequent repainting** is clearly **not sustainable**.

A **balance** must be reached between initial **VOC emissions** (**short-term ecological cost**) and substrate protection and durability (**long-term ecological benefits**).[ix]

A rough balance between VOC emissions and long term durability can be calculated on a life cycle basis. Please see below for a working example.

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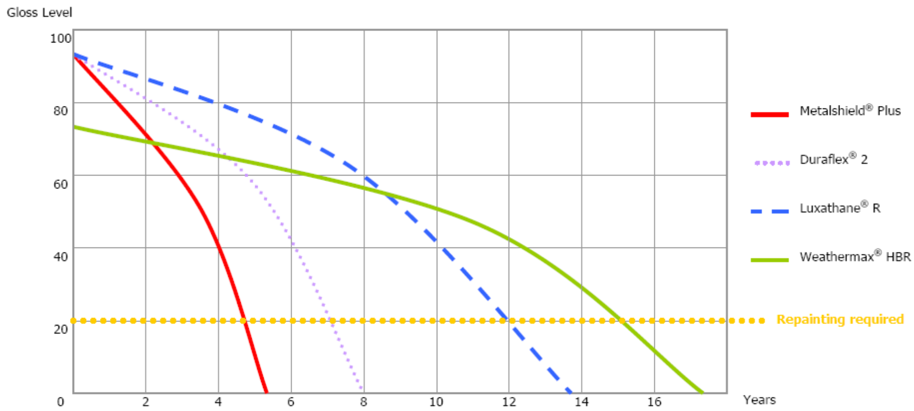
Working Example of Durability – VOC Balance

Option 1 – Enamel Paint



Using the example of a **quick dry alkyd enamel such as Metalshield**, with a **VOC level** of **510 grams per litre**, for every four litre can used, **2 kilograms** of VOC are emitted into the atmosphere, compounding the "**Greenhouse Effect**". Given that alkyd enamels readily chalk and deteriorate when exposed to UV and exterior exposure generally, maintenance repainting is generally necessary on commercial projects every **3-5 years**. **For a life cycle of**, say, **60 years**, this equates to **12 repaints**.

For an area that requires four litres of coating, the solvent released over **60 years** would be

= **12 x 2.04 kilograms** = **<u>24.5 kilograms</u>**

Substituting the quick-dry enamel with a **silicone enamel** product, such as **Duraflex® 2**, (VOC level is 450 grams per litre) increases the maintenance period to about **7.5 years**, which over 60 years, means about 8 repaints

= **8 x 1.8 kilograms** = **<u>14.4 kilograms</u>**

Option 2 – Standard Two-Pack Polyurethane

Replacing the single pack enamel with a **high performance polyurethane** topcoat such as Dulux **Luxathane® R** with a **VOC level** of **500 grams per litre** (mixed), then for every four-litre kit used, **2 kilograms** of VOC are emitted into the atmosphere. Repainting a substrate topcoated with **Luxathane® R** may be necessary every 12 years. For a life cycle of, say, 60 years, this equates to **5 repaints**.

For an area that requires four litres of coating, the solvent released over **60 years** would be

= **5 x 2 kilograms** = **<u>10 kilograms</u>**

Option 3 – High Solids Two-Pack Polyurethane

If, however, **Luxathane® R** is replaced with Dulux **Weathermax® HBR**, with a **VOC level** of **330 grams per litre** (mixed), a four-litre kit releases only **1.32 kilograms** of VOC, and offers further increased protection to the substrate, and may require repainting every 15 years. For a life cycle of, say, 60 years, this equates to **4 repaints**.

For an area that requires four litres of coating, the solvent released over **60 years** would be

= **4 x 1.32 kilograms** = **<u>5.3 kilograms</u>**

And, using a **protective coating** is economically, as well as ecologically, sound **in the long term**, as repaints are less frequent.

A **balance** must also be reached between **VOC emissions** of applying a coating and its corresponding effect on the environment compared with **alternative methods of substrate protection**.[x] For more information on other environmental considerations when choosing a protective coating, please refer to Dulux Protective Coatings Tech Note 2.3.1 ESD – Definitions and Measurement and Tech Note 2.3.3 ESD and Galvanic Corrosion Protection.

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What Has Dulux Protective Coatings Done So Far?

Some years ago, **Dulux Protective Coatings** had made a commitment to developing **high performance**, **low VOC** technology products to replace conventional solvent-borne products in a range of **heavy-duty applications** such as industrial flooring and steelwork. This is not easy.

Our world-class research and development laboratories at Clayton are fulfilling this commitment. To date, our efforts have resulted in the products below.

Water Borne Protective Coatings[xi]

Aquagalv® a high performance anti-corrosive inorganic zinc silicate primer for steel

Enviropoxy® WBE a low VOC two-pack epoxy acrylic coating

Ferreko® No. 5 a single pack acrylic micaceous iron oxide (MIO) coating

Luxafloor® ECO_2 a low VOC two-pack epoxy floor coating

High Solids Protective Coatings

Luxafloor® RollCoat a high solids, low VOC two-pack epoxy floor coating

Weathermax® HBR a high solids, medium VOC, high performance two-pack polyurethane coating

Durebild® STE a high solids, medium VOC surface-tolerant two-pack epoxy coating

Duremax® GPE a high solids, medium VOC high build two-pack epoxy intermediate coating

While we push toward solvent-free coatings and waterborne coatings, we trust that **industry** will be prepared to **embrace and support such developments** as they occur.

Green Specifications

When it comes to specifying coating systems for projects being designed within Green Star guidelines or you simply wish to minimise impact on the environment, call your Dulux Consultant. Many of our Consultants actively and regularly attend environmental conferences, seminars and training sessions, and can help you to specify the most **environmentally responsible** coating systems for your project. For more information, please contact the Dulux Protective Coatings Technical Consultant in your state.

Dulux is a member of the Green Building Council of Australia.

green building council australia MEMBER

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[i] Green Building Council Australia **www.gbcaus.org**
[ii] APAS Document D181, Volatile Organic Compounds (VOC) Limits **www.apas.gov.au/PDFs/D181.pdf**
[iii] USA EPA **www.epa.gov/air/caa/peg/cleanup.html**
[iv] More than a change of color: Autumn foliage may affect air quality, climate. **www.ucar.edu/communications/staffnotes/0110/foliage.html**
[v] Dulux Protective coatings Tech Note 2.2, Correct and safe Use of Solvents **www.duluxprotectivecoatings.com.au/technotespdf/2.2%20Solvents.pdf**
[vi] Dulux Protective Coatings Tech Note 2.3 Solvents, **www.duluxprotectivecoatings.com.au/tech_notes.html**
[vii] Indoor Air Pollution, EA 2001a, **www.abs.gov.au**
[viii] APAS Document D181, Volatile Organic Compounds (VOC) Limits **www.apas.gov.au/PDFs/D181.pdf**
[ix] Dulux Protective Coatings Tech Note 2.3.3 ESD and Coating Specifications
[x] Dulux Protective Coatings Tech Note 2.3.4 ESD and Corrosion Protection
[xi] Dulux Protective Coatings Data Sheets: **www.duluxprotectivecoatings.com.au/data-sheets.shtml**