

## How are solvents regulated? Why do products contain VOC solvents? And why do we (still) use them?

*This document aims to give a generic overview on solvents used in indoor air environments*

### Introduction: solvents – VOC - ozone

When talking about solvents you often also talk about VOCs. VOC stands for Volatile Organic Compounds which may be part of solvents. However, not all VOC are solvents and not all solvents are VOCs.

The main purpose of solvents is to dilute certain materials which are then, in a solution, easier to handle. It makes these materials (like paints, adhesives, cosmetics, construction materials) easier to pour, brush, dip, or spray onto objects or surfaces. Different solvent properties allow various 'drying' time which is a crucial element for many applications. This results in VOCs emissions which may be captured or not.

VOCs are one of the precursors for tropospheric (ground-level) ozone, which is the main component of smog and thus has adverse effects on human health. Ozone is formed in the atmosphere when UV light from the sun reacts with oxides of nitrogen (NO<sub>x</sub>) from different sources such as automobiles, manufacturing plants, power generation facilities. When VOCs, carbon monoxide (CO) or methane (CH<sub>4</sub>) are present, the overall equilibrium between ozone and NO<sub>x</sub> is shifted and more ozone may accumulate.

There are many contributors to VOCs in the atmosphere. The main sources are biogenic or natural sources, such as trees and vegetation. Anthropogenic or man-made sources are vehicle emissions, petroleum refining and combustion - or the use of organic solvents which release VOCs if they evaporate into the air.

### VOC definition & regulations

Because VOCs are subject to regulation, the question "What is a VOC?" is a crucial one.

The legal definition in the EU came from the Solvent Emissions Directive (SED 1999/13/EC) which later was included into the Industrial Emission Directive (IED 2010/75/EU):

*'volatile organic compound' means any organic compound as well as the fraction of creosote, having at 293,15 K a vapour pressure of 0,01 kPa or more, or having a corresponding volatility under the particular conditions of use;*

This directive looks at emissions from all industrial installations, and one of the pollutants are VOCs. The IED establishes permit conditions including emission limit values which must be based on the **Best Available Techniques (BAT)**.

A slightly different definition comes from the Paints Directive (2004/42/CE):

*'Volatile organic compound (VOC)' means any organic compound having an initial boiling point less than or equal to 250°C measured at a standard pressure of 101,3 kPa;*



It is this directive that looks at the limitation of VOC emissions from the use of organic solvents in decorative paints and varnishes and vehicle refinishing products.

### Where do we find VOC solvents?

There is a long list of products containing or emitting VOC solvents.

[https://www.esig.org/wp-content/uploads/2018/03/factsheet\\_What\\_are\\_solvents-simple.pdf](https://www.esig.org/wp-content/uploads/2018/03/factsheet_What_are_solvents-simple.pdf)

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Paints & coatings - paint strippers - degreasers - wood preservatives - fragrances - certain cosmetics - certain cleaning products – air fresheners - disinfectants - stored fuels and automotive products - dry-cleaned clothing – pesticide - building materials and furnishings - office equipment such as copiers and printers, correction fluids and carbonless copy paper - graphics and craft materials including glues and adhesives, permanent markers and photographic solutions.....

### Organic solvents are found in many household products and are critical to their effectiveness.

- They help paint to flow and form a smooth surface on whatever is being painted.
- Solvents improve the cleaning ability of many household cleaners, including hard surface cleaners, window cleaners, floor polishes, and automotive cleaners.
- They also are an important part of many beauty & cosmetic products. Nail polish and removers, hairspray, antiseptics and many other products rely on solvents to dissolve other ingredients and allow them to work properly.
- Solvent-containing adhesives allow for metal pieces to be bonded strongly together.

As a general rule, when solvents are used in a consumer environment, we can assume that all of them are emitted to the atmosphere, but in an industrial environment, the solvents may be retrieved or recovered from the process where they were used or they may be incinerated. Therefore, different use categories of the same solvents may lead to different emission factors.

When looking at VOC content it does not mean that all VOCs are also emitted. With respect to the potential of VOCs the actual emissions are indeed more important to look at than the VOC content.

### Can the solvent VOC content from consumer or household products be further reduced and what would this bring?

VOCs from other sources like car emissions have been declining over the last years, and also the solvent **VOC content in consumer and household products has been declining or stayed at least stable over the last 20 years.** In some products we also see further elimination of solvent based systems (like adhesives) but in general **there seems no potential to further reduce them as each solvent fulfils its dedicated function.**

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### Examples paints & coatings

The role of the solvent is to facilitate the transfer of the paint film to a surface that requires protection and/or beautifying. Following the Paints Directive, substantial efforts have been made to switch to waterborne paints (with up to 15% hydrocarbon solvents) or, where possible, to eliminated the use of solvents altogether by new technologies like powder or UCVB coatings. This led to a substantial reduction of the use of organic solvents in paints used by consumers and professionals, and hence to a reduction of VOCs but did not result necessarily into a substantial reduction of ground level ozone.

There are however applications or products, where for reasons of special properties of the painted surface, waterborne coatings are not suitable: ships, aircrafts and also for the top layer of cars. Here high solids solvent borne products are being used. Where the surface to be coated cannot resist high temperatures (like plastics), also powder coatings cannot be used.

Because of all efforts spent over the last decades, it can be expected that the percentage of organic solvents containing paints will stay stable.





### Examples cleaning products

As with almost all materials or substances that have a smell, most cleaning, maintenance and hygiene products will contain NMVOCs (these are non-methane VOCs) where they provide specific functions.

In biocidal products a NMVOC will be used as a solvent to dissolve the biocidal active ingredient or the NMVOC might be the active ingredient itself such as ethanol in a surface disinfectant. In addition to the above roles in disinfectants a NMVOC solvent will also aid penetration of the biocidal active through an insect cuticle i.e. it allows for the active ingredient to perform its function.

In cleaning and hygiene products a NMVOC can also function as a solvent to provide better surface adsorption of the cleaning agent as well as to loosen dirt to aid physical removal e.g. ethanol in window cleaners.

NMVOCs are also used as propellants in most household aerosols to maintain a constant equilibrium pressure within the container throughout the aerosol dispenser's life. This ensures that the performance of the spray is the same at the end of the product's life as at the beginning. Propellants also deliver an even, targeted application of the cleaning and hygiene product on its intended surface.

In addition to solvents and propellants other volatile substances that evaporate into the air when you use cleaning and hygiene products and air fresheners are simply the perfumes or fragrances that provide the assurance that the item or surface has been cleaned and enhance the sense of wellbeing. Perfumes or fragrances are combinations of mainly the exact same molecules that you smell in the garden, or the woods. Many come from essential oils extracted directly from plants, while some are 'nature-identical' molecules that can be manufactured more efficiently and sustainably. There are also some 'new' molecules, although these are often variants on naturally-occurring structures but with better characteristics.

It would prove challenging and disproportionate to remove or reformulate out NMVOCs in cleaning and hygiene products given the specific functions that NMVOCs perform. In addition, it would have little to no practical impact as cleaning products are a very minor sources of NMVOC.

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### Examples construction chemicals

VOC emissions by using solvents in some applications of construction Chemicals products are today insignificant, as most of Construction Chemicals are water-based formulations or powders to be mixed with water.

However, the very limited amount of solvents still used in Construction Chemicals Industry for e.g. the formulation of certain curing agents for concrete or of certain bituminous products serve only for decorative or for protecting reasons. Thereby the surfaces treated with these products show excellent penetration properties such as waterproof, resistance to washing with water and are highly economical.

Nearly all other type of coatings and construction adhesives usually have no or only low content of solvents or are high solid formulations.

Therefore, potential VOC emissions from construction chemical products are very low, and there is no concern for common construction chemicals as regards organic solvents contained or emitted.



### Example adhesives

Today, VOC emissions from adhesives are minor and the solvent content in adhesives has been reduced steadily over the last decades.

Alternative technologies have replaced solvent based adhesives in most applications. Certain sectors use labelling schemes, such as the flooring adhesives. Almost all companies selling flooring adhesives in Europe are applying the EMICODE label which is awarded based on strict emission requirements (<https://www.emicode.com/the-label/>).

Solvent-containing adhesives may be necessary for certain niche applications where additional surface treatment of substrates is difficult to manage (for example metal with rubber).



### Looking ahead

As stated above, what is important to consider are the actual VOC emissions, not the VOC content, as not all VOCs might in the end be emitted.

When addressing VOCs for Indoor air quality issues we consider the impact of emitted substances on human health. Therefore, to get higher safety level of indoor air quality, the approach via data linked to human health assessment is better than just summing the amount of VOC emitted knowing that some of them have no impact on human health via inhalation route.

Last but not least, when looking at VOCs and potential attempts to lower VOC emissions from household products, any cross effects of lowering VOCs need to be taken into account.

*Biocides have been added to paint to guarantee protection that was formerly achieved with solvent based paints. Now biocides are found to have health and environmental side effects – or are subject to further regulations and authorisation procedures.*

Overall industry believes that in the current policy debate around circular economy, sustainability criteria are of uttermost importance. Therefore, any regulatory approach should also include a life cycle assessment.

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#### **About ESVOC**

ESVOC, the European Solvents Downstream User Coordination Group is a unique platform that brings together manufacturers and their downstream users trade associations to facilitate the implementation of relevant existing legislation. It currently consists of representatives of almost 30 different associations

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