Volatile Organic Compounds (VOCs)

Other Names:

CAS Number	Substance
71-43-2	Benzene
56-23-5	Carbon tetrachloride
67-66-3	Chloroform

List continued in “Additional Information”

May Be Found In:

- Adhesives and glues
- Fabric printing inks
- Coating formulations
- Leather finishing formulations
- Plastic products (e.g. buttons)
- Solvents
- Rubber
- Poly-Urethane

Volatile Organic Compounds (VOCs) are chemicals that easily become gases or vapours from solid materials such as paints, gels or liquids. They are also released from many consumer goods like paints, thinners, adhesives, dry cleaning fluids, air fresheners, building materials, furnishings, footwear and many others. VOCs are ingredients in a wide variety of commercial, industrial, and residential products.**1** Their concentrations are consistently higher indoors than they are outdoors. Combined with NOx in the air, VOCs contribute to smog creation. Some VOCs exist naturally in the environment. They are generally referred to as the highly reactive and/or toxic organics emitted by both human made and natural sources due to their high volatility at normal atmospheric conditions.

Uses in the Supply Chain

Within apparel and footwear supply chains, VOCs are widely used in chemical preparations and in combination with other VOCs as cleaning agents (solvents). These solvent mixtures are often used for cleaning purposes for products and machinery. Some VOCs are used in adhesives, fabric and leather coatings, screen print inks, and synthetic leather. VOCs may be found as impurities in polystyrene-based resins used in the production of plastic trims. In addition, VOCs may be used in processes such as dry cleaning, finishing, degreasing or cleaning operations.[1]

Why Volatile Organic Compounds (VOCs) are Restricted

- Legislation in major markets around the world restricts the presence of VOCs in final products.
- VOCs easily become gases or vapours, and exposure can occur via inhalation. They may also enter the body through food intake or when they come into direct contact with the skin.
- VOCs, particularly those that are restricted, are known to have adverse effects on human health and/or the environment.
- VOCs can cause skin, eye, and respiratory irritation.
- Drowsiness, dizziness, headaches, tremors, confusion and/or unconsciousness may occur from short term exposure to high VOC levels.
- Chronic exposure to high VOC levels may cause damage to organs, including the central nervous system, liver and kidneys.
- Above certain exposure levels, some VOCs may cause cancer and reproductive harm.
- VOCs, such as toluene, may contribute significantly to the formation of smog, which has adverse effects on human health and can damage forests and crops.[2]
- Chemical hazard information for many chemicals can be found in the following external databases:
  - GESTIS Substance Database: http://gestis-en.itrust.de/nxt/gateway.dll/gestis_en/000000.xml?f=templates$fn=default.htm$vid=gestiseng:sdbeng$3.0
  - US National Library of Medicine: https://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB
  - USA EPA Occupational Chemical Database: https://www.osha.gov/chemicaldata/index.html

Sourcing Compliant Materials from Your Suppliers

- Explain that you require materials to be compliant with current AFIRM RSL limits.[4]
- Share this guidance sheet with your material suppliers. Using the guidance in the next section, instruct them to work with their chemical suppliers to source chemical formulations that comply with these requirements. If needed, highlight the existence of harmful substances in materials via chemical management trainings from the ZDHC Academy, existing guidelines, and laws.
- Pay special attention to buttons made from polystyrene-based resins. Monomeric styrene may contain toluene, and sometimes benzene, as production impurities.
- Ensure, via internal policies, that footwear products are not cleaned by using unidentified solvent mixtures. Many of these mixtures contain high amounts of VOCs.
- Many adhesives contain VOCs. Through sufficient drying/curing, VOCs in materials may be removed by evaporation. The best course of action however is to avoid their use altogether to prevent workplace safety and environmental issues.
- Make sure your supplier has a solid chemical management system in place.

Sourcing Compliant Formulations from Your Chemical Formulators

- Explain to chemicals suppliers that you require chemical formulations to comply with current ZDHC MRSL limits.
  - Search for formulations on the ZDHC Gateway Chemical Module. If your preferred formulations are not listed, encourage providers to register their formulations.
  - Ask for a ZDHC ChemCheck report.
- For all formulations, request SDS documentation to ensure none of the CAS Numbers above are listed as ingredients.
- Prior to procuring any formulation, its chemical properties must be reviewed to ensure proper protective equipment, chemical storage facilities, facility engineering controls, and associated treatment/disposal facilities are appropriate for the chemical(s).
- Make sure unidentified solvent mixtures without proper MSD or product information are not used in the manufacturing process.
- Pay special attention to chemical formulations that are likely to contain VOCs, such as:
  - Adhesives
  - Polyurethane coatings
  - Formulations used in finishing
  - Degreasing agents
  - Cleaning operations
  - Spot cleaners
  - Chemical formulations which might contain benzene and toluene

Safer Alternatives

The following substances have been identified as examples of safer alternatives and may be suitable for your production needs. In general, any chosen alternative must be ZDHC MRSL compliant whenever applicable.

- Water-based adhesives are available that may require upfront costs to achieve higher drying temperatures, but use far fewer hazardous chemical ingredients. These are the safest alternatives.
- Solvent-based adhesives and fabric coating formulations that comply with the ZDHC MRSL may also be feasible alternatives.
- Instead of using VOCs as a cleaning agent, water and soap will suffice in many cases.
- Methylcyclohexane-based adhesives may be used as substitutes for adhesives containing restricted VOCs.
- N-Heptane can be used as an alternative to benzene in paints, paint thinners, synthetic resins, rubber adhesives and textile finishes.

Additional Information

Spot cleaners such as 1,2-Dichloroethane and 1,1-Dichloroethylene, PET and other halogenated compounds can be a source of VOCs in a facility. Spot cleaners should be carefully considered and only used in accordance with national regulations and requirements. It is imperative to understand possible impacts on the environment to avoid VOC issues.

Continued list of CAS Numbers and substance names from first page:

CAS Number	Substance
107-06-2	1,2-Dichloroethane
75-35-4	1,1-Dichloroethylene
127-19-5	Dimethylacetamide (DMAC)
76-01-7	Pentachloroethane

630-20-6	1,1,1,2- Tetrachloroethane
79-34-5	1,1,2,2- Tetrachloroethane
127-18-4	Tetrachloroethylene (PER)
108-88-3	Toluene
71-55-6	1,1,1- Trichloroethane
79-00-5	1,1,2- Trichloroethane
79-01-6	Trichloroethylene
1330-20-7	Xylenes (meta-, ortho-, para-)
95-48-7	o-cresol
106-44-5	p-cresol
108-39-4	m-cresol

References

1 United States Agency for Toxic Substances and Disease Registry. (Various). Toxicological Profiles: Benzene, Toluene and Xylene. Retrieved August 15, 2017, from https://www.atsdr.cdc.gov/substances/index.asp.

2 Classification and Risk Phrases According to CLP Regulation (Regulation (EC) 1272/2008). Retrieved August 15, 2017, from http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:353:0001:1355:en:PDF.

3 Apparel and Footwear International RSL Management Group (Ed.). (2018, January 31). Restricted Substances List (Rep.). Retrieved http://afirm-group.com/afirm-rsl/.

4 Directive 2004/42/CE of the European Parliament and the Council; EUR-Lex. European Union Publications Office.

5 World Health Organization, 1989. "Indoor Air Quality: Organic Pollutants." Report on a WHO Meeting, Berlin, 23-27 August 1987. EURO Reports and Studies 111. Copenhagen, World Health Organization Regional Office for Europe.

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