

Sources of indoor air pollution and approaches for minimisation

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EXECUTIVE SUMMARY

Indoor air quality is a key determinant of human health as people spend most of their time indoors. Homes contain a complex mix of pollutants including volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), particulate matter, and combustion gases, originating from building materials, consumer products, heating, cooking, and attached garages. This report reviews major residential pollution sources and outlines practical mitigation strategies.

Building materials are among the largest contributors to indoor VOCs, particularly in new or recently renovated homes. Commonly emitted compounds include formaldehyde, acetaldehyde, and a range of other aldehydes and terpenes. Carpets act as both sources and sinks for VOCs and facilitate formation of secondary pollutants via reaction of airborne pollutants with carpet materials. Mitigation approaches include selecting low-VOC materials, using VOC adsorptive or photocatalytic materials, flushing of spaces with outdoor air after construction, and 'bake-out'.

Cleaning products emit numerous fragrance-related VOCs, with few disclosed on product labels. Regular and 'green' products show similar emissions, while fragrance-free formulations emit substantially less. Mitigation strategies include choosing low-VOC or fragrance-free cleaners, using simple homemade alternatives, avoiding product overuse, and increasing ventilation during and after cleaning.

Electronic devices such as computers, TVs, printers, and 3D printers release a variety of VOCs, SVOCs, and particulate matter, with emissions influenced by temperature, device age, and materials. Mitigation strategies include distancing devices from living areas, using enclosures or covers to contain pollutants, selecting low-emitting materials, and regular maintenance of equipment.

Air fresheners (sprays, diffusers, candles, incense) emit a wide range of VOCs and particulate matter, often with limited disclosure of ingredients. Combustion-based products such as candles and incense also release polycyclic aromatic hydrocarbons (PAHs), carbon dioxide (CO₂) and ultrafine particles. Mitigation approaches include opting for non-combustion alternatives, employing natural odour control methods, and increasing ventilation during use.

Personal care products emit monoterpenes, ethanol, and other fragrance solvents during use, storage, and evaporation from skin. Compounds emitted by 'green' products often overlap considerably with those of conventional products, while fragrance-free options emit far fewer VOCs. Mitigation strategies include selecting low-emission, non-aerosol products, limiting usage in non-ventilated areas and ensuring products are properly closed when stored.

Attached garages allow emissions from stored fuels and other chemicals, and vehicle-related emissions to infiltrate homes. Effective strategies include ensuring stored chemicals are tightly sealed, not idling vehicles in the garage, sealing shared walls and doorways, and improving garage ventilation.

Heating systems vary widely in their pollutant output. Wood burners and fireplaces emit particulate matter and PAHs, gas and oil heaters are major sources of NO₂, whilst electric

heat pumps avoid combustion pollutants altogether. Mitigation approaches focus on appliance maintenance, using clean dry wood, and choosing non-combustion heating where possible.

Cooking is a major pollutant source. High-heat, oil-based methods produce high levels of particulate matter, VOCs, and PAHs, while gas stoves also emit carbon monoxide, NO₂, and methane. Mitigation strategies include using electric or induction cooktops, ensuring effective use of vented rangehoods, minimising high-heat and oil-heavy cooking, and maintaining clean cookware and appliances.

Overall, indoor air pollution arises from many small, everyday sources rather than a single dominant one. Improving indoor air quality requires a layered approach: informed product choices, source reduction, effective ventilation, and adoption of low-emission technologies. Most recommended actions are simple, practical, and cost-effective for typical New Zealand homes, and can substantially reduce exposure while improving occupant health.

1. INTRODUCTION

People spend around 90% of time indoors, most of it within their own homes (Dyląg et al, 2022). Consequently, the quality of the air in indoor environments can have significant impacts on overall health and wellbeing. Indeed, poor air quality has been linked to a range of respiratory and other chronic health conditions (Chamseddine et al, 2025). For example, exposure to formaldehyde, which may originate from indoor sources as well as outdoor emissions, has been associated with development of childhood asthma (McGwin et al, 2010). Additionally, higher exposure to carbon monoxide, sulphur dioxide, nitrogen dioxide (NO_2), $\text{PM}_{2.5}$ and PM_{10} (particles $\leq 10 \mu\text{m}$), pollutants commonly measured in outdoor air quality studies but also relevant to indoor exposure, has been associated with hospitalisation and mortality due to heart failure (Shah et al, 2013).

In 2017, the Building Research Association of New Zealand (BRANZ) published a review of indoor air quality in New Zealand homes and schools, highlighting the variety of pollutants which contribute to poor indoor air quality (Taptiklis and Phipps, 2017). These include volatile organic compounds (VOCs); semi-volatile organic compounds (SVOCs) such as phthalates, flame retardants and polycyclic aromatic hydrocarbons (PAHs); gaseous chemicals such as carbon monoxide and nitrogen dioxide (NO_2); biological contaminants such as mould; and particulate matter.

These pollutants originate from a wide range of sources, as illustrated in Figure 1. To effectively reduce indoor air pollution, it is therefore essential to identify the specific sources that contribute to it.

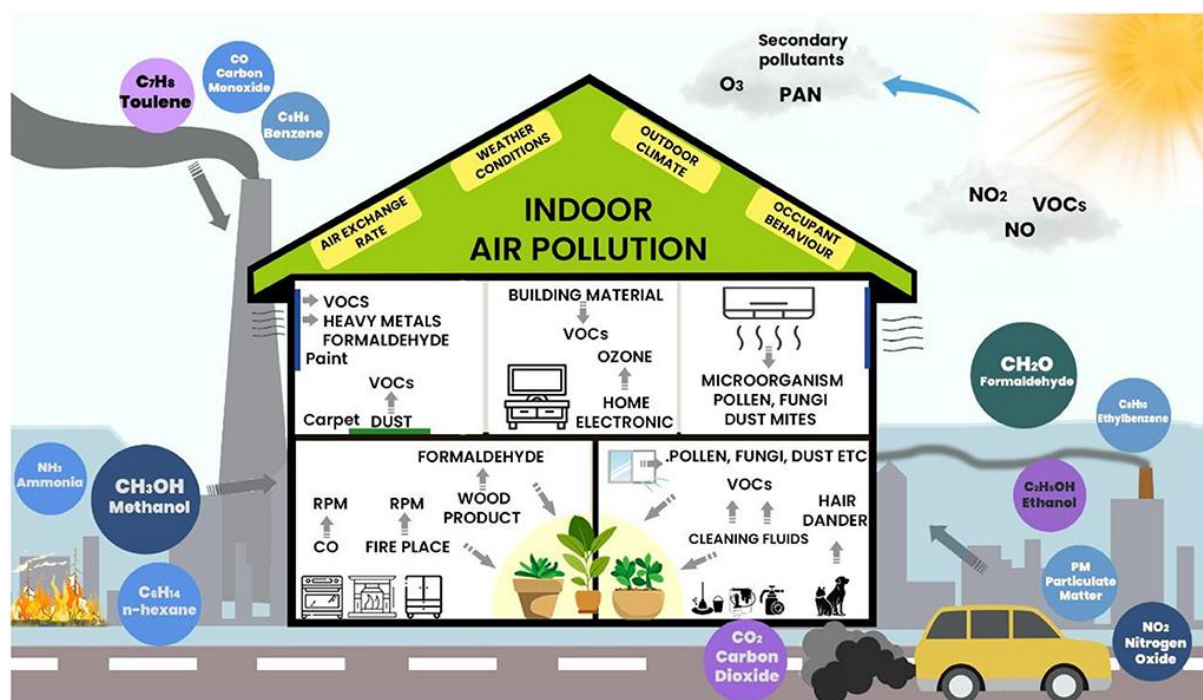


Figure 1 Schematic showing the variety of sources of indoor air contaminants

Reproduced from Ravindra and Mor (2022).

1.1. AIM AND SCOPE

The aim of this report is to provide an overview of the variety of sources of indoor air pollution in residential dwellings and potential mitigation strategies to address these sources.

This report will cover the following aspects:

- a) A review of grey and published literature to identify sources of indoor air pollution in residential dwellings.
- b) A review of grey and published literature to identify potential mitigation strategies for sources of indoor air pollution identified in a).

The following considerations are outside the scope of the current review:

- Assessment of potential health effects associated with inhalation of the various contaminants identified in this report. This report intentionally avoids discussing the potential health effects of the various identified pollutants as there is no assertion that any of those identified pose a risk to human health, particularly due to the absence of standardised concentration data.
- Pollutants specifically associated with allergies (eg, pollen, triggers of hypersensitivity pneumonitis).
- Indoor air pollutants specifically associated with community buildings (eg, schools, daycares, libraries) and workplaces.
- Pollutants associated with consumption of illicit substances (eg, cannabis, methamphetamine).
- Microbial pollutants (eg, bacteria, fungi, viruses). Indoor air pollution specifically associated with mould which will be addressed in a separate report.
- An assessment of the influence of outdoor air pollution on indoor air quality.

In occupied residential environments, it is challenging to attribute indoor pollution to any single source because households typically contain a complex mixture of emission contributors. Although some studies employ various methods to apportion pollutants among different sources, these approaches remain difficult to apply with precision. Therefore, where possible, this report draws on data generated from controlled experiments such as single-source test chambers where the influence of other contributing sources is minimised. Furthermore, experimental designs vary considerably between studies, making direct comparisons of emission levels problematic. For this reason, the report does not focus on absolute concentrations or emission rates. Instead, it evaluates the types of compounds most frequently emitted by different sources. Importantly, although individual pollution sources are identified in this report, their standalone contributions are often insufficient to cause measurable health effects. Instead, it is the combined influence of pollutants emitted from multiple sources that typically determines overall indoor air quality and associated risks. The aim of this study is to identify the sources that, in combination, contribute most significantly to indoor air pollution.

In terms of mitigation strategies, this report will primarily focus on measures tailored to the specific source of interest, rather than broader interventions such as installing ventilation systems or air purifiers.

2. BUILDING MATERIALS AND SOFT FURNISHINGS

Building materials are a major source of VOCs in indoor air, contributing as much as 90% of the total VOCs present (Fan et al, 2025; Kang et al, 2013; Kim and Cho, 2013). Emissions vary considerably between different building materials (Shin and Jo, 2013). For example, a study of new apartments in Dubai found wallpaper and wallpaper adhesive had the highest formaldehyde emissions, whilst total VOC emissions were highest for tile and tile adhesives (Jung et al, 2021). Another study conducted in Dubai found emission of formaldehyde was higher from flooring materials compared to wallpaper (Arar et al, 2022). A separate Chinese study found xylene levels were highest in rooms with tile or stone floors compared to solid wood or laminate wood floors (Zhou et al, 2023). Total VOC emissions were also higher for composite wood floors compared to solid wood floors. Additionally, in their study of emissions by different building materials, Kim and Cho (2013) reported that tile adhesive produced the greatest VOC emissions, eight times more than medium-density fibreboard (MDF) and 36 times more than wallpaper. They also found that low-VOC tile adhesive released only 1.2% of the emissions of conventional adhesive (Kim and Cho, 2013).

VOC emissions also vary greatly depending on the age of the building, with new and renovated buildings having substantially higher VOC emissions compared to established buildings (Brown, 2002; Wang et al, 2024). This was illustrated by a longitudinal study conducted in Korea in which VOCs measured monthly for 24 months following building completion steadily decreased (Shin and Jo, 2013). However, studies have also highlighted the potential for long-term VOC emissions from building materials, leading to chronic, low-level exposure (Brown, 2002; Wang et al, 2024).

In addition to primary VOCs emitted by building materials, interactions between building materials and reactants such as ozone can also lead to the formation and emission of secondary VOCs (Wang and Morrison, 2006). For example, Wang and Morrison (2006) demonstrated that exposure of carpet and a kitchen countertop in a residential house to ozone using an open-based experimental chamber induced emission of a range of aldehydes including formaldehyde, propanal, pentanal, hexanal, heptanal, octanal, nonanal, decanal and 2-nonenal.

VOCs can also adsorb onto building materials such as wallpaper and leather and desorb back into the air over time, impacting indoor air quality (Kang et al, 2013; Ma et al, 2025). A recent study also showed that emissions of VOCs and aldehydes from several different commonly-used building materials (including some marketed as low-VOC) substantially increased at higher temperatures (35°C versus 26°C), suggesting climate change could lead to increased exposure to these pollutants (Chepaitis et al, 2024).

Several studies directly assessed the VOCs emitted by various building materials using a range of experimental setups including microchambers and test cells, small-scale experimental chambers, an experimental room and passive samplers deployed in residential dwellings. Results of these studies are presented in Appendix Table 11. The most commonly detected compounds (although not necessarily present in the highest amounts) emitted by flooring materials and other building materials and soft furnishings are presented in Table 1 and Table 2 respectively.

Table 1 Top 11 most common VOCs emitted by flooring materials in assessed studies

Compound	Chemical class
Formaldehyde	Aldehyde
Acetaldehyde	Aldehyde
Acetone	Ketone
Nonanal	Aldehyde
Xylene	Aromatic hydrocarbon
Toluene	Aromatic hydrocarbon
α -pinene	Terpene
Acetic acid	Carboxylic acid
Decanal	Aldehyde
Hexanal	Aldehyde
Octanal	Aldehyde

Table 2 Top 10 most common VOCs emitted by other building materials and soft furnishings in assessed studies

Compound	Chemical class
Formaldehyde	Aldehyde
Xylene	Aromatic hydrocarbon
Acetaldehyde	Aldehyde
Toluene	Aromatic hydrocarbon
Hexanal	Aldehyde
Limonene	Terpene
Ethylbenzene	Alkylbenzene
α -pinene	Terpene
Styrene	Aromatic hydrocarbon
Benzene	Aromatic hydrocarbon

Several compounds are commonly emitted by building materials and soft furnishings including formaldehyde, acetaldehyde, xylene, toluene, hexanal and α -pinene.

Formaldehyde and acetaldehyde are typically linked to wood-based composites such as plywood, MDF, and particleboard because of the resins used in their production (Kim et al, 2006; Pibiri et al, 2020). Xylene and toluene often indicate the presence of petrochemical-derived materials like plastics, paints and resins¹. In contrast, α -pinene is a natural terpene found in wood, making it a characteristic emission from wood-based products (Harman-Ware et al, 2016). Hexanal, an aldehyde, can form through the oxidation of fatty acids present in wood materials (Baumann et al, 2000).

In addition to VOCs, several studies have also reported emissions of SVOCs from building materials – particularly phthalates and flame retardants. For example, Liang and Xu (2014) found di(2-ethylhexyl) phthalate (DEHP), diisononyl phthalate (DINP), benzyl butyl phthalate (BBP), di(2-ethylhexyl) isophthalate (iso-DEHP) and di-n-butyl phthalate (DnBP) were emitted by vinyl flooring. Similar results were reported by Lin et al (2021) who assessed emissions of phthalates from six different flooring materials (regenerated pseudoplastic

¹ https://www1.eere.energy.gov/manufacturing/resources/chemicals/pdfs/profile_chap4.pdf Accessed 13 November 2025

rubber flooring, healthy pseudoplastic imitation wood floor, regenerated pseudoplastic rubber flooring, PVC floor tile/floor, plastic click floor, composite floor covered with carpet), and detected nine different phthalates - DEHP, DINP, di-n-octylphthalate (DNOP), BBP, dibutyl phthalate (DBP), diisobutyl phthalate (DIBP), diethyl phthalate (DEP), and dimethyl phthalate (DMP). However, the authors noted that emissions at normal room temperature (25°C) were only 0.01 – 1.2% of that at high temperature (220°C) and suggest that they are “unlikely to be volatilized or emitted at normal temperature” (Lin et al, 2021).

A 2014 report from the US National Institute of Standards and Technology reported the detection of the flame retardant tris (1-chloro-2-propyl) phosphate (TCPP) in emissions from spray polyurethane foam used for insulation (Poppendieck et al, 2014).

2.1. CARPET

Carpets have received considerable attention with respect to their impact on indoor air quality. There are three main ways in which carpets can influence indoor air quality: direct emission of air pollutants (eg, VOCs); adsorption of pollutants from the air which then react with carpet materials to produce secondary air pollutants (also referred to as transformation); and the sink effect where pollutants adsorb to the carpet and can then be desorbed at a later stage, impacting air quality (Figure 2) (Najafabadi et al, 2022). Indeed, carpet can be a reservoir for a range of biological and nonbiological pollutants including dust, dirt, allergens and microorganisms which can be resuspended by activity within the carpeted area (eg, walking, vacuuming) (Becher et al, 2018).

With respect to direct emissions of VOCs from carpet, according to the Carpet Institute of Australia, during the manufacturing process carpet is heated in a finishing oven at 150 - 170°C to evaporate off most of the VOCs². They also note that approximately 90% of VOCs dissipate within two days of the carpet being installed. Emission of VOCs from carpets also varies depending on the constituent materials (Abbass et al, 2017).

² https://www.carpetinstitute.com.au/wp-content/uploads/2014/02/indoor_quality1.pdf Accessed 6 November 2025

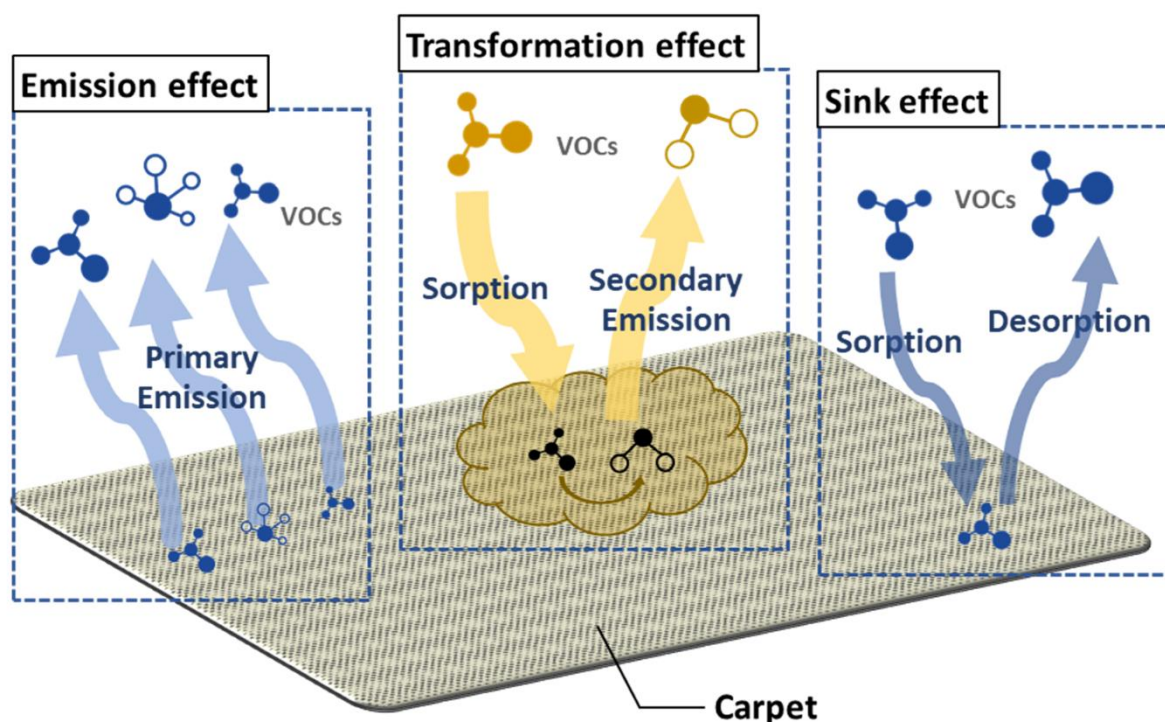


Figure 2 Main ways in which carpets can impact indoor air quality

Reproduced from Najafabadi et al (2022)

2.2. MITIGATION STRATEGIES

A range of approaches to mitigate indoor air pollution caused by building materials and soft furnishings are being developed. These include low-VOC emission materials, passive removal materials (eg, VOC-adsorptive paints), and pretreatments to remove pollutants prior to habitation of the new/renovated environment.

Several studies have demonstrated the effectiveness of low-VOC emission materials. For instance, Kim and Cho (2013) reported that a low-VOC tile adhesive released only 1.2% of the emissions produced by conventional adhesive. Similarly, Simon et al (2020) found that a chemical adhesive-free fibreboard made from coriander emitted formaldehyde at levels 300–600 times lower than standard MDF and chipboard. In another study, Na et al (2014) observed that renovating 24 homes with environmentally friendly wallpaper and flooring significantly reduced formaldehyde concentrations—dropping to 63% of the initial level by week 10. Although total VOCs initially decreased, they rebounded by the tenth week. It is important to note, however, that while low-VOC materials can reduce emissions, they may still adsorb pollutants from the air and later re-emit them (Kang et al, 2013).

A variety of passive removal materials are being developed to enhance indoor air quality. These materials generally fall into two categories: photocatalytic oxidation-based and sorptive-based. Photocatalytic materials such as wallpapers, paints, and cements infused with catalysts like titanium dioxide (TiO_2) work by transforming harmful pollutants into harmless compounds (Shayegan et al, 2022). For example, a TiO_2 -based photocatalytic paint applied in a lecture hall at the University of Madrid significantly reduced NO_2 levels, as

measured by passive samplers, and the effect persisted for over a year (Nieto-Márquez et al, 2023). Sorptive materials, on the other hand, remove pollutants by capturing them on their porous surface (Shayegan et al, 2022). A notable example is a toluene-adsorptive paint evaluated by Jeon et al (2020), which successfully removed 96.3% of the toluene present in an apartment's indoor air.

Two key strategies have been proposed to reduce emissions from building materials in new or renovated residential dwellings. The first, known as the bake-out approach, involves temporarily raising indoor temperatures to accelerate the curing of adhesives, paints, and other finishing materials (Mahmoud and Jung, 2023). This method, however, offers limited benefits unless paired with mechanical ventilation. The second strategy, evaluated by Lee et al (2024), entails flushing new buildings with outdoor air. Their study found that maintaining a ventilation rate of 0.7 air changes per hour (ACH) for nine days reduced formaldehyde emissions by 61% and total VOC emissions by 41%.

3. CLEANING PRODUCTS

In 2009/2010, Statistics New Zealand reported that New Zealanders 15 + devote an average of around 2 hours per day to household tasks³. A significant portion of this time is likely allocated to activities involving the use of cleaning products, such as surface cleaning and disinfection. Many cleaning products contain VOCs either as an active ingredient or as a fragrance (Singer et al, 2006a). During usage of these products, these compounds volatilise, polluting the surrounding air, leading to potential inhalation exposure, as shown in Figure 3.

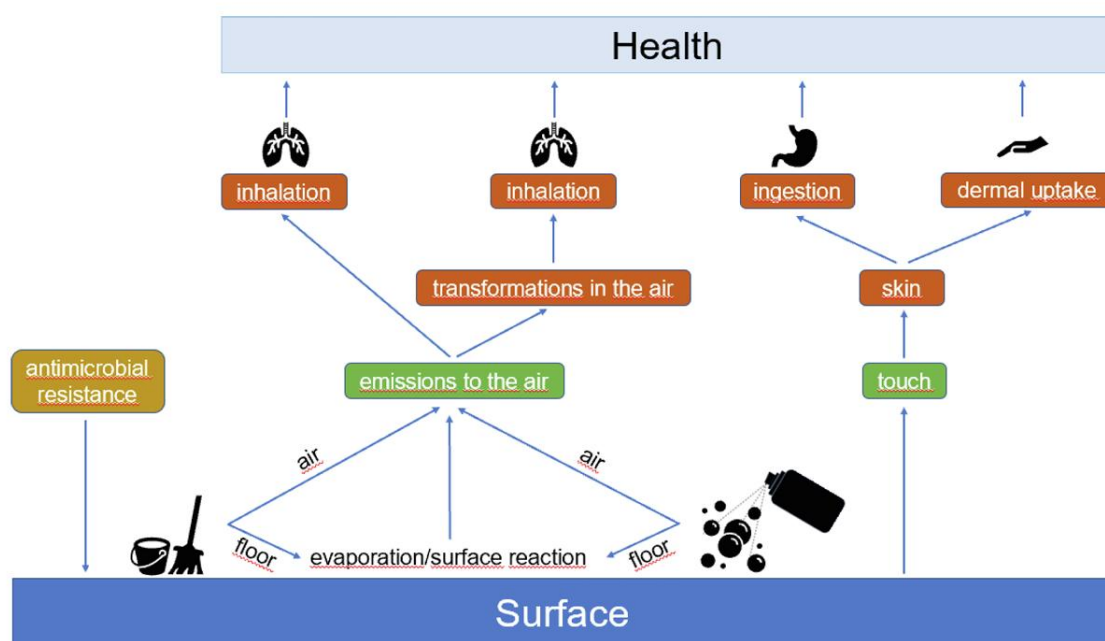


Figure 3 Pathways for exposure to chemicals emitted during surface cleaning

Reproduced from Salonen et al (2024).

In the case of bleach (sodium hypochlorite)-containing products, the chloride may also react with organic components of the cleaner to produce halogenated VOCs, which may pose a greater health risk than the original chemicals (Ayri et al, 2020). Additionally, some VOCs react with oxidants present in the air and on surfaces, such as ozone and hydroxyl radicals to form secondary pollutants (transformation) (Moses, 2025). However, it is unclear to what extent reaction of VOCs with ozone would occur in New Zealand as ground-level ozone concentrations are generally low⁴. Although, Huang et al (2012) has reported the formation of secondary pollutants from reaction of terpenes with ozone even at low ozone concentrations (17.2–21.4 ppb). A 2013 study of 25 new houses in Korea estimated that around 30% of indoor VOCs could be attributed to household cleaning products (Shin and Jo, 2013). Chemicals emitted during cleaning activities can impact indoor air quality for some

³ <https://www.stats.govt.nz/services/customised-data-services/statistics-for-university-staff-and-students/time-use-survey-200910-supplementary-tables/> Accessed 21 October 2025

⁴ [Ground-level ozone concentrations: Data to 2023 | Stats NZ](#) Accessed 11 May 2025

time after cleaning is finished. For example, Bello et al (2010) found that following a 10-minute cleaning task, total VOC levels remained elevated for 20 minutes. Schwarz et al (2017) reported that following use of a monoethanol amine (MEA)-containing kitchen degreaser, emission of transformation products (MEA)₂SO₄ and (MEA)NO₃ persisted for at least 60 hours, despite high ventilation. Similarly, Sweet et al (2025) noted that following use of a carpet cleaner direct emissions of 2-butoxyethanol persisted for several days.

Numerous studies have assessed the VOCs emitted by cleaning products, as detailed in Appendix Table 12 and summarised in Table 3 for regular cleaning products and Table 4 for cleaning products marketed as 'green'. Several products emitted many different VOCs, a number of which are known to be toxic or hazardous (Steinemann, 2015; Temkin et al, 2023). Importantly, Steinemann (2015) note that less than 3% of the VOCs emitted by the fragranced cleaning products assessed in their study were disclosed on the product label or material safety data sheet (MSDS).

Table 3 Top 12 most common VOCs emitted by 'regular' household cleaning chemicals in assessed studies

Compound	Chemical class
Limonene	Monoterpene
Acetaldehyde	Aldehyde
Eucalyptol	Monoterpene ether
Decanal	Aldehyde
α-pinene	Monoterpene
TXIB	Ester
Ethanol	Alcohol
Acetic acid	Carboxylic acid
Camphene	Monoterpene
Cetane	Alkane hydrocarbon
Formaldehyde	Aldehyde
β-pinene	Monoterpene

Table 4 Top 12 most common VOCs emitted by 'green' household cleaning chemicals in assessed studies

Compound	Chemical class
Limonene	Monoterpene
Ethanol	Alcohol
β-myrcene	Monoterpene
β-ocimene	Monoterpene
Acetone	Ketone
Acetaldehyde	Aldehyde
Eucalyptol	Monoterpene ether
α-pinene	Monoterpene
Camphene	Monoterpene
Terpinolene	Monoterpene
α-phellandrene	Monoterpene
β-phellandrene	Monoterpene

Most compounds listed in Table 3 and Table 4 are fragrance-related VOCs, predominantly terpenes and structurally related molecules. These substances are commonly derived from essential oils and are intentionally added to cleaning formulations to impart a pleasant scent. They include limonene which provides a citrus scent and also acts as a degreaser⁵; eucalyptol, the fragrant compound associated with eucalyptus (Salehi et al, 2019); α - and β -pinene which impart a pine-like fragrance⁶; terpinolene which provides a sweet, piney citrus fragrance⁷; camphene⁸ and β -ocimene⁹ which confer a woody scent and herbaceous, citrusy scent respectively ; β -myrcene which imparts a floral citrus aroma (González-Mas et al, 2019); α - and β -phellandrene which confer a citrus, black-pepper like and minty fragrance respectively^{10,11}; and decanal which gives a waxy, citrus odour¹². Acetone and ethanol are both solvents used in many cleaning products. Ethanol is often also employed for its disinfectant properties, and its oxidation leads to the presence of acetaldehyde¹³. Formaldehyde may be present due to its role as a preservative to prevent microbial contamination of cleaning products (Lynn et al, 2024). TXIB (2,2,4-trimethyl-1,3-pentanediol diisobutyrate) is a plasticiser that may be used to control the viscosity of cleaning products¹⁴. Lastly, acetic acid may be added as a disinfectant (Zinn and Bockmühl, 2020) or for its ability to dissolve mineral deposits¹⁵.

In recent years, 'green' cleaning products have gained popularity, largely due to the perception that they are safer for human health and the environment. However, there is currently no robust evidence to suggest that these products improve indoor air quality (Harding-Smith et al, 2024). Studies reviewed for this report indicate considerable overlap in the types of chemicals emitted by conventional and 'green' cleaning products. Temkin et al (2023) found that 'green' products generally emitted lower concentrations of VOCs and fewer hazardous VOCs compared to regular products. In contrast, Steinemann (2015) found that emissions of carcinogenic hazardous air pollutants from fragranced 'green' products were not significantly different from those of regular fragranced products. Furthermore, Harding-Smith et al (2024) observed that 'green' products generally emitted more monoterpenes than conventional products, which can lead to increased formation of secondary pollutants such as formaldehyde. Although, the most reactive monoterpenes such as terpinolene and α -phellandrene were detected more frequently from standard products.

⁵ <https://icccitrus.com/what-is-d-limonene/> Accessed 20 November 2025

⁶ <https://www.nbinno.com/article/synthetic-flavors-and-fragrances/comparing-beta-pinene-alpha-pinene-sourcing-applications-do> Accessed 20 November 2025

⁷ <https://www.thegoodscentscompany.com/data/rw1007171.html> Accessed 24 November 2025

⁸ <https://www.nbinno.com/article/other-organic-chemicals/camphene-cas-79-92-5-a-fine-chemical-for-fragrance-and-flavor-innovations-ms> Accessed 20 November 2025

⁹ <https://www.scentspiracy.com/fragrance-ingredients/p/ocimene> Accessed 24 November 2025

¹⁰ <https://www.thegoodscentscompany.com/data/rw1009891.html> Accessed 24 November 2025

¹¹ <https://www.thegoodscentscompany.com/data/rw1103551.html> Accessed 24 November 2025

¹² <https://www.benscents.com/aromaversity/cas-library-numbers/a-cas-numbers/aldehyde-c-10-decanal-112-31-2> Accessed 20 November 2025

¹³ <https://pubchem.ncbi.nlm.nih.gov/pathway/PathBank:SMP0000449> Accessed 20 January 2026

¹⁴ <https://www.nbinno.com/plasticizers/understanding-the-benefits-of-224-trimethyl-13-pentanediol-diisobutyrate-as-a-coalescing-agent-pm> Accessed 20 November 2025

¹⁵ <https://www.brothersplumbing.ca/blog/limescale-prevention/how-to-remove-limescale-and-prevent-it-from-coming-back/> Accessed 24 November 2025

An assessment of several fragrance-free products found these emitted significantly lower levels and numbers of VOCs compared with regular cleaning products (Temkin et al, 2023).

3.1. MITIGATION STRATEGIES

There are several approaches which can be taken to minimise indoor air pollution associated with cleaning products. These include:

- Using cleaning products labelled as 'green', 'low-VOC', or 'fragrance-free' as they generally emit fewer VOCs compared to regular products (Temkin et al, 2023).
- Employ homemade cleaning solutions consisting of non-toxic ingredients such as white vinegar and baking soda which offer effective cleaning while minimising chemical emissions. Vinegar acts as a mild disinfectant and deodoriser, while baking soda provides gentle abrasion and odour neutralisation. However, care should be taken when incorporating essential oils into homemade solutions as some release VOCs that react with ozone to form toxic secondary pollutants such as formaldehyde (Huang et al, 2012).
- Overuse of cleaning products should be avoided to minimise release of VOCs (Salonen et al, 2024).
- Increase ventilation by opening windows or using exhaust fans during and after cleaning activities to disperse airborne pollutants. As noted above, VOC levels may remain elevated for some time after cleaning ceases so ensure ventilation is maintained for an adequate period after cleaning.
- Avoid mixing different cleaning products (eg, bleach and ammonia) as this may generate toxic gases such as chloramines¹⁶. Bleach-containing products should never be mixed with any other cleaning product.
- For frequently used products, purchase ready-to-use rather than concentrated solutions to minimise exposure to concentrated VOC emissions (Salonen et al, 2024).
- Ensure cleaning tools (eg, cloths, mops) are promptly washed after usage to avoid prolonged emission of VOCs. Also ensure that cleaning products are securely closed and stored safely.

¹⁶ <https://www.turi.org/dangers-of-mixing-common-chemical-products/> Accessed 25 November 2025

4. ELECTRONIC EQUIPMENT

Research on indoor air pollution from electronic equipment has traditionally focused on offices and other workplace environments. However, the rise of remote work has introduced devices such as laser printers and photocopiers into homes, impacting indoor air quality. Additionally, the growing popularity of emerging technologies such as desktop three-dimensional (3D) printers is adding to the burden of electronics-associated indoor air pollution. Emissions can vary with device age, operating temperature and the diversity of materials used in modern electronics. In many cases, the smaller nature of home environments compared to the workplace means occupants are often in closer proximity to electronic devices.

A variety of pollutants are emitted by electronic equipment including VOCs, SVOCs (eg, PAHs), particulate matter and ultrafine particles (Destailats et al, 2008). This section provides an overview of current knowledge on indoor air pollution linked to the most extensively studied electronic devices – computers, televisions, printers, and 3D printers. Specific details on emissions from assessed studies are provided in Appendix Table 13.

4.1. COMPUTERS AND TELEVISIONS

Computers and televisions are well-documented sources indoor air pollutants including VOCs, PAHs and dust-associated flame retardants and heavy metals. These pollutants arise from display materials, polymer housings, circuit boards, adhesives, and wiring insulation, and are influenced by device design and operating conditions (eg, temperature).

A recent study found that over 30 different VOCs were emitted from the liquid crystal displays (LCDs) of a computer monitor, laptop and television, with the most abundant being acetic acid, isoprene, nonanal, 1,9-nonanediol and cyclohexene (Liu and Abbatt, 2021). Emissions were found to be humidity-sensitive, increasing up to nine-fold when the relative humidity rose from 23% to 58% (Liu and Abbatt, 2021). Ten different liquid crystal monomers (LCMs) were also found to be emitted by the assessed devices.

Seo et al (2022) assessed the emission of PAHs by computers by sampling air collected from inside these devices and found that naphthalene and phenanthrene were the dominant emitted compounds, with eight others also detected. The levels of these compounds were also found to be 2 – 25 times higher in rooms with computers (office, computer room, server room) compared to a room with no computer. Emissions were generally higher when the computers were running, but overall PAH emissions were found to decrease as the devices aged.

Computers and televisions have also been linked to emission of flame retardants, which are commonly present in printed circuit boards, microprocessor packaging, and plastic casings (Rauert et al, 2014). Several flame retardants have been identified in dust samples collected from the inside and exterior surface of personal computers, with BDE 209, decabromodiphenyl ethane (DBDPE) and triphenyl phosphate (TPHP) being the highest in interior dust samples and tris(2-chloroisopropyl) phosphate (TCIPP), TPHP, and DBDPE the highest in exterior dust samples (Yu et al, 2021). The presence of these pollutants in dust is significant because they can easily become airborne, particularly when the devices' cooling

fan is operating, leading to inhalation. Interestingly, Zhang et al (2009) found that replacing an old computer with a newer one led to an 80% reduction in polybrominated diphenyl ether (PBDE) flame retardant levels in the air.

A study of dust collected on LCD and cathode ray tube (CRT) screens identified the presence of a number of heavy metals including chromium, lead, copper, cadmium and mercury (Vosoughi et al, 2021), which similar to the flame retardants discussed above may easily be aerosolised and inhaled.

4.2. PRINTERS

Printers emit a variety of different air pollutants, referred to as printer emitted particles (PEPs), including toner particles released into the air, VOCs, and SVOCs (Wang and Wang, 2024). Emitted toner particles may include atomised toner – extremely fine toner particles aerosolised during the printer process, and fugitive toner – larger toner particles unintentionally released into the air due to mechanical leakage or during maintenance. Toner particles may then condense to reform original particles, and the VOCs and SVOCs can react with ozone to produce secondary pollutants. Several factors are likely to influence emissions, including printer age, maintenance state and paper type¹⁷.

Several studies have focused on characterisation of particulate matter released by printers. For example, Zou et al (2022) detected emitted particles ranging from 15.8 – 949 nm and observed that the amount of particles released varied depending on the printer and amount of toner used. They also noted that most emitted particulate matter decayed within 1 h after printing, although the rate of decay varied depending on particle size. Serfozo et al (2018) focused on nanoparticle emissions (particles predominantly < 50 nm) and found these were primarily emitted during ‘cold startup’ of the printer. Wang et al (2016) focused on emission of ultrafine particles < 0.1 µm, noting that emissions increased with increasing toner coverage. Emissions rose with increasing fuser temperature, likely due to elevated toner evaporation at higher temperatures. Similar to Serfozo et al (2018), they also observed an ‘initial start effect’, with high emissions from the first job of the day even with 0% toner coverage. It is hypothesised that this is due to SVOCs which had diffused to other parts of the printer overnight as the machine cooled becoming re-evaporated as the fuser heated up. A recent conference paper highlighted that emissions of particulate matter are considerably higher from laser printers compared to inkjet printers, with 2.5 – 3.8 times more particles emitted during printing and 12.8 - 15.9 times more emitted after printing (Paegle et al, 2021). A variety of VOCs have also been shown to be emitted by desktop printers, with Kowalska et al (2015) identifying a range of VOCs in emissions from two laser printers, an inkjet printer and a multi-function device, with trimethylbenzene and xylenes emitted at the highest levels.

4.3. DESKTOP 3D PRINTERS

The popularity of desktop 3D printers has surged in recent years, and as these devices have become more affordable their prevalence in the home environment has increased. These devices emit a range of pollutants which vary depending on the filament material used (eg,

¹⁷ https://www.iagip.wki.fraunhofer.de/en/all_topics/laserprinter.html Accessed 12 January 2026

acrylonitrile butadiene styrene (ABS) or polylactic acid (PLA)) and the printing method (eg, material extrusion or vat photopolymerisation) (Baguley et al, 2025).

Several studies have assessed the VOCs emitted by desktop 3D printers, as detailed in Appendix Table 13 and summarised in Table 5 below. Emissions vary not only based on the filament material but also the brand (Finnegan et al, 2023). Emissions also vary between different printer models using the same filament (Azimi et al, 2016).

Table 5 Top 10 most common VOCs emitted by desktop 3D printers

Compound	Chemical class
Nonanal	Aldehyde
Styrene	Aromatic hydrocarbon
Octanal	Aldehyde
Ethylbenzene	Alkylbenzene
Caprolactam	Lactam
Octane, 4-methyl	Alkane
Decanal	Aldehyde
2-ethyl-1-hexanol	Alcohol
Heptane, 2,4-dimethyl	Alkane
Nonane, 2,6-dimethyl	Alkane

Several studies have focused on emission of particulate matter by desktop 3D printers. Finnegan et al (2023) observed that both the amount and size of particles released varied depending on the filament used (both material and colour) (as shown in Figure 4). Mendes et al (2017) observed a burst of nanoparticle emissions when the extruder reaches the materials' melting point, after which particle emissions stabilise. They also observed that particle emissions increased at higher printing temperature. A separate study by Yi et al (2016) observed that ABS filaments emitted larger particles compared to PLA filaments. They also found that the amount and size of particles emitted varied significantly between different coloured filaments of the same type. Importantly, they found that a cover over the printer reduced total particle emissions two-fold.

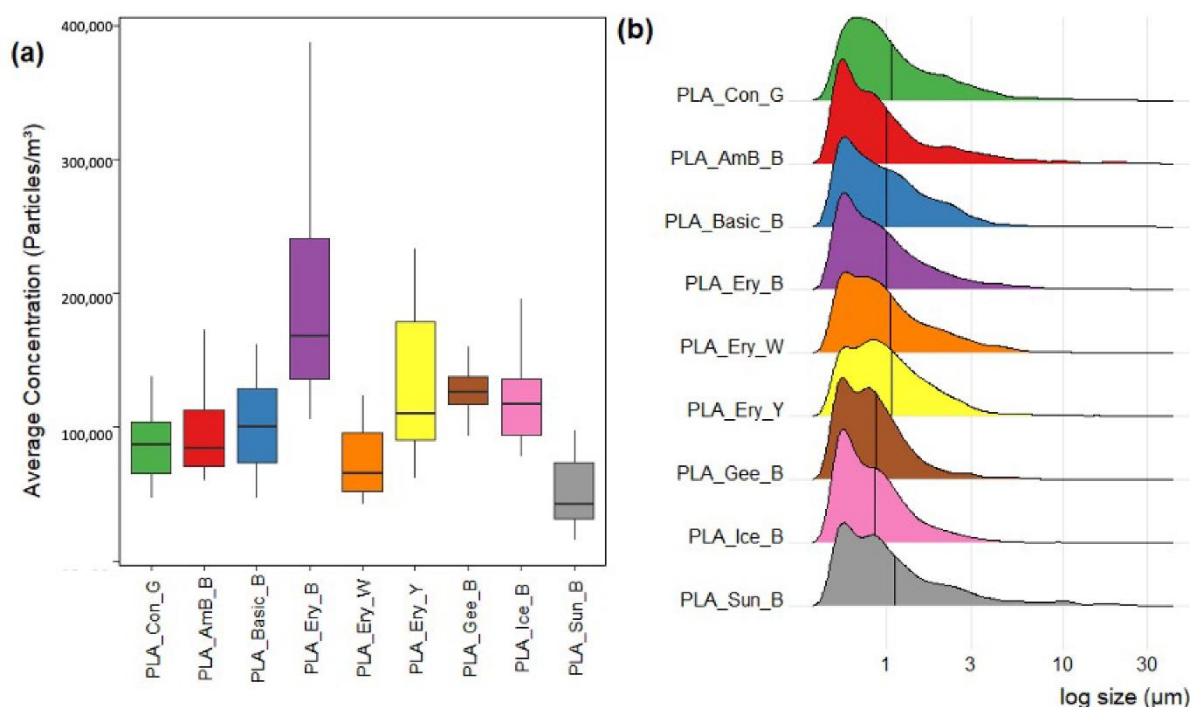


Figure 4 Emission of particulate matter by a desktop 3D printer

Reproduced from Finnegan et al (2023).

4.4. MITIGATION STRATEGIES

There are several approaches which can be taken to minimise indoor air pollution associated with electronic devices, particularly printers and 3D printers. These include:

- Operate printers and 3D printers in well-ventilated areas to allow for dispersal of pollutants. Do not operate in small living areas such as bedrooms where pollutants may build up.
- If several devices are being run within a confined space, an air purifier with high-efficiency particulate air (HEPA) and activated carbon filters is recommended to remove particulate matter and VOCs.
- Choose a 3D printer which has been certified as producing lower emissions¹⁸.
- Operate 3D printers in a sealed enclosure with ventilation and a filtration system to remove gas and particle emissions (Azimi et al, 2017). In the absence of a sealed enclosure, a cover provides some protection, with Yi et al (2016) noting that usage of a manufacturer-provided plastic cover which rests atop the device reduced particle emissions by a factor of 2. Do not remain close to the printer watching as it works as this will increase exposure to pollutants¹⁹.

¹⁸ https://www.uvm.edu/d10-files/documents/2024-12/3DPrintersandAirQualityHigherEd_062022.pdf
Accessed 25 November 2025

¹⁹ https://www.uvm.edu/d10-files/documents/2024-12/3DPrintersandAirQualityHigherEd_062022.pdf
Accessed 25 November 2025

- Ensure 3D printers are operated with the extrusion nozzle at the lowest temperature possible to minimise VOC and particle emissions²⁰.
- When using a 3D printer, choose low-emitting filament materials where possible. In general, emissions from PLA filaments are lower than ABS or nylon²¹. It has also been recommended that manufacturers “work toward designing low-emitting filament materials and/or printing technologies” (Azimi et al, 2016).
- When 3D printing is completed, clean up any filament build up from the nozzle and build plate and wipe down the device with a wet cloth to remove settled particulate matter²².

²⁰ https://www.uvm.edu/d10-files/documents/2024-12/3DPrintersandAirQualityHigherEd_062022.pdf
Accessed 25 November 2025

²¹ https://www.uvm.edu/d10-files/documents/2024-12/3DPrintersandAirQualityHigherEd_062022.pdf
Accessed 25 November 2025

²² https://www.uvm.edu/d10-files/documents/2024-12/3DPrintersandAirQualityHigherEd_062022.pdf
Accessed 25 November 2025

5. AIR FRESHENERS

Air fresheners are consumer products which emit a fragrance to mask an odour and/or impart a pleasant aroma to an indoor space (Steinemann, 2017). They come in a range of forms including sprays, oils, gels, beads, scented candles, wick diffusers and potpourri (Steinemann, 2017). In many cases, the exact composition of air fresheners is not disclosed (Steinemann, 2009). Indeed, according to Steinemann (2017), there are no laws which require disclosure of all the ingredients that contribute to a products fragrance, which may include dozens or even hundreds of different chemicals. Often, fewer than 10% of the VOCs contained within an air freshener are disclosed on the label or MSDS (Steinemann, 2017).

Air fresheners emit a variety of chemicals that impact indoor air quality including VOCs (eg, terpenes, terpenoids) and SVOCs (eg, phthalates) (Steinemann, 2017). Chemicals emitted from air fresheners can also react with oxidants in the air such as ozone to produce secondary pollutants (Steinemann, 2017)

This section will provide an overview of indoor air pollutants associated with the most well-studied air freshener forms – candles and wax melts, incense, essential oil diffusers and aerosol sprays.

5.1. CANDLES AND WAX MELTS

Burning of candles has been associated with the release of a wide range of air pollutants including carbon monoxide, nitrogen oxides, PAHs and aldehydes (Derudi et al, 2014). In recent years, scented wax melts have become a popular alternative to traditional candles and incense, being viewed as safer and nontoxic (Patra et al, 2025). However, Patra et al (2025) note that terpenes emitted by scented wax melts react with atmospheric ozone, leading to indoor nanoparticle concentrations similar to those emitted by traditional, combustion-based scented wax candles.

When candles burn, they emit a range of gaseous products from both combustion and evaporation of fragrance compounds (Salthammer et al, 2021). Complete combustion primarily produces CO₂ and water, while incomplete combustion generates carbon monoxide, elemental carbon (also referred to as black carbon or soot), and hydrocarbons (Salthammer et al, 2021). The heat of the candle flame also causes oxygen and nitrogen present in the air to react to form NO₂ (Salthammer et al, 2021). Fragrance molecules can evaporate from the molten wax or be drawn into the wick and combust, contributing to CO₂ and other by-products (Salthammer et al, 2021).

Candle burning releases a variety of VOCs and SVOCs as detailed in Appendix Table 14 and summarised in Table 6. Emissions are generally significantly higher from scented candles than unscented ones (Salthammer et al, 2021). Emission profiles vary widely between different candles, particularly for compounds such as benzene, toluene, ethylbenzene, xylenes and PAHs, likely due to differences in raw wax materials (Derudi et al, 2012). Emissions of aldehydes have been shown to be more closely linked to candle additives (Derudi et al, 2012). Scented candles and wax melts also emit a variety of terpenes and monoterpenoids, with wax melts showing higher monoterpene levels than candles (Liu

et al, 2024). Scented candles can also release fragrance compounds even when unlit (Uhde and Schulz, 2015).

Table 6 Top 10 most common VOCs/SVOCs emitted by candles

Compound	Chemical class
Toluene	Aromatic hydrocarbon
Formaldehyde	Aldehyde
Benzene	Aromatic hydrocarbon
Ethylbenzene	Alkylbenzene
Phenanthrene	Polycyclic aromatic hydrocarbon
Fluoranthene	Polycyclic aromatic hydrocarbon
Acetaldehyde	Aldehyde
Naphthalene	Polycyclic aromatic hydrocarbon
Anthracene	Polycyclic aromatic hydrocarbon
Xylenes	Aromatic hydrocarbon

In addition to emission of gaseous pollutants, burning of candles is a well-recognised source of particulate matter. Immediately after lighting, concentrations of ultrafine particles (6–60 nm) are observed to rise sharply (Salthammer et al, 2021). Particle emissions are generally highest during the initial burning phase, due at least in part to rapid release of additives present in the exposed wick (Rasmussen et al, 2021). Under steady burning conditions, particle emissions are dominated by ultrafine particles mostly consisting of inorganic compounds (Rasmussen et al, 2021). Under stressed burning conditions (eg, flickering caused by airflow), particle emissions are dominated by black carbon (Andersen et al, 2021). This emission of black carbon, as well as particulate matter (PM_{2.5}) and particle-phase PAHs under stressed burning conditions is ‘strongly influenced’ by the wick and wax composition (Andersen et al, 2021).

5.2. INCENSE

Incense refers to a variety of aromatic materials that release fragrant smoke when burned. Traditionally composed of plant-based substances such as resins, herbs, and essential oils (Yadav et al, 2020), incense is often shaped into sticks, cones, or coils for ease of use. In residential settings, incense is primarily used for its pleasant aroma and is commonly associated with cultural, religious, and ceremonial practices. Beyond these purposes, many households also burn incense for relaxation, meditation, or to mask unwanted odours.

Burning of incense has been associated with several different classes of indoor air pollutants including particulate matter, VOCs and combustion-related gases (eg, carbon monoxide, CO₂, NO₂). A number of studies have highlighted the contribution of incense burning to particulate matter present in indoor air (Cohen et al, 2013; Goel et al, 2021; Guo et al, 2020; See and Balasubramanian, 2011; Thinh et al, 2022; Yang et al, 2024). Thinh et al (2022) found that PM concentrations increase rapidly within the first 15 minutes of incense being lit, then levels stabilise before decreasing gradually once burning ceases. Both Thinh et al

(2022) and Yang et al (2024) highlight the importance of ventilation in reducing PM levels associated with incense burning, with both studies showing ventilation can decrease PM levels by up to 70%, albeit after a potential initial increase in levels caused by airflow disturbing settled particles. In a separate study, Guo et al (2020) found PM levels at an in-home shrine were highest 30 minutes after incense was lit and returned to background levels 1 hour after burning ceased. With regard to particle size, Goel et al (2021) found that levels of PM₁₀ were greater than PM_{2.5}, followed by PM₁. They also found that PM_{2.5} from incense sticks was associated with the trace metals aluminium, cobalt, manganese, strontium and zinc. Kuo et al (2016) assessed PM_{2.5}-associated carboxylate emissions from incense sticks and observed that acetate accounted for around 90% of emissions, although levels varied between different incense brands. Levels of several PM_{2.5}-associated carboxylates (acetate, formate, pyruvate, glutarate, succinate, fumarate and tartarate) decreased under simulated light indicating they are photodegradable, whilst levels of malonate, maleate, oxalate and phthalate increased. The authors noted that based on this finding, it is advisable to not burn incense in poorly lit areas as light will aid degradation of the dominant acetates.

Several studies have investigated the VOCs emitted during incense burning, as detailed in Appendix Table 14 and summarised in Table 7.

Table 7 Top 10 most common VOCs emitted during incense burning

Compound	Chemical class
Benzene	Aromatic hydrocarbon
Toluene	Aromatic hydrocarbon
Formaldehyde	Aldehyde
Acetaldehyde	Aldehyde
Styrene	Aromatic hydrocarbon
Furfural	Aldehyde
Acrolein	Aldehyde
Furan	Heterocyclic aromatic compound
Isoprene	Conjugated diene
Naphthalene	Polycyclic aromatic hydrocarbon

In their assessment of 10 different incense products, Di Fiore et al (2023) found all emitted benzene and six of the 10 emitted toluene. In their assessment of 12 different incense products, including both sticks and cones, Silva et al (2021) found acetaldehyde, acrolein, furfural and furan were of the most concern. They also note that incense cones are likely a higher source of air pollutants than sticks. Thinh et al (2022) assessed four different incense products and found all emitted formaldehyde, an observation they noted may be due to anti-termite preservatives added to the incense.

In addition to VOCs, studies have also highlighted the contribution of incense burning to indoor concentrations of carbon monoxide, CO₂, and nitrogen oxides (NO_x) (Cohen et al, 2013; Goel et al, 2021).

5.3. ESSENTIAL OIL DIFFUSERS

An essential oil diffuser works by dispersing tiny droplets of essential oils into the air, creating an aromatic mist. Examples include reed diffusers, which use porous reeds to draw scented oil from a container and naturally release fragrance through evaporation and capillary action; passive diffusers, such as porous wooden balls infused with essential oils that gradually evaporate; heat diffusers, which gently warm oils to disperse their aroma; and ultrasonic diffusers, which employ high-frequency vibrations to transform water and essential oils into a fine mist, adding both fragrance and moisture to the air without heat.

Several studies have assessed emission of VOCs from various different diffusers, as detailed in Appendix Table 14. Although the exact VOCs emitted will vary depending on the essential oil added, there are some similarities. VOCs most commonly emitted by the assessed diffusers are shown in Table 8.

Table 8 Top 6 most common VOCs emitted by essential oil diffusers

Compound	Chemical class
α -pinene	Monoterpene
Limonene	Monoterpene
β -pinene	Monoterpene
Eucalyptol	Monoterpene ether
Linalool	Monoterpene alcohol
Linalyl acetate	Ester

Angulo-Milhem et al (2023) compared emissions from two types of essential oil diffusers – an electric diffuser, which releases emissions only while operating (ie, transient), and a capillarity diffuser, which emits continuously. Tea tree oil was added to both devices, and terpenoid VOC emissions were monitored. While the VOC profiles were similar across the two diffusers, the electric diffuser produced peak total VOC concentrations roughly an order of magnitude higher than the capillarity diffuser. Moreover, the time to reach steady-state concentrations differed markedly with 1 – 2 hours for the electric diffuser versus more than 15 hours for the capillarity diffuser. Similarly, Schwartz-Narbonne et al (2021) investigated emissions from an ultrasonic diffuser using four different essential oils. They observed substantial overlap in VOC species among the oils, though relative abundances varied. Particulate matter emissions also differed by oil type, both in particle size distribution and emission rates. Notably, particulate emissions increased fivefold when eucalyptus oil was diffused with tap water instead of deionised water.

5.4. SPRAY AIR FRESHENERS

Information on VOCs emitted by spray air fresheners was identified for only four products as detailed in Appendix Table 14. Of these, all were found to emit linalool and three emitted ethanol, decanal and acetic acid, in addition to several other VOCs.

5.5. MITIGATION STRATEGIES

Although there are several straight-forward approaches which can be taken to reduce indoor air pollution associated with air fresheners (eg, swapping scented candles for unscented), in many cases their purpose is to impart a pleasant aroma. As such, mitigation strategies need to balance fragrance enjoyment with reducing pollutant exposure. With this in mind, possible mitigation strategies include:

- Where possible, choose products labelled as 'low-VOC' or 'phthalate-free'.
- Increase ventilation during use to avoid accumulation of high levels of pollutants. This may include natural ventilation such as opening of doors or windows to bring in outdoor air and dilute air contaminants, and/or mechanical ventilation such as exhaust fans or ventilation systems such as those equipped with HEPA filters which remove contaminants from the air.
- Limit both the duration and quantity of product used to minimise emission of air pollutants. Additionally, avoid using multiple fragrance products simultaneously as this will not only lead to higher overall pollutant levels but may lead to additive or synergistic effects (Rádis-Baptista, 2023).
- Where possible, opt for non-combustible options rather than candles and incense to reduce emissions of PM, black carbon and combustion-related gases (carbon monoxide, CO₂, NO₂).
- Use passive rather than active diffusers as these generally emit VOCs at a lower rate and maximum air concentrations tend to be lower (Angulo-Milhem et al, 2023).
- For odour removal, choose natural odour absorbers such as baking soda and activated charcoal rather than commercial air fresheners which only mask the odour and emit a variety of air pollutants.

6. PERSONAL CARE PRODUCTS

Personal care products (PCPs) including cosmetics, skincare items, fragrances, deodorants, shampoos and baby products represent an important source of indoor air pollutants. These products are known to emit a variety of pollutants which can arise directly during product usage, via evaporation from skin and surfaces, and off gassing from stored products. Fragranced PCPs have been shown to emit numerous VOCs, many of which are not disclosed on product labels (Steinemann, 2015). Unfortunately, products labelled as 'green', 'natural' or 'eco-friendly' do not necessarily correspond to lower or fundamentally different emission profiles compared to conventional products (Nematollahi et al, 2019; Steinemann, 2015). Additionally, baby products, which are often assumed to be gentler, have also been found to emit a variety of VOCs (Nematollahi et al, 2018).

Several studies have directly assessed the VOCs emitted by PCPs as detailed in Appendix Table 15 and Table 16 and summarised in Table 9 for regular PCPs and Table 10 for PCPs labelled as 'green'. Despite this difference in marketing, a considerable overlap in commonly emitted VOCs was observed for the regular and 'green' products. Overlapping compounds include the fragrance-related monoterpenes limonene, linalool, β -pinene and eucalyptol which occur naturally in essential oils (Kumar et al, 2023) and are also common ingredients in synthetic fragrance formulas²³. Ethanol is also commonly emitted by products in both groups, likely linked related to its solvent²⁴, antimicrobial and quick-drying properties. Acetaldehyde was also commonly emitted by products in both groups and is likely related to breakdown of ethanol²⁵ and fragrance terpenes (Lee et al, 2006).

Table 9 Top 12 most common VOCs emitted by regular personal care products in assessed studies

Compound	Chemical class
Limonene	Monoterpene
Ethanol	Alcohol
Acetaldehyde	Aldehyde
Linalool	Monoterpene alcohol
Benzyl acetate	Ester
Isopropanol	Alcohol
Ethyl acetate	Ester
β -pinene	Monoterpene
Ethyl 2-methylbutyrate	Ester
Butane	Alkane
Eucalyptol	Monoterpenoid
Phenoxyethanol	Glycol ether

²³ <https://terpene-lab.com/knowledge-base/terpenes-the-secret-behind-the-fragrance-in-perfumes/> Accessed 20 January 2026

²⁴ https://www.idealchemical.com/wp-content/uploads/2017/10/Ideal_Chemical-Ethanol_for_Personal_Care_Bulletin.pdf Accessed 20 January 2026

²⁵ <https://pubchem.ncbi.nlm.nih.gov/pathway/PathBank:SMP0000449> Accessed 20 January 2026

Table 10 Top 10 most common VOCs emitted by 'green' personal care products in assessed studies

Compound	Chemical class
Limonene	Monoterpene
Ethanol	Alcohol
Linalool	Monoterpene alcohol
Acetaldehyde	Aldehyde
β -pinene	Monoterpene
Eucalyptol	Monoterpene ether
β -myrcene	Monoterpene
α -pinene	Monoterpene
Acetone	Ketone
γ -terpinene	Monocyclic monoterpene

Other compounds commonly emitted by regular products included benzyl acetate, ethyl acetate, isopropanol, butane, ethyl 2-methylbutyrate, and phenoxyethanol. Benzyl acetate²⁶ (Lalikoglu and Ince, 2021) and ethyl acetate²⁷ are common synthetic esters which impart floral and fruity aromas respectively. Isopropanol is commonly used as a solvent and antifoaming agent²⁸ and for its disinfecting and quick-drying properties²⁹. Phenoxyethanol is commonly used as a preservative in cosmetics (Dréno et al, 2019). The common presence of butane is likely related to inclusion of aerosol products such as deodorants and hair sprays in the assessed studies.

With respect to the assessed 'green' products, the other commonly emitted compounds include β -myrcene, α -pinene, γ -terpinene, and acetone. The presence of the additional monoterpenes likely reflects the heavy reliance of 'green' products on natural essential oils or botanical extracts, whilst the presence of acetone may be due to oxidation of these terpenes (Lee et al, 2006).

In their comparison of regular and 'fragrance-free' PCPs, Nematollahi et al (2019) found that the number of VOCs emitted by 'fragrance-free' products were considerably lower than those emitted by regular products. This can be seen in Table 15 where the six regular shampoo products assessed by Nematollahi et al (2019) emitted between 13 to 20 different VOCs compared to only one VOC emitted by the assessed fragrance-free shampoo.

Use of personal care products has also been associated with formation of ultrafine particles due to the reaction of constituent VOCs with ozone, with Wu et al (2024) showing that concentrations can reach ~ 34,000 – 200,000 per cm³.

6.1. MITIGATION STRATEGIES

To help minimise indoor air pollution arising from everyday usage of personal care products, there are several practical steps which can be taken, including:

²⁶ <https://fragranceconservatory.com/ingredient/benzyl-acetate> Accessed 20 January 2026

²⁷ <https://fragranceconservatory.com/ingredient/ethyl-acetate> Accessed 20 January 2026

²⁸ <https://www.cosmeticsinfo.org/ingredient/isopropyl-alcohol/> Accessed 20 January 2026

²⁹ <https://www.skincarelab.org/ingredient/isopropyl/> Accessed 20 January 2026

- Where possible, opt for low-emission or fragrance-free products which generally emit lower amounts of VOCs (Nematollahi et al, 2019).
- Apply products in well-ventilated areas or increase ventilation during and immediately after use (eg, opening windows/doors, running a bathroom exhaust fan).
- Where possible, opt for non-spray products, or pump sprays rather than aerosols, as these generally emit lower VOCs (eg, roll-on deodorants, solid/creams) (Lin et al, 2022; Wu et al, 2024).
- Ensure all products are closed tightly when not in use and avoid storing fragranced products in bedrooms.
- Where possible, reduce the amount and frequency of use of personal care products to limit exposure to associated pollutants.

7. ATTACHED GARAGES

Attached garages are a common feature in New Zealand homes, but they can pose a significant risk to indoor air quality. These spaces often act as reservoirs for pollutants that can infiltrate living areas, creating potential health hazards for occupants. Garages accumulate contaminants from multiple sources, including particulate matter, CO₂, carbon monoxide and nitrogen oxides emitted by vehicles (Zimakowska-Laskowska and Laskowski, 2024), as well as VOCs released from stored fuels (eg, petrol for lawnmowers) and from chemicals products like paints, solvents, pesticides, and cleaning agents (Batterman et al, 2007; Merrin et al, 2016).

Pollutant migration into the home is not limited to times when the internal access door is open – it can also occur through hidden pathways such as structural gaps, ductwork, and interconnected ventilation systems (Merrin et al, 2016). A 2003 report prepared for the US Department of Housing and Urban Development noted that, on average, the house-garage interface is “almost two and a half times leakier than the rest of the house envelope” (Emmerich et al, 2003). Pressure differences between the garage and home can drive transport of pollutants into living spaces (Emmerich et al, 2003).

A study conducted in Barcelona, Spain identified attached garages as a key determinant of indoor concentrations of benzene, toluene, and xylene in rural residences (Gallego et al, 2008). Similarly, a study of 567 homes in France found indoor formaldehyde, benzene, toluene, ethylbenzene and xylene concentrations were significantly higher in homes with attached garages (Brown et al, 2015). A separate Australian study also found that indoor levels of n-pentane and isopentane exceeded outdoor concentrations exclusively in homes with attached garages (Brown, 2002). These dwellings also exhibited high indoor benzene concentrations. Another study, conducted in Michigan, USA identified garages as the dominant source of benzene and several other VOCs including trimethylbenzene, xylene, ethyl toluene, cyclohexane, isopropyltoluene detected indoors (Batterman et al, 2007).

7.1. MITIGATION STRATEGIES

Strategies to minimise indoor air pollution from attached garages focus on three key areas: reducing emissions within the garage, preventing pollutant transport into the home, and improving ventilation to remove contaminants. These strategies include:

- Avoiding idling vehicles in the garage, even when the door is open as pollutant levels can rise rapidly (Batterman et al, 2007). However, it is important to note that vehicles may still release VOCs even after the engine is turned off due to evaporation of fuel (Noumura et al, 2022).
- Seal or remove containers of fuels or solvents from the garage (Batterman et al, 2007). Where possible, relocate chemical storage to a cool, well-ventilated detached space.
- Where possible, avoid using the garage as a workspace for activities that generate VOCs or particulate matter (eg, painting, use of power tools, activities involving glue or solvents).

- Seal air passages between the house and garage to minimise transport of pollutants into the house. Merrin et al (2016) found that sealing air bypasses with caulk, expanding polyurethane foam, and/or rigid materials reduced transport of a tracer gas from the garage into the house by 71%.
- Install ventilation in the garage to remove contaminants. Mallach et al (2017) found that use of a garage exhaust fan led to a 62% reduction in indoor benzene concentrations, 53% reduction in toluene, 47% reduction in ethylbenzene, 45% reduction in m,p-xylene, 43% reduction in o-xylene and 23% reduction in carbon monoxide. However, care should be taken when designing ventilation systems as improper design could lead to elevated migration of pollutants into the home (Nirvan et al, 2012). Garages should be maintained at negative pressure relative to the house³⁰.
- In the absence of mechanical garage ventilation, employ regular passive ventilation by opening external doors and/or windows.

³⁰https://www.energy.gov/sites/default/files/2014/12/f19/ba_case_study_air_leakage_transfer_garage.pdf Accessed 3 December 2025

8. HEATING

Indoor air pollution arising from residential heating systems varies substantially depending on the fuel type, appliance design, and operational characteristics of the heating source. Common household heating technologies including wood burners, open fireplaces, gas heaters and electric heat pumps differ markedly in the pollutants they emit. Combustion-based heating, in particular, can be a major contributor to indoor concentrations of particulate matter and gaseous pollutants.

Wood-burning appliances are widely cited as significant contributors to indoor particulate pollution, particularly when combustion conditions are suboptimal. Vicente et al (2020) conducted a detailed assessment of indoor emissions from open fireplaces in unoccupied rural Portuguese households. Their measurements revealed the presence of carbon monoxide, confirming incomplete combustion during fireplace use. Particulate matter emissions were also pronounced with PM₁₀ concentrations increasing to approximately 12 times background levels during fireplace operation, with the most substantial pollutant spikes occurring during the ignition and refuelling phases. These transient activities likely disturb ash deposits and disrupt airflow, facilitating sudden releases of fine particles into indoor air.

Wood combustion also resulted in the emission of particulate-bound PAHs, including retene, benzo[a]pyrene, chrysene, benzo[a]anthracene and benzo[k]fluoranthene. Vicente et al (2020) additionally observed emissions of heavy metals, such as copper and cadmium which may enter the indoor environment through resuspension of ash containing concentrated trace metals from combusted fuels.

Evidence from New Zealand research aligns with these findings, with a 2019 BRANZ report highlighting the contribution of household wood burners to indoor PM₁₀ concentrations, although these were greatly outweighed by emissions from cooking (Trompetter and Davy, 2019).

While gas and oil heaters generally produce fewer particulates than wood-burning appliances, they can be important sources of NO₂ in indoor environments, particularly where ventilation is insufficient. A large-scale study of 344 Canadian homes conducted by Sun et al (2025) reported that the use of oil heating systems corresponded to a 58% increase in indoor NO₂ levels during winter months, and usage of gas heating in older homes was associated with a 62% increase in indoor NO₂. A similar observation was made by the albeit dated Gillespie-Bennett et al (2008) study of approximately 350 New Zealand homes, where residences using unflued gas heaters exhibited more than threefold higher indoor NO₂ concentrations in living rooms compared with homes without such heaters.

In contrast, electric heat pumps, which do not involve combustion, do not directly emit pollutants into indoor environments. Their air-quality impacts therefore depend primarily on secondary factors such as dust resuspension and maintenance rather than chemical emissions from fuel burning.

8.1. MITIGATION STRATEGIES

There are several practical steps which can be undertaken to reduce indoor air pollutants generated during home heating. These include:

- Ensure fixed heating appliances are professionally installed, with gas appliances installed by a licensed gas fitter.
- Where possible, opt for heat pumps or electric heaters to eliminate combustion-related pollutants (eg, particulate matter, carbon monoxide, NO₂).
- Where wood burners are used, burn only clean, seasoned, dry firewood as this burns cleaner and hotter. Never burn rubbish or plastic as these will emit toxic pollutants.³¹
- Ensure fireplaces and flues are cleaned annually to promote efficient combustion and reduce emissions³². Additionally, regularly clear the ash bed from the fireplace to minimise aerosolisation of settled ash during lighting and refuelling. When cleaning minimise disturbance of the ash bed and cleaning with a damp cloth rather than sweeping to reduce aerosolisation.
- Ensure oil and gas appliances are regularly serviced³³.
- Open windows slightly while operating heating appliances to help dilute pollutant concentrations. This is particularly important when operating an unflued gas heater³⁴.
- Never operate an unflued gas heater in a bathroom or sleeping area³⁵.

³¹ [Backyard recreational fires | US EPA](#) Accessed 29 January 2026

³² <https://www.epa.gov/burnwise/learn-you-burn-wood-what-you-can-do> Accessed 20 January 2026

³³ [Unflued gas heaters](#) Accessed 29 January 2026

³⁴ [Unflued gas heaters](#) Accessed 29 January 2026

³⁵ [Unflued gas heaters](#) Accessed 29 January 2026

9. COOKING

Cooking represents a significant source of indoor air pollution in residential environments. Emissions generated during food preparation can vary widely depending on multiple factors, including the type of appliance used (eg, gas versus electric stoves), the materials and cookware involved, and the specific cooking method (eg, boiling, baking, deep-frying). These factors influence both the quantity and composition of pollutants released, particularly particulate matter, PAHs, and combustion-derived gases such as nitrogen oxides and carbon monoxide.

Different cooking methods produce markedly different emission profiles. A comparative analysis of particulate matter and PAH emissions from air-frying, oven-baking, and deep-frying demonstrated that deep-frying generates the highest levels of pollutants across all measured indicators (Wu et al, 2025). Specifically, deep-frying produced the greatest total particle concentrations, particle mass, and overall PAH concentrations. This outcome is consistent with the high temperatures and substantial lipid aerosolisation associated with deep-frying, both of which increase the formation of fine and ultrafine particles as well as SVOCs compounds such as PAHs. Additional evidence from Tang et al. (2024) further highlights the variability between cooking techniques with pan-frying producing peak $PM_{2.5}$ and total VOC concentrations of $92.9 \mu\text{g}/\text{m}^3$ and 260 ppb, respectively – substantially higher than stir-frying ($26.7 \mu\text{g}/\text{m}^3$; 110 ppb) and deep-frying ($7.7 \mu\text{g}/\text{m}^3$; 230 ppb). In contrast, low-temperature and low-aerosolisation methods such as boiling ($0.7 \mu\text{g}/\text{m}^3$; 30 ppb) and air-frying ($0.6 \mu\text{g}/\text{m}^3$; 20 ppb) generated the lowest emissions. Together, these findings reinforce the dominant role of high-heat, oil-based cooking in producing both particulate and gaseous pollutants.

The characteristics of cookware and heated materials also strongly influence emissions. Ciuzas et al (2015) investigated particulate emissions generated during several cooking-related activities on an electric stove. They found that ultrafine particles ($PM_{0.01-0.3}$) were most abundant during the heating of an empty Teflon pan. This was followed by emissions from heating cooking oil in a Teflon pan and frying onions in oil. Larger particles ($PM_{0.3-10}$) were most prevalent during heating of cooking oil, followed by heating of the Teflon pan and frying onions. These results demonstrate that preheating cookware, particularly non-stick surfaces, and the volatilisation of oils are major contributors to indoor particle generation. In contrast, activities involving little or no combustion or aerosolisation, such as boiling water, produced substantially lower levels of particulate matter. The electric stove operating without any cookware or food generated negligible particulate matter, confirming that emissions arise predominantly from the heated materials rather than the appliance itself.

New Zealand evidence reinforces the central role of cooking as a major source of indoor particulate matter. A Wellington study that monitored indoor and outdoor air quality across several homes found that cooking emissions were the dominant contributor to indoor PM_{10} levels (Trompetter and Davy, 2019).

The type of stove fuel also affects indoor air quality. Natural gas stoves release a suite of combustion-related pollutants, including methane, nitric oxide, and NO_2 . Lebel et al (2022) reported that methane emissions occur not only during combustion but also from leaks when gas stoves are turned off. Indeed, the contribution of gas appliances to indoor air pollution

has been demonstrated in real-world residential settings. A Canadian study examining 344 homes across summer and winter reported strong associations between gas stove use and elevated indoor concentrations of NO₂ and carbon monoxide (Sun et al, 2025). In New Zealand, Gillespie-Bennett et al (2008) assessed around 350 homes and found that NO₂ levels were significantly higher in the living rooms of homes with gas stove-tops. Furthermore, a 2025 Energy Efficiency and Conservation Authority (EECA) -commissioned indoor combustion study synthesised New Zealand and international data to show that gas stoves contribute a measurable increase in indoor NO₂ levels (Metcalf et al, 2025).

9.1. MITIGATION STRATEGIES

There are several practical steps which can be undertaken to reduce indoor air pollutants generated during cooking and home heating. These include:

- Where possible, opt for induction or electric cooktops rather than gas stoves to eliminate combustion-related pollutants. A 2014 US study found that replacement of a gas stove with an electric stove led to a 51% reduction in kitchen NO₂ concentrations (Paulin et al, 2014).
- When frying, searing or grilling use lids to reduce pollutant release into the room, or increase ventilation during this period (eg, opening doors, windows, using exhaust fan).
- Limit high-temperature, oil-based cooking whenever possible due to its tendency to result in higher pollutant levels (Tang et al, 2024; Wu et al, 2025).
- Before cooking ensure the cooktop is clean and free of grease build-up which can burn and release pollutants.
- Use a rangehood that vents outdoors, and operate it at the highest practical setting during and immediately after cooking (Zhao et al, 2019). Alternatively, in the absence of an externally vented rangehood, employ manual ventilation (eg, opening windows or doors).

10. SUMMARY

Given individuals spend the majority of their time indoors, the quality of indoor air is a major determinant of human health. Indoor environments contain a complex mixture of pollutants, including VOCs, SVOCs, particulate matter, and gaseous pollutants such as carbon monoxide and NO₂. These pollutants arise from diverse sources such as building materials, furnishings, consumer products, combustion-based activities (eg, cooking and heating), and attached garages. The aim of this report was to review the major sources of indoor air pollutants in homes and outline source-specific mitigation strategies.

Building materials were identified as one of the largest contributors to indoor VOC levels, accounting for up to 90% of total indoor VOCs. Newly built or recently renovated homes have especially high emissions, which decline over months but may continue at low levels for years. Commonly emitted VOCs include formaldehyde, acetaldehyde, xylene, toluene, α-pinene, hexanal, and various other aldehydes. Carpets in particular have a pronounced impact on indoor air quality through direct emissions, adsorption–transformation reactions, and sink/desorption effects. Identified strategies to reduce pollution associated with building materials include the use of low-VOC materials, VOC-adsorptive or photocatalytic materials, and ‘bake-out’ or enhanced ventilation after construction or renovation.

Cleaning products were identified as a major source of fragrance-related VOCs, although less than 3% of those emitted are estimated to be disclosed on the product label or MSDS. Key emitted compounds include limonene, α-pinene, acetaldehyde, eucalyptol, ethanol, formaldehyde, and TXIB. Considerable overlap in emissions between regular and ‘green’ products was observed. In contrast, fragrance-free products tended to emit lower numbers and concentrations of VOCs. Potential mitigation strategies include selecting low-VOC or fragrance-free products, using simple homemade cleaners (e.g., vinegar, baking soda), avoiding product overuse, and increasing ventilation during and after cleaning.

Electronic devices, including computers, televisions, printers and desktop 3D printers, emit a variety of indoor air pollutants such as VOCs, SVOCs and particulate matter, with emissions influenced by device age, temperature and materials. Computers and TVs release VOCs, PAHs, flame retardants and heavy metals, while printers generate toner-derived particles and VOCs, especially during startup and high-temperature operation. Desktop 3D printers can emit substantial VOCs and particles depending on filament type and printing temperature. Mitigation steps include operating devices away from living/sleeping areas, employing device enclosures or covers and air filtration for 3D printers, selecting low-emitting materials, and maintaining devices to reduce pollutant release.

Air fresheners emit a wide range of VOCs, SVOCs and particulate matter, often with limited ingredient disclosure, and many fragranced products generate additional secondary pollutants when their emissions react with indoor ozone. Combustion-based products such as candles and incense are major sources of ultrafine particles, PAHs and combustion gases, while diffusers and sprays release terpene-rich VOC mixtures that can accumulate indoors. Mitigation strategies focus on choosing lower-emission or non-combustion products, improving ventilation during use, limiting the amount and duration of fragranced product use, and favouring passive or natural odour-control methods.

Personal care products emit a wide range of VOCs during use, storage and evaporation from treated skin, with 'green' products showing broadly similar emission profiles to conventional ones. Commonly released compounds include monoterpenes such as limonene and linalool, ethanol, acetaldehyde, and other fragrance- or solvent-related VOCs. Fragrance-free products typically emit far fewer VOCs. Mitigation approaches focus on choosing low-emission or fragrance-free products, improving ventilation during use, preferring non-aerosol forms, and minimising frequency of use.

Attached garages can negatively impact indoor air quality by allowing vehicle emissions and VOCs from stored fuels and chemicals to infiltrate homes through leaks and pressure-driven airflow. Studies show higher levels of pollutants such as benzene, toluene, xylene and formaldehyde in homes with attached garages. Mitigation strategies focus on reducing emissions within the garage, sealing air pathways between the living areas and garage, and improving garage ventilation.

Residential heating systems affect indoor air quality in different ways depending on the fuel and appliance used, with combustion-based heaters producing the greatest pollutant emissions. Wood burners and open fireplaces can generate high levels of particulate matter, PAHs, and trace metals, especially during ignition and refuelling, while gas and oil heaters are important indoor sources of NO₂, particularly when ventilation is inadequate. In contrast, electric heat pumps do not emit combustion pollutants. Mitigation strategies focus on proper system maintenance, choosing non-combustion heating where possible, using clean dry firewood in wood burners, and ensuring adequate ventilation during heater use.

Cooking is a major source of indoor air pollution, with emissions varying widely depending on the appliance, cookware, and cooking method. High-heat, oil-based techniques such as pan frying and deep frying generate the greatest levels of particulate matter, VOCs, and PAHs, while low-temperature methods like boiling produce far fewer pollutants. Cookware materials and heated oils also contribute substantially to particle emissions, and gas stoves add combustion-related pollutants such as NO₂, carbon monoxide, and methane. Mitigation strategies include favouring electric or induction cooktops, using lids and ventilation during high-heat cooking, limiting oil-heavy cooking, maintaining clean cooktops, and operating externally vented rangehoods.

Overall, this report highlights that indoor air pollution is not driven by a single dominant source but by the cumulative effect of many everyday household materials, behaviours and practices. As such, improving indoor air quality requires a multi-layered approach, combining informed product choices, source control, good ventilation, and the adoption of lower-emission technologies. Most of the mitigation strategies outlined in this report are simple, practical and cost-efficient, and can be readily implemented in typical New Zealand homes. By applying these mitigation strategies, households can meaningfully reduce pollutant exposures and create healthier indoor environments for occupants.

APPENDIX

Table 11 VOCs emitted by building materials and soft furnishings

Material	Compounds emitted	Test conditions	Reference
Carpet	Formaldehyde Toluene <i>p</i> -dichlorobenzene Limonene Ethylbenzene α -pinene Decane <i>m,p</i> -xylene <i>o</i> -xylene 1,2,4-trimethylbenzene Acetaldehyde 1,3,5-trimethylbenzene	Passive sampling in a residential dwelling	Shinohara et al (2009)
Olefin carpet	Nonanal 1-hexanol, 2-ethyl DnBP Dodecane Undecane, 3-methyl Tetradecane Phenol	Microchamber analysis	Chepaitis et al (2024)
Nylon carpet	Caprolactam 2,2,4-trimethyl-1,3-pentanediol monoisobutyrate Acetone Nonanal Benzaldehyde Phenol 1-dodecanol	Microchamber analysis	Chepaitis et al (2024)

Material	Compounds emitted	Test conditions	Reference
Felt-backed carpet tile	Toluene 1,4-dichlorobenzene 1,3-dichlorobenzene Benzene Xylenes Bromodichloromethane Chlorobenzene Trichloromethane Ethylbenzene Dibromochloromethane Tetrachloroethene	45 ml test cell	Kowalska and Gierczak (2012)
Polypropylene fitted carpet	Toluene Tetrachloroethene Styrene Trichloromethane Bromodichloromethane Xylenes Benzene Ethylbenzene 1,3-dichlorobenzene Tetrachloromethane	45 ml test cell	Kowalska and Gierczak (2012)
Plastic carpet	DINP BBP DEHP DNOP	630 ml microchamber	Lin et al (2021)
Wool carpet	Nonanal Acetone Formaldehyde Acetaldehyde Decanal Octanal Heptanal	52 l experimental chamber	Abbass et al (2017)

Material	Compounds emitted	Test conditions	Reference
Nylon carpet	Acetone Formaldehyde Nonanal Acetaldehyde Octanal Decanal	52 l experimental chamber	Abbass et al (2017)
Triexta carpet	Nonanal Acetone Octanal Acetaldehyde Heptanal Formaldehyde Decanal	52 l experimental chamber	Abbass et al (2017)
Polypropylene carpet	Nonanal Acetone Formaldehyde Acetaldehyde Octanal Heptanal Decanal	52 l experimental chamber	Abbass et al (2017)
Poly-triexta carpet	Acetone Nonanal Formaldehyde Octanal Acetaldehyde Heptanal Decanal	52 l experimental chamber	Abbass et al (2017)

Material	Compounds emitted	Test conditions	Reference
Polyester carpet	Nonanal Acetone Formaldehyde Acetaldehyde Decanal Octanal Heptanal	52 l experimental chamber	Abbass et al (2017)
Flooring	Formaldehyde Toluene α -pinene Limonene Ethylbenzene Acetaldehyde <i>p</i> -dichlorobenzene <i>m,p</i> -xylene Decane <i>o</i> -xylene 1,2,4-trimethylbenzene 1,3,5-trimethylbenzene	Passive sampling in a residential dwelling	Shinohara et al (2009)
Plywood flooring bonded with epoxy resin adhesive	Toluene <i>m,p</i> -xylene Ethylbenzene <i>o</i> -xylene Benzene	Passive emission cell measurements taken in a residential house 1 month post construction	Kang et al (2013)
PVC flooring	Cyclohexanone 4-methyl-2-pentanone n-butyl acetate 2-ethyl-1-hexanol 2-butyl acetate	2 l experimental chamber	Xue et al (2023)

Material	Compounds emitted	Test conditions	Reference
PVC flooring	2-ethylhexanoic acid Cyclohexanone n-butyl acetate Tetradecane Pentadecane 4-tert-butylbenzoic acid Chlorododecane 4-methyl-2-pentanone Hexadecane 2-ethyl-1-hexanol	2 l experimental chamber	Xue et al (2023)
PVC flooring	Cyclohexanone 2-methyl-2-pentanone n-butyl acetate 2-ethyl-1-hexanol 2-butyl acetate	2 l experimental chamber	Xue et al (2023)
PVC flooring	n-butyl acetate Tetradecane Pentadecane Cyclohexanone	2 l experimental chamber	Xue et al (2023)
PVC flooring	2-ethylhexanoic acid Chlorododecane Triethyl phosphate Cyclohexanone 4-tert-butylbenzoic acid Pentadecane	2 l experimental chamber	Xue et al (2023)
Hardwood flooring	Acetic acid Acetone Hexanal	Microchamber analysis	Chepaitis et al (2024)

Material	Compounds emitted	Test conditions	Reference
Laminate flooring	α -terpineol Caryophyllene Acetone Humulene Diethyl phthalate Texanol Hexanal Cyclopentasiloxane, decamethyl α -pinene	Microchamber analysis	Chepaitis et al (2024)
Linoleum tile	Acetic acid Propanoic acid Octanoic acid Heptanoic acid Nonanoic acid Nonanal Hexanal Octanal Heptane 2-heptanone 1-octanol Octane Propanoic acid, 2-methyl Heptanal Decanal	Microchamber analysis	Chepaitis et al (2024)

Material	Compounds emitted	Test conditions	Reference
Natural wood flooring	2-naphthalenemethanol, decahydro- $\alpha,\alpha,4a$ -trimethyl-8-methylene-, [2R-(2 α .,4 α .,8 α .)]- Acetic acid 2-naphthalenemethanol, 1,2,3,4,4a,5,6,7-octahydro- $\alpha,\alpha,4a,8$ -tetramethyl-, (2R-cis)- Propanoic acid Cyclohexanemethanol, 4-ethenyl- $\alpha,\alpha,4$ -trimethyl-3-(1-methylethenyl)-, [1R-(1 α .,3 α .,4 β .)]- Cyclohexane, 1-ethenyl-1-methyl-2,4-bis(1-methylethenyl)- 4a,8-dimethyl-2-(prop-1-en-2-yl)-1,2,3,4,4a,5,6,7-octahydronaphthalene Caryophyllene Butanoic acid, 2-methyl- Furfural 1-naphthalenol, decahydro-1,4a-dimethyl-7-(1-methylethylidene)-, [1R-(1 α .,4 α .,8 α .)]- 1-hexanol, 2-ethyl α -terpineol Nonanal Pentanal	Microchamber analysis	Chepaitis et al (2024)
Rubber flooring	Butylated hydroxytoluene Octane, 2,6-dimethyl Dodecane Phenol Tetradecane	Microchamber analysis	Chepaitis et al (2024)

Material	Compounds emitted	Test conditions	Reference
Terrazo flooring	Hexylene glycol Heptane, 2,2,4,6,6-pentamethyl- 1-hexanol, 2-ethyl- Benzene, 1,2,4-trimethyl- Octane, 2,2,6-trimethyl- Acetic acid, butyl ester 1-butanol Benzene, propyl- 1-methoxy-2-propyl acetate ortho-xylene o-cymene	Microchamber analysis	Chepaitis et al (2024)
Flooring	Toluene Formaldehyde Ethylbenzene Benzene Xylene Styrene	15 l experimental chamber	Arar et al (2022)
Wood panel flooring – soy adhesive	α -pinene Acetic acid Hexanal d-limonene Furfural Acetaldehyde β -pinene Acetone Formaldehyde α -terpineol Triethylphosphate Pentanal	0.067 m ³ experimental chamber	Yauk et al (2020)

Material	Compounds emitted	Test conditions	Reference
Wood panel flooring – polyurethane adhesive	α -pinene Acetic acid Hexanal Furfural 2,2,4-trimethyl-1,3-pentanediol Formaldehyde	0.067 m ³ experimental chamber	Yauk et al (2020)
Wood panel flooring – no adhesive	α -pinene d-limonene (+)-camphene Acetic acid o-isopropenyltoluene Hexanal p-(1 propenyl)-toluene p-cymene Terpinolene Acetone 3-carene β -pinene β -myrcene Camphene Acetaldehyde Tricyclene Pentanal Dehydrosabinene Toluene β -phellandrene 1-pentanol Formaldehyde o-cymene α -phellandrene Triethylphosphate	0.067 m ³ experimental chamber	Yauk et al (2020)

Material	Compounds emitted	Test conditions	Reference
Wood panel flooring – melamine formaldehyde adhesive	α-pinene Formaldehyde Methyl acetate Acetic acid d-limonene Acetaldehyde Furfural Terpinolene α-terpineol Acetone	0.067 m ³ experimental chamber	Yauk et al (2020)
Wooden flooring	Formaldehyde Hexanal Acetaldehyde α-pinene Styrene 3-carene Toluene d-limonene	24.5 l experimental chamber	Plaisance et al (2017)
Vinyl flooring	DEHP DINP DnBP Iso-DEHP BBP	Experimental chamber	Liang and Xu (2014)
Polystyrene plastic flooring	DNOP BBP DEHP DBP DIBP DEP DMP	630 ml microchamber	Lin et al (2021)
Wood plastic composite flooring	DNOP BBP	630 ml microchamber	Lin et al (2021)

Material	Compounds emitted	Test conditions	Reference
PVC flooring	DBP DEP DMP DIBP DNOP	630 ml microchamber	Lin et al (2021)
Stone plastic composite flooring	BBP DNOP DEHP	630 ml microchamber	Lin et al (2021)
Imitation wood floor panels	Benzene Dibromochloromethane Toluene	45 ml test cell	Kowalska and Gierczak (2012)
PVC wallpaper	Butylated hydroxytoluene Triethyl phosphate Neodecanoic acid Hexadecane Pentadecane Tetradecane Chlorododecane 4-tert-butylbenzoic acid 2-ethylhexanoic acid 4-methyl-2-pentanone 2-ethyl-1-hexanol Cyclohexanone n-butyl acetate	2 l experimental chamber	Xue et al (2023)
PVC wallpaper	Triethyl phosphate Pentadecane	2 l experimental chamber	Xue et al (2023)
PVC wallpaper	Triethyl phosphate 2-ethylhexanoic acid Chlorododecane Pentadecane	2 l experimental chamber	Xue et al (2023)

Material	Compounds emitted	Test conditions	Reference
Wallpaper and adhesive	Toluene Xylene Styrene Ethylbenzene Benzene	0.02 m ³ experimental chamber	Jung et al (2021)
Wallpaper	Toluene Ethylbenzene Formaldehyde Xylene Styrene Benzene	15 l experimental chamber	Arar et al (2022)
Wallpaper	Toluene Ethylbenzene Formaldehyde Xylene Styrene Benzene	15 l experimental chamber	Arar et al (2022)
Ceiling	Toluene Formaldehyde Ethylbenzene Acetaldehyde <i>p</i> -dichlorobenzene <i>m,p</i> -xylene Decane α -pinene Limonene <i>o</i> -xylene 1,2,4-trimethylbenzene 1,3,5-trimethylbenzene	Passive sampling in a residential dwelling	Shinohara et al (2009)

Material	Compounds emitted	Test conditions	Reference
Closet	Formaldehyde Toluene α -pinene <i>p</i> -dichlorobenzene Ethylbenzene <i>m,p</i> -xylene Limonene <i>o</i> -xylene Decane 1,2,4-trimethylbenzene Acetaldehyde 1,3,5-trimethylbenzene	Passive sampling in a residential dwelling	Shinohara et al (2009)
Door	Toluene Formaldehyde <i>p</i> -dichlorobenzene Ethylbenzene α -pinene Limonene <i>m,p</i> -xylene <i>o</i> -xylene Decane 1,2,4-trimethylbenzene Acetaldehyde 1,3,5-trimethylbenzene	Passive sampling in a residential dwelling	Shinohara et al (2009)

Material	Compounds emitted	Test conditions	Reference
Wall	Formaldehyde Toluene <i>p</i> -dichlorobenzene Limonene α -pinene Ethylbenzene <i>m,p</i> -xylene Decane <i>o</i> -xylene 1,2,4-trimethylbenzene Acetaldehyde 1,3,5-trimethylbenzene	Passive sampling in a residential dwelling	Shinohara et al (2009)
Wallpaper bonded onto gypsum board with starch-based adhesive (low VOC)	Toluene <i>m,p</i> -xylene Ethylbenzene <i>o</i> -xylene Benzene	Passive emission cell measurements taken in a residential house 1 month post construction	Kang et al (2013)
Electric wall switch	Chlorobenzene Toluene Styrene Xylenes Benzene Bromodichloromethane 1,3-dichlorobenzene	45 ml test cell	Kowalska and Gierczak (2012)
Tile and tile adhesive	Toluene Xylene Ethylbenzene Styrene	0.02 m ³ experimental chamber	Jung et al (2021)
Flooring materials and adhesives	Xylene Ethylbenzene Toluene Styrene	0.02 m ³ experimental chamber	Jung et al (2021)

Material	Compounds emitted	Test conditions	Reference
MDF and adhesive	Toluene Xylene Ethylbenzene Styrene Benzene	0.02 m ³ experimental chamber	Jung et al (2021)
Glass wool interior partitions	Acetaldehyde Formaldehyde	24.5 l experimental chamber	Plaisance et al (2017)
Gypsum board	Acetaldehyde Formaldehyde	24.5 l experimental chamber	Plaisance et al (2017)
Oriented strand board	Formaldehyde Acetaldehyde Hexanal	24.5 l experimental chamber	Plaisance et al (2017)
Oriented strand board	Hexanal Formaldehyde Acetaldehyde α -pinene 3-carene Styrene d-limonene	24.5 l experimental chamber	Plaisance et al (2017)
Polyurethane adhesive mastic sealant	<i>m/p</i> -xylenes Ethyl benzene Formaldehyde Styrene Toluene Acetaldehyde Hexanal	24.5 l experimental chamber	Plaisance et al (2017)
Wooden studs	Hexanal Formaldehyde α -pinene d-limonene	24.5 l experimental chamber	Plaisance et al (2017)

Material	Compounds emitted	Test conditions	Reference
Skirting board	Formaldehyde Acetaldehyde Hexanal	24.5 l experimental chamber	Plaisance et al (2017)
Wooden battens	α -pinene d-limonene 3-carene Hexanal Formaldehyde Acetaldehyde	24.5 l experimental chamber	Plaisance et al (2017)
Noise protection panel	Formaldehyde Acetaldehyde Hexanal	24.5 l experimental chamber	Plaisance et al (2017)
Sound insulator	Formaldehyde	24.5 l experimental chamber	Plaisance et al (2017)
Wall vapour barrier	Formaldehyde	24.5 l experimental chamber	Plaisance et al (2017)
Ceiling vapour barrier	Formaldehyde Acetaldehyde	24.5 l experimental chamber	Plaisance et al (2017)
Glass wool wall material	Formaldehyde	24.5 l experimental chamber	Plaisance et al (2017)
Glass wool wall material	Formaldehyde	24.5 l experimental chamber	Plaisance et al (2017)
Blown-out glass wool ceiling material	Hexanal Formaldehyde	24.5 l experimental chamber	Plaisance et al (2017)
Ceiling paint	Formaldehyde Acetaldehyde Hexanal Styrene <i>m/p</i> -xylenes d-limonene	24.5 l experimental chamber	Plaisance et al (2017)

Material	Compounds emitted	Test conditions	Reference
Interior partition paint	Formaldehyde Acetaldehyde Styrene d-limonene Ethyl benzene <i>m/p</i> -xylenes	24.5 l experimental chamber	Plaisance et al (2017)
Furnishing plaster	Formaldehyde Acetaldehyde Hexanal	24.5 l experimental chamber	Plaisance et al (2017)
Furnishing plaster	Formaldehyde Acetaldehyde Hexanal	24.5 l experimental chamber	Plaisance et al (2017)
Paint	o-xylene <i>m/p</i> -xylene Formaldehyde Benzene α -pinene d-limonene Toluene	Field and laboratory emission cell (FLEC) analysis	Missia et al (2010)
Laminate	Formaldehyde <i>m/p</i> -xylene α -pinene o-xylene Benzene Toluene d-limonene	Field and laboratory emission cell (FLEC) analysis	Missia et al (2010)

Material	Compounds emitted	Test conditions	Reference
Plywood panels and treated fir boards	Formaldehyde α-pinene 2,5-dimethylbenzaldehyde d-limonene β-pinene 3-carene Acetone Camphene Acetaldehyde Hexanal Pentanal β-phellandrene Propanal Butanal	40 m ³ experimental room (IRINA)	Harb et al (2018)
Medium-density fibreboard (MDF)	Formaldehyde Linalool Heptanal Hexanal Acetone Pentanal Acetaldehyde	Experimental test cell (0.03 m ²)	Simon et al (2020)
Coriander biorefinery fibreboard	Acetaldehyde Linalool Camphor p-cymene Nonanal	Experimental test cell (0.03 m ²)	Simon et al (2020)

Material	Compounds emitted	Test conditions	Reference
Chipboard	Linalool Formaldehyde Camphor Acetone Hexanal α -pinene Benzaldehyde Acetaldehyde 2-butanone/butyraldehyde Pentanal Propionaldehyde Borneol	Experimental test cell (0.03 m ²)	Simon et al (2020)
Low pressure, closed cell spray polyurethane foam (commonly used for DIY)	PMDTA TCPP	Microchamber analysis	Poppendieck et al (2014)
High pressure, open cell, low density spray polyurethane foam	TCPP	Microchamber analysis	Poppendieck et al (2014)
High pressure, open cell, low density spray polyurethane foam	BDMAEE TCPP	Microchamber analysis	Poppendieck et al (2014)

Where possible, chemicals are listed in order of abundance.

Table 12 VOCs emitted by household cleaning products

Product(s)	Pollutants detected	Test conditions	Reference
Bleach-containing automatic toilet-bowl cleaner – in reservoir type	Chloroform Benzene Carbon tetrachloride Bromodichloromethane Bromoform Bromochloromethane 1,4-dichlorobenzene Dibromochloromethane Naphthalene 1,3-dichlorobenzene 1,2-dichlorobenzene	20 ml headspace vials containing 1 g of sample with water	Ayri et al (2020)
Bleach-containing automatic toilet-bowl cleaner – in bowl type	Chloroform 1,4-dichlorobenzene Bromoform Carbon tetrachloride Bromodichloromethane Dibromochloromethane 1,2-dichlorobenzene Naphthalene Benzene	20 ml headspace vials containing 1 g of sample with water	Ayri et al (2020)
General purpose, glass and bathroom cleaners	2-butoxyethanol	Air sampled from residential bathrooms	Bello et al (2010)

Product(s)	Pollutants detected	Test conditions	Reference
Water-based carpet deodoriser	Dihydromyrcenol Linalool Eucalyptol Camphor α -terpineol d-limonene o-cymene Benzyl acetate Dipropylene glycol monomethyl ether (isomers) Nonanal (secondary emission) Dodecanal (secondary emission)	20 m ³ walk-in climate chamber with textile carpet	Palmisani et al (2020)
Dish cleaner	Phenoxyethanol 1-chloroundecane d-limonene N,N-dimethyl-1-undecanamine 2-butyloctanol 1-undecene 1-tridecene	100 μ l of sample in a 20 ml headspace vial with 5.0 ml of dispersant (10% water/PEG 400)	Lin et al (2022)
Toilet cleaner	Benzaldehyde Dimethoxymethylbenzene Heptanoic acid Acetic acid Hexanoic acid 2-propyl-1-heptanol	100 μ l of sample in a 20 ml headspace vial with 5.0 ml of dispersant (10% water/PEG 400)	Lin et al (2022)
Laundry detergent	1-chloroundecane N,N-dimethyl-1-undecanamine 2-butyloctanol Dihydromyrcenol Linalool	100 μ l of sample in a 20 ml headspace vial with 5.0 ml of dispersant (10% water/PEG 400)	Lin et al (2022)
Orange oil-based degreaser	d-limonene	50 m ³ chamber simulating a residential room	Singer et al (2006a)

Product(s)	Pollutants detected	Test conditions	Reference
Pine oil-based general-purpose cleaner	d-limonene Terpinolene α -terpineol Eucalyptol α -terpinene γ -terpinene <i>p</i> -cymene γ -terpineol α -pinene Camphene β -terpineol α -phellandrene 4-terpineol 1-terpineol	50 m ³ chamber simulating a residential room	Singer et al (2006a)
Essential oil-based kitchen cleaner	Limonene β -pinene	44 ml microchamber	Milhem et al (2021)
Essential oil-based kitchen cleaner	γ -terpinene Cymene Limonene Menthol α -pinene Linalool β -pinene Camphor Eucalyptol	44 ml microchamber	Milhem et al (2021)
Essential oil-based multiuse cleaner	Eucalyptol Limonene α -pinene Cymene β -pinene γ -terpinene	44 ml microchamber	Milhem et al (2021)

Product(s)	Pollutants detected	Test conditions	Reference
Essential oil-based multiuse cleaner	α -pinene γ -terpinene Limonene β -pinene Cymene Linalool	44 ml microchamber	Milhem et al (2021)
Essential oil-based surface cleaner	α -terpineol Camphor Bergamol Eucalyptol Linalool Limonene γ -terpinene β -pinene	44 ml microchamber	Milhem et al (2021)
Essential oil-based glass cleaner	Eucalyptol	44 ml microchamber	Milhem et al (2021)
Foam surface detergent	1-butoxy-2-propanol 2-propanol, 1-(2-methoxypropoxy)- Limonene di-sec-butyl ether Dipropylene glycol monomethyl ether 2-propanol, 1-(2-methoxy-1-methylethoxy) Dihydromyrcenol Eucalyptol Isoborneol Decanal 6-methyl-5-hepten-2-one 1-propanol, 2-(2-methoxy-1-methylethoxy)- Camphor	Experimental test house	Rossignol et al (2013)

Product(s)	Pollutants detected	Test conditions	Reference
Windex glass cleaner	Ethanol, 2-(hexyloxy) Acetic acid 1-butoxy-2-propanol Di-sec-butyl ether Propylene glycol 7-octen-2-ol, 2,6-dimethyl TXIB Cyclopentaneethanol, .β.,2,3-trimethyl- 1-octanol Vertenex 2-ethylhexanol Phytol 3-octanol Citronellol epoxide Ethyl acetoacetate ethylene acetal Cyclotetrasiloxane, octamethyl 1-Hexanol Ethanol, 2-[2-(2-methylpropoxy)ethoxy]- Dipropylene glycol monobutyl ether 3-cyclohexene-1-methanol, a,a,4-trimethyl 4-(2-methoxypropan-2-yl)-1-methylcyclohex-1-ene Cyclohexanol, 5-methyl-2-(1-methylethyl)-, [1S-(1a, 2b, 5b)]- 1-butanol Pentanoic acid, 2,2-dimethyl-, ethenyl ester E-10-dodecen-1-ol propionate Octanal Pyrene, hexadecahydro- Decanal 1-propanol, 2-(2-methoxy-1-methylethoxy)- Silane, methylenebis(dimethyl- 1,1'-biphenyl, 2,2',5,5'-tetramethyl- 1-nonanol Hexanal	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Windex glass cleaner (continued)	Dimethylsilanediol 2-propanol, 1-(2-propenyloxy)- Propane, 1-chloro-3-(2-methoxyethoxy)- Acetaldehyde Cyclohexane, 1,1'-(1,5-pentanediy)bis- Formaldehyde Benzaldehyde d-limonene Pentanehydrazide, 5-(5-tert-butyl-2-thienyl)- 2-furanmethanol, 5-ethenyltetrahydro-a,a,5-trimethyl-, cis- 2-tert-butylcyclohexyl acetate Cyclohexasiloxane, dodecamethyl Oxime-, methoxy-phenyl- Benzenemethanol, a-methyl-, acetate Geraniol Butanoic acid, 2-methyl-, ethyl ester 2-propanol, 1-propoxy Heptanoic acid, ethyl ester Acetate, ethyl Butanal Benzothiazole Dodecane Cyclotrisiloxane, hexamethyl Undecanal 4-octanol Pentanal	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
365 glass cleaner	Acetate, ethyl Ethanol Isobutyl alcohol 1-propanol TXIB Pentadecane 2-ethylhexanol Acetaldehyde Ethanol, 2-(hexyloxy) Hexanal Formaldehyde Acetic acid Tetradecane d-limonene	0.09 m ³ experimental chamber	Temkin et al (2023)
Solimo disinfecting wipes	d-limonene 9-decene-1-nitrile Myrcene 2,6-octadien-1-ol, 3,7-dimethyl-, acetate, (Z)- 1,4-cyclohexadiene, 1-methyl-4-(1-methylethyl)- Bicyclo[4.1.0]hept-2-ene, 3,7,7-trimethyl Bicyclo[3.1.1]heptane, 6,6-dimethyl-2-methylene-, (1S)- 1-octanol 3-cyclohexene-1-methanol, a,a,4-trimethyl Benzene, (ethoxymethyl)- Bicyclo[3.1.0]hexane, 4-methylene-1-(1-methylethyl) Geraniol 3-cyclohexen-1-ol, 4-methyl-1-(1-methylethyl) 8-nonene-1-nitrile (R)-(-)-carvone 1-phenyl-1-propene, 2-methyl 1-decanol (N-decyl alcohol) α -pinene	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Solimo disinfecting wipes (continued)	Octanal 1,3-cyclohexadiene, 1-methyl-4-(1-methylethyl)- 2-cyclohexen-1-ol, 1-methyl-4-(1-methylethenyl)-, trans- Acetaldehyde Decanal Tridecane 2,6-octadienal, 3,7-dimethyl, (Z) 1-dodecene Cyclopentasiloxane, decamethyl 2,6-octadienal, 3,7-dimethyl-, (E)- Isopropanol 6-octen-1-ol, 3,7-dimethyl-, acetate α-phellandrene 3-dodecanone 4-oxononanal 2,4,7,9-tetramethyl-5-decyn-4,7-diol Formaldehyde Diphenyl methanone Undecane Octane, 4-methyl Bicyclo[3.1.0]hexan-3-ol, 4-methyl-1-(1-methylethyl) TXIB 2,2,4-trimethyl-1,3-pentanediol monoisobutyrate 7-octenal, 3,7-dimethyl- 1-tridecene 2-hydroxy-iso-butyrophenone 3-decanol 3-decanone 3-hexanol Benzaldehyde 3-cyclohexen-1-ol, 1-methyl-4-(1-methylethyl) 5-chloropentanoic acid, 6-ethyl-3-octyl ester 4,6,6-trimethyl-bicyclo[3.1.1]heptan-2-ol	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Solimo disinfecting wipes (continued)	Cyclohexene, 1-methyl-5-(1-methylethenyl), (R) Heptanal Toluene, 2-chloro	0.09 m ³ experimental chamber	Temkin et al (2023)
Spic and Span Multi-Surface Cleaner	d-limonene Acetic acid 3-cyclohexene-1-methanol, .α.,.α.,4-trimethyl-, (R)- Linalool BHT Nonanal Glycerol 1-acetate Decanal Formaldehyde Myrcene Caprolactam 1-hexanol Camphor 3-octen-1-yne, (Z)- Propylene glycol	0.09 m ³ experimental chamber	Temkin et al (2023)
Lestoil Heavy Duty Multi-Purpose Cleaner	p-cymene Trimethylbenzene Benzene, 1,4-diethyl 1,3-Cyclohexadiene, 1-methyl-4-(1-methylethyl)- Linalool Decane γ-terpineol 3-cyclohexen-1-ol, 4-methyl-1-(1-methylethyl) Benzene, 1,2,4,5-tetramethyl Heptyl tetradecyl ether Benzene, 1-ethyl-3-methyl Decane, 2,6-dimethyl Undecane, 4-methyl Butyric acid, 2-phenyl-, dec-2-yl ester	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Lestoil Heavy Duty Multi-Purpose Cleaner (continued)	1,3-pentanediol, 2,2,4-trimethyl Nonane Benzene, 1-methyl-2-propyl Decane, 4-methyl 3-cyclohexene-1-methanol, a,a,4-trimethyl-, (S) Benzene, (1,1-dimethylpropyl) Benzene, 4-ethyl-1,2-dimethyl o-cymene Undecane d-limonene Benzene, 1,3-diethyl-5-methyl Dodecane Benzene, (2-methyloctyl)- 1H-indene, 2,3-dihydro-4-methyl Nonane, 4-methyl 2-ethyltoluene 1-(3,3-dimethylbutyn-1-yl)-2,2-dimethylcyclopropene s-butylbenzene Cyclohexane, propyl Bicyclo[3.1.0]hexane, 4-methylene-1-(1-methylethyl) Decyl isobutyl carbonate Undecane, 2,6-dimethyl Xylene Octane Nonane, 2-methyl Octane, 2,6-dimethyl Dodecane, 2,6,10-trimethyl 5-isopropyl-2-methylbicyclo[3.1.0]hexan-2-ol Octane, 4-methyl Tridecane, 7-methyl Naphthalene, decahydro-2-methyl	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Lestoil Heavy Duty Multi-Purpose Cleaner (continued)	Sulfurous acid, cyclohexylmethyl nonyl ester Naphthalene, decahydro- Cyclopentane, 1-methyl-3-(2-methylpropyl) Octane, 3-methyl Cyclohexane, 2-butyl-1,1,3-trimethyl Benzene, 1,2-diethyl Xylene, ortho 2-naphthalenol, 1,2-dihydro-, acetate Cyclopentane, 1,2-dipropyl- Tridecane Cyclohexane, (1,2-dimethylpropyl) 1-octadecyne 1,3-cyclohexanedione, 2,4,6-trimethyl- Undecane, 5,6-dimethyl Cyclohexane, pentyl Benzene, ethyl Cyclohexane, butyl Bicyclo[2.2.1]heptan-2-ol, 1,3,3-trimethyl Octane, 4-ethyl Dodecane, 4-methyl Cyclododecanemethanol Cyclohexane, 1-methyl-4-isopropyl, trans Tridecane, 6-methyl Cyclodecane Octane, 5-ethyl-2-methyl Cyclopentane, 1-methyl-2-propyl Tricyclodecanedimethanol Naphthalene, 1,2,3,4-tetrahydro-6-methyl Cyclohexane, ethyl Heptane, 2-methyl Longifolene Cyclohexane, 1-ethyl-2,3-dimethyl Cyclohexanone, 2-methyl-5-(1-methylethyl)-, trans-	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Lestoil Heavy Duty Multi-Purpose Cleaner (continued)	2,3,4-trimethyl-hex-3-enal 3-ethyl-5-methyl-1-heptyn-3-ol Cyclooctane, cyclohexyl- Cyclohexane, methyl Octane, 2,5-dimethyl Isoborneol trans-1,2-diethyl cyclopentane Heptane, 3-methyl Cyclohexane, 1-ethyl-3-methyl Cyclohexane, 1-ethyl-2-methyl Toluene Heptane Cyclohexane, 2,4-diisopropyl-1,1-dimethyl- Cyclohexene, 4,5-diethyl-1,2-dimethyl-, cis- 6-methyl-2-heptanol, pentafluoropropionate Nonane, 3-methyl Cycloheptane, methyl Cyclopentane, propyl Heptane, 2,6-dimethyl Borneol Heptane, 3-ethyl-2-methyl Cyclohexane, 1,4-dimethyl Bicyclo[3.1.1]heptan-3-ol, 3-allyl-6,6-dimethyl-2-methylene- Octane, 2,7-dimethyl Naphthalene, 1,2,3,4-tetrahydro-5-methyl Octane, 3-ethyl 2(4H)-benzofuranone, 5,6,7,7a-tetrahydro-3,6-dimethyl- 1-nonadecanol 5-undecene, 5-methyl Heptane, 2,3-dimethyl Undecane, 5,5-dimethyl Oxalic acid, di(cyclohexylmethyl) ester Benzene, 1,4-dimethyl-2-(2-methylpropyl)	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Lestoil Heavy Duty Multi-Purpose Cleaner (continued)	Naphthalene, decahydro-1,1-dimethyl- trans-decalin, 2-methyl- BHT Tricyclo[5.4.0.0(2,8)]undec-9-ene, 2,6,6,9-tetramethyl- 3-cyclohexene-1-methanol, .α.,α.,4-trimethyl-, (R)- Naphthalene, 2-methyl Tetradecane Decanal Dodecane, 2,6,11-trimethyl 1,2,4-methenoazulene, decahydro-1,5,5,8a-tetramethyl-, [1S-(1.α.,2.α.,3a.β.,4.α.,8a.β.,9R)]- Cyclooctane, (1-methylpropyl) Butanoic acid, 3-[(1-phenylethyl-2-propynyl)oxy] Cyclohexane, 1-methyl-2-propyl Heptane, 2,5-dimethyl 1,2,4-metheno-1H-indene, octahydro-1,7a-dimethyl-5-(1-methylethyl)-, [1S-(1a,2a,3aa,4a,5a,7aa,8S)]- Dimethylsilanediol Formamide, N,N-diethyl- Cyclopentane, 1-ethyl-3-methyl Cyclohexane, 1,2,4-trimethyl Spiro[5.5]undecane Cyclopentane, 1-ethyl-2-methyl- Propanoic acid Glycerol 1-acetate	0.09 m ³ experimental chamber	Temkin et al (2023)
Dr Bronner's Pure Castile Soap	Formaldehyde	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Attitude Sensitive Skin Natural All-Purpose Cleaner with Colloidal Oatmeal	Propylene glycol Isopropanol TXIB 1-hexanol 1-octanol Terephthalic acid, cyclobutyl undecyl ester Cetane 1-octanol, 2-butyl-	0.09 m ³ experimental chamber	Temkin et al (2023)
Fit Organic Multi-surface Cleaner and Degreaser	Ethanol d-limonene Acetate, ethyl Acetic acid Bicyclo[3.1.1]heptane, 6.6-dimethyl-2-methylene-, (1S)- 1,4-Cyclohexadiene, 1-methyl-4-(1-methylethyl)- Myrcene β-phellandrene α-pinene Glycerol 1-acetate Acetaldehyde TXIB Formaldehyde Nonanal Octanal 2,4,6,8-Tetramethyl-1-undecene Linalyl acetate Decanal	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Grandma's Secret Spot Remover Laundry Spray	d-limonene Silanol, trimethyl Myrcene Linalool Heptane, 2,2,4,6,6-pentamethyl α -pinene Cyclohexane, 1-methylene-4-(1-methylethenyl)- TXIB 1-octanol, 2-butyl- β -phellandrene Nonanal 2-deoxyribofuranose, 1(O)-(t-butyl dimethylsilyl)-5(O)-(4,4'-dimethoxytrityl)- Undecane, 5-methyl Acetaldehyde Tricyclo[2.2.1.0(2,6)]heptane, 1,7,7-trimethyl- Octanal Disiloxane, hexamethyl Cyclopentasiloxane, decamethyl Cetane Pentadecane, 3-methyl 3-hepten-2-one, 3-methyl- Phenol, 4,6-di(1,1-dimethylethyl)-2-methyl- Glycerol 1-acetate Decanal 2-hexadecene, 2,6,10,14-tetramethyl- Pentadecane, 7-methyl- Longifolene 6,10-dodecadien-1-ol, 3,7,11-trimethyl-, (E)-(.+/-.)-	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Dapple Baby Stain Remover	Propylene glycol 1-octanol TXIB 1-decanol Terephthalic acid, cyclobutyl undecyl ester Glycerol 1-acetate Cetane Decanal Acetaldehyde Ethylene glycol	0.09 m ³ experimental chamber	Temkin et al (2023)
Babyganics Floor Cleaner Concentrate	Acetic acid TXIB 1-octanol Cetane Propanoic acid Nonanal BHT	0.09 m ³ experimental chamber	Temkin et al (2023)
Comet 2x Bleach Cleanser	Chloroform Isobornyl acetate 2-ethylhexanol Bicyclo[2.2.1]heptan-2-one, 1,7,7-trimethyl-, (1R) p-menth-8-en-3-ol, acetate Acetone Acetaldehyde Pentanal Butanal Hexanal Propanal Acetic acid, 1,7,7-trimethyl-bicyclo[2.2.1]hept-2-yl ester TXIB 2-carene-4-ol γ-terpineol	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Comet 2x Bleach Cleanser (continued)	7-oxabicyclo[4.1.0]heptane, 1-methyl-4-(2-methyloxiranyl)- Carbon tetrachloride Acetophenone Eucalyptol Fenchyl acetate Cyclotrisiloxane, hexamethyl Ethanone, 1-(2,3,4-trihydroxyphenyl)- 2-(1-cyclopent-1-enyl-1-methylethyl)cyclopentanone Nonanal Heptanal 1-butoxy-2-propanol Acetic acid Bicyclo[2.2.1]heptan-2-one, 5-(acetyloxy)-4,7,7-trimethyl-, 1-butanol Bicyclo[2.2.1]heptan-2-ol, 4-chloro-1,7,7-trimethyl-, exo- 7-octen-2-ol, 2,6-dimethyl Decanal Bicyclo[2.2.1]heptan-2-one, 1,3,3-trimethyl-, (1R)- 1-hexanol Limonene Octanal 3,3-dichlorocamphor Hexanal, 2-ethyl Benzene, (1-butylheptyl) Acetic acid, 2-ethylhexyl ester Nonane, 1-chloro 5-dodecanone Acetaldehyde, (3,3-dimethylcyclohexylidene)-, (E)- 4-decanone Benzene, (1-propyloctyl) 3-undecanone Tetradecane Octane, 1-chloro	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Comet 2x Bleach Cleanser (continued)	Camphene 2-octanone Formamide, N,N-diethyl- 1-pentanol Formaldehyde 3-heptanone Bicyclo[2.2.1]heptan-2-ol, 2-allyl-1,7,7-trimethyl- Furfural 2-heptanone 2-butanone 7-oxabicyclo[4.1.0]heptan-2-one, 6-methyl-3-(1-methylethyl)- 2-hexanone Methane, bromodichloro 1-octyn-3-ol, 4-ethyl 2-ethylhexyl methacrylate Diphenyl methanone Benzene, (1-ethylnonyl) Butane, 1,1-dichloro Cetane Bornyl acetate 3-hydroxy-2-methyl-5-(prop-1-en-2-yl)cyclohexanone Benzoic Acid Bicyclo[2.2.1]heptan-2-one, 4-chloro-1,7,7-trimethyl- Heptadecane 2-pentanone	0.09 m ³ experimental chamber	Temkin et al (2023)
Fabuloso Professional Multi-use Cleaner	Acetic acid Glycerol 1,2-diacetate Decanal TXIB Propanoic acid	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Martha Stewart Premium Wood and Floor Cleaner	Ethanol Acetic acid Ethanol, 2-phenoxy Acetate, ethyl Decanal Glycerol 1,2-diacetate Eucalyptol TXIB Propanoic acid BHT	0.09 m ³ experimental chamber	Temkin et al (2023)
Scott's Liquid Gold Wood Care	Benzaldehyde Cyclohexane, methyl Octane Heptane, 3-methyl Octane, 2-methyl Nonane Octane, 3-methyl Cyclohexane, 1,3,5-trimethyl Cyclohexane, ethyl Cyclohexane, 1,4-dimethyl Cyclohexane, 1,2,4-trimethyl Cyclohexane, propyl Heptane, 2-methyl Heptane Heptane, 4-methyl Propane, 2-bromo- Decane Cyclohexane, t-1,2-dimethyl Cyclohexane, 1,4-dimethyl, cis Cyclohexane, t-1-ethyl-4-methyl Cyclopentane, 1-ethyl-3-methyl trans-1,2-diethyl cyclopentane	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Scott's Liquid Gold Wood Care (continued)	Heptane, 2,5-dimethyl Octane, 4-methyl Hexane, 2,3-dimethyl Heptane, 2,3-dimethyl 4-octen-3-one Octane, 2,5-dimethyl 1-tetradecyne Heptane, 2,4-dimethyl 1-pentanol, 2-ethyl Formic acid, 2-propylpentyl ester Sulfurous acid, 2-ethylhexyl nonyl ester Cyclopentane, 1-methyl-2-propyl Hexane, 2,2,4-trimethyl Hexane, 2,5-dimethyl Pentalene, octahydro- Nonane, 3-methyl Nonane, 2-methyl Heptane, 2,4,6-trimethyl Octane, 2,7-dimethyl Hexane, 3-methyl 1-undecene, 5-methyl 5-tridecene, (Z)- Cyclopentane, 1,2,4-trimethyl 1-propanol Cyclohexane, 1-methyl-4-(2-hydroxyethyl)- Toluene Undecane, 6,6-dimethyl 2,10-dodecadien-1-ol, 3,7,11-trimethyl-, (Z)- Trimethylbenzene Cyclooctene, 3-methyl- Hexane, 2-methyl Cyclopentane, 1,2,3-trimethyl, (1a,2a,3b) 1,3-dioxolane	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Scott's Liquid Gold Wood Care (continued)	Phenanthrene, tetradecahydro- Octane, 4,5-dimethyl Hexadecahydro-benzo[de]anthracene Nonane, 4-methyl Octyl acetate Cyclopentane, ethyl Cyclopentane, 1,3-dimethyl Bicyclo[7.7.0]hexadec-1(9)-ene Cyclohexane, 1-methyl-4-isopropyl, cis Tetradecahydro-1-methylphenanthrene Terephthalic acid, but-2-enyl undecyl ester 2-piperidinone, N-[4-bromo-n-butyl]- Pyrene, hexadecahydro- Dodecane, 2,6,10-trimethyl Undecane, 2,6-dimethyl Anthracene, tetradecahydro- Trans-1-methyl-2-nonyl-cyclohexane Cyclopentane, 1-butyl-2-ethyl Cyclohexanol, 5-methyl-2-(1-methylethyl)-, [1S-(1a, 2b, 5b)]- Sulfurous acid, 2-ethylhexyl tridecyl ester Butyric acid, 1-propylpentyl ester 2,3-dihydroquinoxaline, 1-[2-hydroxyethyl]-6,7-dimethyl- Z-11-pentadecenal Cyclohexane Glycerol 1,2-diacetate Cyclohexane, 1-ethyl-1-methyl Cyclohexane, butyl 1,1'-bicyclohexyl, 4-ethoxy-4'-pentyl- Phenanthrene, tetradecahydro-4,5-dimethyl- Hexadecane, 3-methyl Isophthalic acid, heptyl tridec-2-ynyl ester 1H-indene, octahydro-, trans Dodecanoic acid, ethenyl ester	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Scott's Liquid Gold Wood Care (continued)	Anthracene, 9-butyltetradecahydro- Octane, 3-ethyl-2,7-dimethyl Octane, 3-ethyl Nonanal Undecane Decanal Octane, 4-ethyl Cyclopentane, (1-methylethyl) Formaldehyde	0.09 m ³ experimental chamber	Temkin et al (2023)
Scotchgard Oxy Spot & Stain Remover	2-propanol, 1-methoxy- Acetaldehyde Acetic acid Propylene glycol 1-butanol Acetone Formaldehyde 2-propanone, 1-methoxy Dodecane 1-propanol, 2-methoxy 1-dodecanol Butanal TXIB Hexanoic acid Formamide, N,N-diethyl- Butanoic acid Formamide, N,N-dimethyl Propanoic acid, 2-oxo-, methyl ester n-butyl ether 1-butoxy-2-propanol Benzaldehyde Hexanal 2-octanone	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Scotchgard Oxy Spot & Stain Remover (continued)	Tetradecane 2-ethylhexanol Acetophenone Cetane Glycerol 1-acetate Decanal 1-octanol, 2,2-dimethyl- 2(3H)-furanone, dihydro-5-pentyl Nonanal 7-octen-2-ol, 2,6-dimethyl Pentadecane	0.09 m ³ experimental chamber	Temkin et al (2023)
Biokleen Bac-Out Stain & Odor Remover	d-limonene 1,4-cyclohexadiene, 1-methyl-4-(1-methylethyl)- Ethanol, 2-phenoxy Cyclohexene, 1-methyl-4-(1-methylethylidene) 1,3-cyclohexadiene, 1-methyl-4-(1-methylethyl)- Myrcene Bicyclo[3.1.1]heptane, 6,6-dimethyl-2-methylene-, (1S)- 7-oxabicyclo[2.2.1]heptane, 1-methyl-4-(1-methylethyl) β-phellandrene α-pinene α-phellandrene Bicyclo[2.2.1]heptan-2-ol, 1,3,3-trimethyl 1-dodecanol 3-cyclohexen-1-ol, 1-methyl-4-(1-methylethyl) TXIB Camphene 3-cyclohexen-1-ol, 4-methyl-1-(1-methylethyl) Cyclohexanol, 1-methyl-4-(1-methylethenyl)- Decanal Cyclotrisiloxane, hexamethyl Eucalyptol	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Biokleen Bac-Out Stain & Odor Remover (continued)	Dodecane 1,3,6-octatriene, 3,7-dimethyl-, (E)- Cyclohexene, 3-methyl-6-(1-methylethenyl)-, (3R-trans)- 1-butoxy-2-propanol (S)-(+)-carvone Sulfurous acid, 2-propyl tetradecyl ester Terephthalic acid, phenyl undecyl ester Pentadecane Cetane 2-oxabicyclo[2.2.2]octan-6-ol, 1,3,3-trimethyl-, acetate Dimethylsilanediol Benzaldehyde (+)-camphene Citronellal δ -terpineol, acetate Heptane, 2,3,4-trimethyl Phenol, 2-ethyl-4,5-dimethyl- trans-ascaridol glycol Tetradecane 1-octanol, 2-butyl- 3-cyclohexene-1-methanol, . α .,. α .,4-trimethyl-, (R)-	0.09 m ³ experimental chamber	Temkin et al (2023)
Swiffer Sweeper Wet Mopping Cloths	1-butoxy-2-propanol 1,3-hexadiene, 3-ethyl-2,5-dimethyl Di-sec-butyl ether 4-hexen-1-ol, acetate 3-octanol, 3,7-dimethyl- Hexanoic acid, 2-propenyl ester Butanoic acid, 2-methyl-, ethyl ester 3-octanol, 3,6-dimethyl 4-acetyl-1-methylcyclohexene 9-decene-1-nitrile Tricyclo[4.2.1.1(2,5)]dec-3-en-9-ol, acetate, stereoisomer	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Swiffer Sweeper Wet Mopping Cloths (continued)	Benzyl acetate Benzenemethanol, a-methyl-, acetate 7-octen-2-ol, 2-methyl-6-methylene 2,6-octadien-1-ol, 3,7-dimethyl-, acetate, (Z)- 2-buten-1-ol, 3-methyl-, acetate Hexanoic acid, ethyl ester Acetic acid, pentyl ester Myrcene Acetic acid, hexyl ester 1-octanol 3-cyclohexene-1-ethanol 7-octen-1-ol, 3,7-dimethyl-, (S)- o-cymene Decanal 1-butanol, 2-methyl-, acetate 1-butanol 1,3,6-octatriene, 3,7-dimethyl- (8CI9CI) 2-buten-1-one, 1-(2,6,6-trimethyl-1-cyclohexen-1-yl)- Cyclohexanemethanol, 4-(1-methylethyl)-, cis- Ethyl butyrate Acetaldehyde Cyanogen Linalyl acetate Propanal 6-octen-1-ol, 3,7-dimethyl-, acetate 2,4-pentadien-1-ol, 3-pentyl-, (2Z)- o-toluylamide, N-(2-phenylethyl)-N-propyl- Acetic acid α-pinene Acetic acid, (3-methylbutoxy)-, 2-propenyl ester 3-methylene-2-norbornanone Cyclohexanemethanol, 4-(1-methylethyl)-, trans 1,3,6-octatriene, 3,7-dimethyl-, (E)-	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Swiffer Sweeper Wet Mopping Cloths (continued)	Indan-1,3-diol monoacetate 1-butanol, 2-methylene, acetate 2-propanol, 1-propoxy Hedione Styrene 3-hexen-1-ol, (Z)- 3,7-dimethyloctyl acetate 2,7-octadien-1-ol Butanal Toluene 1-decanol, 2-methyl- 2(3H)-furanone, 5-heptyldihydro Allyl heptanoate 3-buten-2-ol, 2-methyl Butanoic acid, 1,1-dimethyl-2-phenylethyl ester 1,5-cyclooctadiene, 1,3-dimethyl- 2-butanol, 3,3-dimethyl Cyclohexane, 1-methylene-4-(1-methylethenyl)- 1-pentanol, 4-methyl-2-propyl Ethanone, 1-(1-methyl-2-cyclopenten-1-yl) 1-nonene, 4,6,8-trimethyl- Cetane Dipropylene glycol Benzene, ethyl α -pinene 1-pentanol Oxirane, dodecyl- Heptadecane Hexane, 3,3-dimethyl 2,10-dodecadien-1-ol, 3,7,11-trimethyl-, (Z)- Pentadecane, 3-methyl 1-methoxy-3-(2-hydroxyethyl)nonane Decane, 5,6-dipropyl-	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Swiffer Sweeper Wet Mopping Cloths (continued)	Tridecane, 7-hexyl- Glycerol 1,2-diacetate Formaldehyde a-damascone (2-Buten-1-one, 1-(2,6,6-trimethyl-2-cyclohexen-1-yl)-, (E)-) Hexanal, 2-ethyl Butane, 2-ethoxy-2-methyl- Sulfurous acid, hexyl tridecyl ester Tridecane, 6-methyl	0.09 m ³ experimental chamber	Temkin et al (2023)
CLR Brilliant Bath Cleaner	Propanoic acid Acetic acid Tripropylene glycol monobutyl ether Acetaldehyde TXIB 1-dodecene Undecane Glycerol 1-acetate Cetane Formaldehyde Pentadecane Tetradecane Hexanal Nonanal E-11-hexadecen-1-ol Decanal Tetradecane, 6,9-dimethyl Heptanal Heptadecane 1-butanol Pentadecane, 7-methyl- Dipropylene glycol monobutyl ether Octanal	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
CLR Brilliant Bath Cleaner (continued)	Ethanol, 2-butoxy Tridecane Tetradecane, 2,6,10-trimethyl- Tridecane, 6-methyl Decane, 1,2-dibromo- 1-butoxy-2-propanol Pentadecane, 3-methyl Isophthalic acid, 3,3-dimethylbut-2-yl undecyl ester 1-decanol, 2-hexyl Ethanol, 2-(hexyloxy) Cyclopentasiloxane, decamethyl Cyclotetradecane Pentadecane, 4-methyl Tetradecane, 2-methyl 1-decanol, 2-octyl- Hexadecane, 2-methyl- Dimethylsilanediol 2-ethylhexanol Toluene Silane, diethyl(2-methoxyethoxy)undecyloxy- 2-propenoic acid, 2-methyl Butanal Tridecanol, 2-ethyl-2-methyl- Cyclotrisiloxane, hexamethyl Propylene glycol	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Krud Kutter Tough Task Remover	Propylene glycol 1-heptanol, 2-propyl Acetic acid 2-decanol, chlorodifluoroacetate 1-hexanol, 5-methyl-2-(1-methylethyl)- TXIB 2-ethylhexanol Pentadecane Cetane 2,5-di-tert-butylhydroquinone, trifluoroacetate Tetradecane Glycerol 1-acetate Nonanal 1-decanol, 2-octyl- Dimethylsilanediol Pentadecane, 2,6,10-trimethyl- 3-cyclopentylpropionic acid, 6-ethyl-3-octyl ester Pentadecane, 3-methyl Z-11-pentadecenal Cyclohexane, 1,2-dimethyl-3-pentyl-4-propyl Heptadecane Dodecane, 5,8-diethyl- Tridecane 6-cyclohexyl-, 6-cyclohexyl 1-octanol, 2-butyl- Heptanal Toluene Hexanal Tridecane Pentadecane, 7-methyl- Decanal Tridecane, 3-ethyl Octanal	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
HDX Glass Cleaner	Isopropanol Ethanol, 2-butoxy Toluene Dichloromethane Ethanol, 2-(hexyloxy) Pentane, 2-methyl Pentane, 3-methyl 2-ethyl-oxetane Ethylene glycol monoisobutyl ether Cyclopentane, methyl Cyclohexane Propane, 1-(chloromethoxy)-2-methyl Propanoic acid TXIB Hexanoic acid Hexane, 2-methyl Glycerol 1-acetate Cyclopentasiloxane, decamethyl Hexane, 3-methyl Pentadecane 1-butanol Nonanal Ethanol, 2-(2-butoxyethoxy) Tetradecane Cetane 2-ethylhexanol Hexanal Decanal Pentadecane, 3-methyl Ethoxy(methoxy)methylsilane 1-decanol, 2-octyl- 3-heptanol, 6-methyl- Carbonic acid, 2-ethylhexyl hexadecyl ester	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
HDX Glass Cleaner (continued)	1-pentene, 2-methyl Heptadecane, 2,3-dimethyl- Spiro[4.5]decan-7-one, 1,8-dimethyl-4-(1-methylethyl)- Octanal 4,4-dimethyl-2-pentanol, 2-methylpropionate Isophthalic acid, 3,5-difluorophenyl heptyl ester Heptadecane 2-deoxyribofuranose, 1(O)-(t-butyl dimethylsilyl)-5(O)-(4,4'-dimethoxytrityl)- Pentadecane, 7-methyl- Formaldehyde 2-piperidinone, N-[4-bromo-n-butyl]- Propylene glycol 2-hexen-1-ol, 2-ethyl- Terephthalic acid, but-2-enyl undecyl ester 1-butoxy-2-propanol Cyclohexasiloxane, dodecamethyl Benzaldehyde 2-nonenal, (E) Hexadecane, 2,6,10,14-tetramethyl- 1-heptanol, 2-propyl n-nonylcyclohexane Formamide, N,N-diethyl- Acetaldehyde Dodecane, 2,6,11-trimethyl Diethylene glycol monoethyl ether 2-fluoro-5-trifluoromethylbenzoic acid, 3-tridecyl ester Tetrahydro-1,3-oxazine-2-thione Pentadecane, 4-methyl Cyclohexane, methyl Tetradecane, 3-methyl Hexadecane, 3-methyl Pentadecane, 5-methyl	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
HDX Glass Cleaner (continued)	4-methoxymethoxy-hex-1-ene Hexadecane, 2-methyl- 1-propanol, 2-(2-methoxy-1-methylethoxy)- Propanenitrile, 3-(diethylamino)- Decane, 2,3,5-trimethyl 2-propanol, 1-[1-methyl-2-(2-propenyloxy)ethoxy] Tetradecane, 2-methyl 1-butanol, 2,3-dimethyl Phenanthrene, tetradecahydro-4,5-dimethyl- Tridecane Hexadecane, 4-methyl- 2,5-dihydroxyacetophenone. bis(trimethylsilyl) ether Trans-1-methyl-2-nonyl-cyclohexane Diethylamine Glycerol 1,2-diacetate Carbamic acid, methyl-, phenyl ester Dodecane Benzenemethanol Decane, 1,1'-oxybis Acetophenone Dimethylsilanediol Phenol 2-hexene, (E) Acetate, ethyl Heptanoic acid Benzene, ethyl (1R,2S,4S,5R,7R)-5-isopropyl-1-methyl-3,8-dioxatricyclo[5.1.0.02,4]octane Undecanal Decane, 1-chloro 2-dodecen-1-yl(-)succinic anhydride 2-t-butyl-cyclopropanecarboxylic acid, 2,6-di-t-butyl-4-methyl-phenyl ester	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
HDX Glass Cleaner (continued)	Undecane α -pinene 2-decen-1-ol, (E) 4-heptanol, ethyl- Cyclopentene, 3-methyl Disulfide, di-tert-dodecyl 11-methyldodecanol 2,2,4-trimethyl-1,3-pentanediol monoisobutyrate Tetradecane, 4-methyl	0.09 m ³ experimental chamber	Temkin et al (2023)
ZEP Shower, Tub, & Tile Cleaner	7-octen-2-ol, 2,6-dimethyl Dipropylene glycol monobutyl ether Propanoic acid Formaldehyde Acetic acid TXIB 1-propanol, 2-(2-hydroxypropoxy) Dipropylene glycol Cetane Acetaldehyde Nonanal Pentadecane Decanal 1-decanol Phenylethyl Alcohol 1-nonanol Cyclohexanol, 4-(1,1-dimethylethyl), cis Heptadecane Dipropylene Glycol Tetradecane Ethanol, 2-butoxy Pentadecane, 7-methyl- Pentadecane, 2,6,10,14-tetramethyl	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
ZEP Shower, Tub, & Tile Cleaner (continued)	1H-indole-3-carboxaldehyde, 2-phenyl- 2-piperidinone, N-[4-bromo-n-butyl]- Hexadecane, 3-methyl 2-methyl-E-7-hexadecene Cyclohexane, propyl Ethanol, 2-(dodecyloxy) Dodecane, 5,8-diethyl- 1-undecanol Tetradecane, 6,9-dimethyl 1-dodecanol, 3,7,11-trimethyl Cyclohexane, 1,1,3-trimethyl-2-(3-methylpentyl)- Sulfurous acid, cyclohexylmethyl nonyl ester Decyl isobutyl carbonate n-nonylcyclohexane 4,7-methano-1H-indenol, hexahydro- Dodecane, 1,2-dibromo Tetradecane, 3-methyl Tetradecane, 4-methyl 1-decanol, 2-methyl- Tridecane Pentadecane, 4-methyl Dimethylsilanediol 2(3H)-furanone, 4,5-dihydro-4-(2,3-dimethyl-2-buten-4-yl)- Pentadecane, 3-methyl Undecane, 6-ethyl 2-ethylhexanol Undecanal Octanal Diethylmalonic acid, monochloride, hept-4-yl ester Cyclopentasiloxane, decamethyl Undecane, 4,4-dimethyl 1-butanol Cyclohexanone, 4-(1,1-dimethylethyl)	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
ZEP Shower, Tub, & Tile Cleaner (continued)	Isophthalic acid, heptyl 2-methylprop-2-en-1-yl ester 1,1'-biphenyl, 2,2',5,5'-tetramethyl- Glycerol 1-acetate 2-propanol, 1-[2-(2-methoxy-1-methylethoxy)-1-methylethoxy]- Toluene Cyclopentane, 1-ethyl-1-methyl Heptane, 3-ethyl-3-methyl Nonane, 2-methyl-5-propyl Cyclotrisiloxane, hexamethyl 2,5-di-tert-butylhydroquinone, trifluoroacetate Hexanal Propylene glycol Undecane Propanal Decane Linalyl acetate	0.09 m ³ experimental chamber	Temkin et al (2023)
ECOS All Purpose Cleaner	Ethanol Carbon disulfide 3-hexen-1-ol, (Z)- Trimethylene glycol Linalool Acetic acid d-limonene Propanoic acid Unidentified 1,3-dioxane, 2-methyl- Eucalyptol 1-octanol Acetaldehyde TXIB 4-hexen-1-ol, acetate Cetane	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
ECOS All Purpose Cleaner (continued)	Glycerol 1-acetate 2.10-dodecadien-1-ol. 3.7.11-trimethyl-. (E)-(.+/-.)- 1,4-cyclohexadiene, 1-methyl-4-(1-methylethyl)- Tetradecane β-caryophyllene α-pinene Nonanal 1-decanol, 2-hexyl α-caryophyllene Pentadecane Heptadecane Nonane, 5-butyl Cycloheptanone, 4-acetyl-7,7-dimethyl-2-(2-oxopropyl)- Dodecane, 5,8-diethyl- Heptadecane, 1-bromo- Pentadecane, 3-methyl Ethanol, 2-butoxy Dodecane, 1,2-dibromo α-pinene 1-decanol n-nonylcyclohexane 4-hydroxy-3-(.α.-iminobenzyl)-1-methyl-6-phenylpyridin-2(1H)-one Pentadecane, 7-methyl- Nonane, 2-bromo-5-ethyl- Isophthalic acid, heptyl 2-methylprop-2-en-1-yl ester Tridecane, 4-methyl Tridecane Toluene Ethane, bromo Tetradecane, 1-iodo 2-furanmethanol, 5-ethenyltetrahydro-a,a,5-trimethyl-, cis- Tetradecane, 3-methyl 1-butanol	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
ECOS All Purpose Cleaner (continued)	Decanal 2-ethylhexanol Propylene glycol Bicyclo[2.2.1]heptan-2-one, 1,7,7-trimethyl-, (1R) Dimethylsilanediol	0.09 m ³ experimental chamber	Temkin et al (2023)
Bissell Pet Pro Oxy Stain Destroyer for Carpet & Upholstery	Acetic acid 7-octen-2-ol, 2,6-dimethyl Propanoic acid 2-propanol, 2-methyl Acetaldehyde Dipropylene glycol 1-heptanol, 2-propyl 1-propanol, 2-(2-hydroxypropoxy) TXIB Cetane Decane, 1,1'-oxybis o-cymene Pentadecane, 7-methyl- Pentadecane 5-nonanol, 2-methylpropionate Eucalyptol Heptadecane Decanal Formaldehyde Isophthalic acid, 4-chlorophenyl undecyl ester Hexanoic acid Glycerol 1,2-diacetate 1-decanol Ethanol, 2-(dodecyloxy) 1-penten-3-one, 1-(2,6,6-trimethyl-1-cyclohexen-1-yl)- Octadecane, 1-bromo- Tetradecane, 2,6,10-trimethyl-	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Bissell Pet Pro Oxy Stain Destroyer for Carpet & Upholstery (continued)	1H-indene, 2,3,3a,4,7,7a-hexahydro- Eicosane 1-hexanol Tetradecane Carbonic acid, eicosyl vinyl ester 2,5-di-tert-butylhydroquinone, trifluoroacetate Diallylvinylmethylsilane Carbonic acid, nonyl vinyl ester 2-piperidinone, N-[4-bromo-n-butyl]- 1-pctanol, 2,7-dimethyl 1-undecanol Dodecane, 5,8-diethyl- Ethyl 2-(5-methyl-5-vinyltetrahydrofuran-2-yl)propan-2-yl carbonate 1-nonanol 1-decanol, 2-hexyl 2-furanmethanol, 5-ethenyltetrahydro-a,a,5-trimethyl-, cis- Cyclohexane, decyl Cycloheptasiloxane, tetradecamethyl- Dodecane, 2-methyl-6-propyl Hexadecane, 2-methyl- 1,1'-biphenyl, 3,4-diethyl- Formamide, N,N-diethyl- 1-decanol, 2-ethyl 1-propanol, 2,2'-oxybis- 3-cyclohexene-1-methanol, a,a,4-trimethyl-, acetate Cyclopentasiloxane, decamethyl 1-hexanoyl-pyrrolidine-2-carboxylic acid, diisobutylamide Tetradecane, 4,11-dimethyl Nonanal Toluene 9-cyclohexylbicyclo(3.3.1)nonan-9-ol Cyclohexasiloxane, dodecamethyl Octanal	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Bissell Pet Pro Oxy Stain Destroyer for Carpet & Upholstery (continued)	Dimethylsilanediol 1-hexadecanol 1H-indene, 2,3,3a,4,7,7a-hexahydro-2,2,4,4,7,7-hexamethyl-, trans-Decyl isobutyl ether Octadecane Ethanol, 2-butoxy Cyclohexene, 4-(1,1-dimethylethyl) 7-oxabicyclo[2.2.1]heptane, 1-methyl-4-(1-methylethyl) 5-methoxyindane Heptane, 3-methylene 2,5-cyclohexadiene-1,4-dione, 2,6-bis(1,1-dimethylethyl) 2-ethylhexanol Cyclohexanemethanol, 4-(1-methylethyl)-, cis-	0.09 m ³ experimental chamber	Temkin et al (2023)
Boulder Clean Foaming Bathroom Cleaner	d-limonene 1-octanol Isopropanol Eucalyptol 7-octen-2-ol, 2,6-dimethyl Propanoic acid 1-decanol 9-decene-1-nitrile 1,4-cyclohexadiene, 1-methyl-4-(1-methylethyl)- Fenchyl acetate Acetic acid TXIB 3-cyclohexene-1-methanol, .α.,.α.,4-trimethyl-, (R)- Pentadecane 3-cyclohexen-1-carboxaldehyde, 3,4-dimethyl- 1-dodecanol Cetane Borneol Ethanol, 2-butoxy	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Boulder Clean Foaming Bathroom Cleaner (continued)	Tetradecane 2-tert-butylcyclohexyl acetate Bicyclo[2.2.1]heptan-2-ol, 1,3,3-trimethyl Acetaldehyde Heptadecane Pentadecane, 2,6,10-trimethyl- Dodecane, 5,8-diethyl- Tridecane, 6-propyl 1-decanol, 2-octyl- Acetamide, N-benzyl-2-oxo-2-(2-phenyl-1H-indol-3-yl)- 2-piperidinone, N-[4-bromo-n-butyl]- Dodecane, 1,2-dibromo Isoborneol Isophthalic acid, 3,3-dimethylbut-2-yl undecyl ester Cedrane, 8-propoxy- Myrcene Nonanal Hexadecane, 3-methyl 2(3H)-furanone, dihydro-5-pentyl Toluene Formaldehyde Isophthalic acid, heptyl 2,4,6-trichlorophenyl ester Cyclohexasiloxane, dodecamethyl Pentadecane, 2,6,10,14-tetramethyl Cyclohexane, decyl Benzeneethanol, a,b-dimethyl Octanal Dimethylsilanediol Hexanoic acid, 2-ethyl 3-cyclohexene-1-methanol, a,a,4-trimethyl-, acetate Pentadecane, 4-methyl Tridecane, 5-propyl Decanal	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Boulder Clean Foaming Bathroom Cleaner (continued)	Cyclododecyl isothiocyanate Decane, 5-ethyl-5-methyl 2-ethylhexanol Acetic acid, 1,3,7-trimethylocta-2,6-dienyl ester 1,3-cyclohexadiene, 1-methyl-4-(1-methylethyl)- Tridecane, 3-methyl 2,5,5,8a-tetramethyl-4-methylene-6,7,8,8a-tetrahydro-4H,5H-chromen-4a-yl hydroperoxide Formamide, N,N-diethyl- 1-butanol Terephthalic acid, but-2-enyl undecyl ester Dodecanal Nonane, 5-methyl-5-propyl 2-fluoro-5-trifluoromethylbenzoic acid, 3-hexadecyl ester Hexanal Dipropylene glycol	0.09 m ³ experimental chamber	Temkin et al (2023)
Clorox Clean-Up Cleaner + Bleach	Dichloromethane Chloroform 3-octanol, 3,7-dimethyl- 7-octen-2-ol, 2,6-dimethyl Hexanoic acid Butanal Formaldehyde Acetaldehyde Carbon tetrachloride TXIB Hexanal 1-dodecanamine, N,N-dimethyl- Methane, bromodichloro Formamide, N,N-diethyl- 1-dodecene Carbamic chloride, diethyl-	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Clorox Clean-Up Cleaner + Bleach (continued)	Cetane Acetic acid Cyclohexanol, 2-(1,1-dimethylethyl)-, trans- 2(3H)-furanone, dihydro-5,5-dimethyl- Pentadecane Dodecanal Tetradecane Heptadecane Benzeneacetic acid, .α.-hydroxy-.α.-phenyl-, 2-(dimethylamino)ethyl ester Bicyclo[2.2.1]heptan-2-one, 1,7,7-trimethyl-, (1R) Chloral Hydrate Isophthalic acid, cis-hex-3-enyl undecyl ester tert-hexadecanethiol Undecane E-9-methyl-8-tridecen-2-ol, acetate 1-dodecanol, 3,7,11-trimethyl Octanenitrile, 6-aza-2,8-bis(3,4-dimethoxyphenyl)-6-methyl-2-propyl- Cyclohexasiloxane, dodecamethyl Benzaldehyde Benzo[b]dihydropyran, 6-hydroxy-4,4,5,7,8-pentamethyl- 2-pentanone, 4-cyclohexylidene-3,3-diethyl- Benzoic Acid Dodecane, 5,8-diethyl- 2-propanone, 1,1,1-trichloro- Ethanol, 2-butoxy Cyclododecane 2-heptanone, 6-methyl Phenyl cyclohexyl ketone Acetonitrile, trichloro Hexadecane, 2-methyl- Dimethylsilanediol E-9-tetradecenoic acid	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Clorox Clean-Up Cleaner + Bleach (continued)	Toluene 1-butanol 2,2,9-trimethyldec-5-ene-3,8-dione Pentan-2-ol, 4-allyloxy-2-methyl- Tridecane, 2,5-dimethyl Pentanal 1,4-dioxane Undecanal Cyclohexane, decyl 2,6,9-undecatrione Benzene, 1-chloroethyl Propane, 1-(1,1-dimethylethoxy)-2-methyl 2,5-cyclohexadiene-1,4-dione, 2,6-bis(1,1-dimethylethyl) 1-cyclohexanol, 1-[5-hydroxy-4-methyl-2-hexenyl] Pentadecane, 4-methyl 6-dodecene, (E) Naphthalene-2,6-dicarboxylic acid, pentyl ester 4-pentyl-phenyl ester Decanal Phosphonofluoridic acid, methyl-, nonyl ester Cyclohexanol, 1-(2-hexenyl)- 2-ethylbutyric acid, 2,3,5-trichlorophenyl ester 3,3,5,5-tetramethylcyclohexyl isopropylphosphonofluoridate Methane, dibromochloro 2-butanone	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
CleanSmart Daily Surface Cleaner	Propanoic acid Formaldehyde Acetic acid TXIB Cetane Pentadecane Tetradecane 6,10,13-trimethyltetradecanol Heptafluorobutyric acid, pentadecyl ester Isophthalic acid, phenyl undecyl ester Hexadecane, 5-butyl- Dodecane, 5,8-diethyl- 3,7-dimethyl-6-nonen-1-ol acetate Dodecane, 2-methyl-8-propyl 2-piperidinone, N-[4-bromo-n-butyl]- Glycerol 1,2-diacetate Heptadecane Toluene Isophthalic acid, heptyl 2-methylprop-2-en-1-yl ester Tridecane Cyclohexane, (3-methylpentyl)- Tetradecane, 1-iodo Ethanol, 2-butoxy Terephthalic acid, but-2-enyl undecyl ester Tridecane, 2-methyl Hexadecane, 2,6,10-trimethyl-	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Bona Hard-Surface Floor Cleaner	1,3-dioxolane-4-methanol, 2,2-dimethyl-, (S)- Hexylene glycol Acetone Limonene 7-octen-2-ol, 2,6-dimethyl Formic acid, octyl ester Acetic acid 1,3-dioxane, 2,2-dimethyl-5-hydroxy- TXIB Isophthalic acid, 2-methylprop-2-en-1-yl undecyl ester Isopropanol Linalool Carbonic acid, but-3-yn-1-yl octyl ester Glycerol 1,2-diacetate 1,2-dihydropyridine, 1-(1-oxobutyl)- Nonanal Dimethylsilanediol Cyclotetrasiloxane, octamethyl 2-ethylhexanol Undecane, 5-ethyl Benzenemethanol, a-methyl-, acetate Benzaldehyde Ethylinalool Cyclotetradecene, 1,2-dimethyl- 2,5-di-tert-butylhydroquinone, trifluoroacetate Decanal	0.09 m ³ experimental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
General purpose cleaner	d-limonene Terpinolene α -terpineol Eucalyptol p-cymene α -terpinene γ -terpinene Camphene 1-terpineol α -pinene 4-terpineol β -terpineol γ -terpineol α -phellandrene β -pinene	50 m ³ experimental chamber simulating a residential room	Singer et al (2006b)
Glass cleaner	2-butoxyethanol 2-hexyloxyethanol	50 m ³ experimental chamber simulating a residential room	Singer et al (2006b)

Product(s)	Pollutants detected	Test conditions	Reference
Regular fragranced laundry cleaner	d-limonene isocineole α -terpinolene α -terpinene Cymene Ethanol γ -terpinene β -pinene 2,4-dimethyl-3-cyclohexene-1-carboxaldehyde α -pinene 2-butanone Camphene Tetrahydro-2,2-dimethyl-5-(1-methyl-1-propenyl) furan α -phellandrene n,n-dimethyl acetamide 6-methyl-5-hepten-2-one β -phellandrene α -fenchene	Headspace GC/MS	Steinemann (2015)

Product(s)	Pollutants detected	Test conditions	Reference
Regular fragranced laundry cleaner	ethanol d-limonene 2-methyl-2-propanol 1,4-dioxane 3,7-dimethyl-1,6-octadiene Ethyl acetate α-pinene β-pinene 2-butanone 1-methyl-3-(1-methylethyl)-cyclohexene 2,4-dimethyl-3-cyclohexene-1-carboxaldehyde undecane β-terpinene Benzyl acetate Dodecane α-terpinene Carene isomer	Headspace GC/MS	Steinemann (2015)

Product(s)	Pollutants detected	Test conditions	Reference
Regular fragranced laundry cleaner	Linalool Ethanol Benzyl acetate Cis-rose oxide carene isomer 2,4-dimethyl-3-cyclohexene-1-carboxaldehyde d-limonene Prenyl acetate 2,7-dimethyl-2,7-octanediol α -pinene Trans-rose oxide Eucalyptol α -phenylethyl acetate β -pinene Dimethyl-3-cyclohexene-1-carboxaldehyde Methyl benzoate Acetone Decanal	Headspace GC/MS	Steinemann (2015)

Product(s)	Pollutants detected	Test conditions	Reference
Regular fragranced laundry cleaner	Ethanol d-limonene Methoxy ethane α -pinene Benzyl acetate Isocineole β -pinene 2-methoxy propane Linalool (z)-3,4-dimethyl-3-hexen-2-one Chloromethane γ -terpinene coeluted with 2,7-dimethyl-2,7-octanediol Acetaldehyde 2,4-dimethyl-1,3-cyclopentanedione Prenyl acetate α -terpinolene Diethoxy methane 1,5-dimethyl-1,4-cyclohexadiene 1-methyltricyclo[2.2.1.0(2,6)]-heptane α -terpinene	Headspace GC/MS	Steinemann (2015)
Regular fragranced laundry cleaner	d-limonene Methanol 2,7-dimethyl-2,7-octanediol Butane (z)-2-(3,3-dimethylcyclohexylidene)ethanol Acetone Acetaldehyde β -pinene Carbonyl sulfide Isopropanol Ethanol	Headspace GC/MS	Steinemann (2015)

Product(s)	Pollutants detected	Test conditions	Reference
Regular fragrance-free laundry cleaner	Ethanol t-butyl alcohol 1,4-dioxane Ethyl ether Acetaldehyde Cumene Methanol Dodecane Undecane 1,3-dioxan-5-ol	Headspace GC/MS	Steinemann (2015)
Regular fragrance-free laundry cleaner	Ethanol Methoxy ethane 2-methoxy propane Ethyl formate t-butyl alcohol Chloromethane Acetaldehyde Diethoxy methane Chloroethane	Headspace GC/MS	Steinemann (2015)
Regular fragrance-free laundry cleaner	Ethanol Methanol Acetaldehyde Carbon disulfide	Headspace GC/MS	Steinemann (2015)
Regular fragrance-free laundry cleaner	Ethanol 2-butanone Undecane Acetaldehyde	Headspace GC/MS	Steinemann (2015)

Product(s)	Pollutants detected	Test conditions	Reference
Fragrance-free 'green' laundry cleaner	Methanol Dimethyl ether Ethanol Methyl butanoate Methyl propionate Methyl pentanoate Pentane Methyl hexanoate Acetone 1-propanol Methyl acetate Undecane 2,2,3-trimethylpentane	Headspace GC/MS	Steinemann (2015)
Fragrance-free 'green' laundry cleaner	Ethanol Acetone Methanol Isopropanol 1,4-dioxane 2-methoxy propane Butane Carbonyl sulfide	Headspace GC/MS	Steinemann (2015)
Regular fragranced cleaner	Ethanol 3-methoxy-3-methylbutanol d-limonene Ethyl acetate Cumene α -pinene β -pinene α -terpinene	Headspace GC/MS	Steinemann (2015)

Product(s)	Pollutants detected	Test conditions	Reference
Regular fragranced cleaner	Ethanol α -pinene β -pinene Ethyl acetate d-limonene Cyclohexane	Headspace GC/MS	Steinemann (2015)
Fragranced 'green' cleaner	Eucalyptol d-limonene Isocineole Camphor Cymene β -pinene α -pinene 2-butanone Butanal γ -terpinene 1-methoxy-4-propylbenzene α -terpinolene Cyclohexane 2-butoxy-ethanol α -phellandrene Acetone Tridecane Camphene Dodecane	Headspace GC/MS	Steinemann (2015)

Product(s)	Pollutants detected	Test conditions	Reference
Regular fragranced cleaner	1-butoxy-2-propanol Eucalyptol n,n-dimethyl acetamide 4-tert-butylcyclohexyl acetate Di-sec-butyl ether 2,7-dimethyl-2,7-octanediol Cis-rose oxide 3-methoxy-3-methylbutanol 4-heptanone Carene isomer 2,3-epoxyhexanol	Headspace GC/MS	Steinemann (2015)
Fragranced 'green' cleaner	d-limonene β -pinene Isopropanol α -pinene 6-methyl-5-hepten-2-one Acetaldehyde β -phellandrene Methanol γ -terpinene Ethanol 3,4-dimethyl-3-cyclohexene-1-carboxaldehyde Butane α -terpinene α -terpinolene Carene isomer Carbonyl sulfide Cymene α -phellandrene Acetone	Headspace GC/MS	Steinemann (2015)

Product(s)	Pollutants detected	Test conditions	Reference
Fragranced 'green' cleaner	d-limonene Isopropanol γ -terpinene β -pinene α -terpinolene α -terpinene Isocineole α -pinene methanol Cymene Camphene 2-ethenyltetrahydro-2,6,6-trimethyl-2H-pyran α -phellandrene Trans-ocimene Cis-ocimene α -fenchene Acetone 1-methyl-1,4-cyclohexadiene Dodecane Menthone Butane α -thujene β -phellandrene Undecane	Headspace GC/MS	Steinemann (2015)
Fragranced 'green' cleaner	Isopropanol Acetone Ethanol Butane 2,7-dimethyl-2,7-octanediol Carbonyl sulfide	Headspace GC/MS	Steinemann (2015)

Product(s)	Pollutants detected	Test conditions	Reference
Dust, shine and protect cleaner	Butane Isopentane 5-Butylnonane Tridecane 6-methylundecane 2,3-dimethyloctane 2,4-dimethyldodecane 2,3,4-trimethyldecane 6-methyltridecane 2,6,11-trimethyldodecane 2,2,3,3,5,6,6-heptamethylheptane 5-methylundecane Limonene 2,5-dimethyldodecane 3,6-dimethylundecane 2,3,4-trimethylpentane Pentane Dodecane 2,2,4,6,6-pentamethylheptane 2-butene	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
Glass spray cleaner	Propylene glycol butyl ether Ethanol D,l-isobornyl acetate Dihydromyrcenol Di-sec-butyl ether 2-methyl-2-(4-methylpent-3-enyl)cyclopropane-1-carbaldehyde Methanol Eucalyptol Ethyl acetate Decanal Cyclopropane, 1-methyl-2-(1-methylethyl)-3-(1-methylethylidene)-, cis- 4-tert-butylcyclohexyl acetate 2-methylundecanal (R)-(+)- β -citronellol (-)-camphor o-cymene Hexyl acetate 3-ethyl-3-methyl-1-pentene Octanal Acetylpentacarbonylmanganese	Headspace GC/MS	Nematollahi et al (2019)
Glass spray cleaner	2-hexyloxyethanol Limonene Linalool 1-octanol 4-tert-butylcyclohexyl acetate Tridecane Tetracarbonylnickel	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
Hand dishwashing liquid	Limonene β -trans-ocimene β -pinene Eucalyptol 1,4-cineole Terpinolene 3-methylhexane Dihydromyrcenol 2-methylhexane γ -terpinene Camphene 6-methyl-1,6-heptadiene 2,3-dimethylpentane Heptane (-)-camphor Isoamyl acetate 3,5-dimethyloctane o-cymene Carbon monoxide Tridecane	Headspace GC/MS	Nematollahi et al (2019)
Oven and BBQ cleaner	Limonene 1,4-cineole Eucalyptol p-cymene Acetone β -trans-ocimene Dihydromyrcenol Terpinolene Camphene 2-methyl-2-(4-methylpent-3-enyl)cyclopropane-1-carbaldehyde β -myrcene Carbon monoxide	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
Wooden furniture cleaner	Methanol 4-dodecene 1,4-dioxane (E)-2-dodecene 2-methylenehexanal Undecane Carbon monoxide 2,2-dimethylbutane 2,2,6-trimethyloctane 2-pentylfuran Hexanal Amitrole Vinyl formate	Headspace GC/MS	Nematollahi et al (2019)
Bathroom power gel	Carbon tetrachloride Chloroform 1,1-dichloroethylene Tetracarbonylnickel Decane N-chlorodimethylamine 4-tert-butylcyclohexyl acetate 6-methyl-5-hepten-2-one Diphenyl ether	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
Dishwashing liquid	Limonene β -trans-ocimene Terpinolene Eucalyptol 1,4-cineole Octanal 1-methyl-2-(3-methylpentyl)cyclopropane β -myrcene Camphene 1-isopropyl-2-methyl-3-(1-methylethylidene)cyclopropane γ -terpinene Carbon monoxide Acetaldehyde Octylcyclopropane o-cymene	Headspace GC/MS	Nematollahi et al (2019)
Dishwasher liquid	Limonene Eucalyptol 1,4-cineole β -myrcene Terpinolene (Z)-linalool oxide β -trans-ocimene 2-methyl-2-(4-methylpent-3-enyl)cyclopropane-1-carbaldehyde Dihydromyrcenol 4-tert-butylcyclohexyl acetate 6-methyl-5-hepten-2-one γ -terpinene Sabinene β -pinene Linalool Camphene Tetracarbonylnickel	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
Multi-purpose kitchen spray	Ethanol Limonene (E)-2,5-dimethyl-1,6-octadiene Eucalyptol 4-tert-butylcyclohexyl acetate 1-(1,2-dimethyl-cyclopent-2-enyl)-ethanone 2-(2-hydroxypropoxy)-1-propanol 1,3-dimethyl-2-(1-methylethyl)cyclopentene 1-[2-(allyloxy)-1-methylethoxy]-2-propanol 2,7-dimethyl-1,7-octadiene 1-isopropyl-2,3-dimethyl-1-cyclopentene Cyclopropane, 1-methyl-2-(1-methylethyl)-3-(1-methylethylidene)-, cis- (E)-citral 6-methyl-5-hepten-2-one Terpinyl acetate trans-3-isopropyl-6-methylcyclohexene Acetaldehyde Dihydromyrcenol β-citral Isocitronellene	Headspace GC/MS	Nematollahi et al (2019)
'Green' rinse aid	Ethanol Ethyl acetate Isopropanol 1-octanol Ethyl butyrate 1-undecanol Octyl acetate Acetaldehyde	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
'Green' dishwash liquid	Limonene γ -terpinene β -myrcene β -trans-ocimene (Z)- β -ocimene Sabinene α -phellandrene 1,4-dioxane β -phellandrene Undecane Terpinolene 4-dodecene (E)-2-dodecene	Headspace GC/MS	Nematollahi et al (2019)
'Green' dish liquid	Limonene β -myrcene β -trans-ocimene Benzyl alcohol 3-methylpentane Methylcyclopentane Hexane Octane Undecane 3-carene Sabinene β -trans-ocimene 2-methylpentane	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
'Green' glass cleaner	Isopropanol Limonene Menthone α -pinene D,L-menthol β -pinene Sabinene Eucalyptol DL-menthyl acetate 6-Methyl-1,6-heptadiene Dihydroterpineol 4,5,6,7-tetrahydro-3,6-dimethylbenzofuran Camphene γ -terpinene Caryophyllene 4-carene α -phellandrene Pulegone 3-octanol Terpinolene	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
'Green' multipurpose cleaner	Ethanol Limonene Methanol Ethyl acetate 4-tert-butylcyclohexyl acetate Methyl hexanoate Hexyl acetate Methyl valerate Methyl laurate Methyl butyrate Hexyl propionate β-myrcene Methyl propionate Allyl heptanoate Methyl acetate	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
'Green' multipurpose cleaner	Limonene Ethanol β -myrcene 3-methoxy-3-methylbutanol β -pinene β -trans-ocimene Linalool Methanol γ -terpinene L-menthol Sabinene 1-octanol α -fenchene Camphene 3-carene Octanal Menthone Terpinyl acetate β -trans-ocimene 1-decanol	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
'Green' bathroom cleaner	Limonene Eucalyptol Ethanol o-cymene Acetaldehyde γ-terpinene 4-carene Camphene β-trans-ocimene 2-isopropenyltoluene 4-terpineol 5,5-dimethylcyclopentadiene (-)-camphor Terpinolene 3'-methylacetophenone β-myrcene 1-acetyl-2-methyl-1-cyclopentene p,α,α-trimethylbenzyl alcohol Ethyl acetate Acetone	Headspace GC/MS	Nematollahi et al (2019)
'Green' everyday cleaner	Limonene Ethanol β-trans-ocimene β-myrcene Sabinene Octanal Eucalyptol γ-terpinene	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
'Green' bathroom and shower cleaner	Ethanol Methyl isobutyl ketone (E)-5-tetradecene Acetone Acetaldehyde (E)-3-tetradecene (Z)-7-tetradecene	Headspace GC/MS	Nematollahi et al (2019)
'Green' dishwashing liquid	(S)-p-mentha-1,8-diene β-myrcene β-trans-ocimene 6-methyl-5-hepten-2-one Acetaldehyde 2-methyl-4-penten-2-ol Ethanol 3-methyl-1-hexene Sabinene	Headspace GC/MS	Nematollahi et al (2019)
Almond milk laundry cleaner	Tetrahydrolinalool Dihydromyrcenol 4-tert-butylcyclohexyl acetate 2,4-dimethylpentane 1-propanol Dibutyl phthalate 2-tert-butylcyclohexanol 3-phenyl-2-butanone 4,4'-isopropylidenebis(2,6-dimethylphenol) Verdyl acetate n-butyl ether N-butylbenzenesulfonamide 1-hexanol Allyl alcohol Acetaldehyde	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
Lemon fresh laundry cleaner	Limonene 1,4-cineole Terpinolene Camphene Eucalyptol γ -terpinene Octanal α -pinene 2,4,6-trimethyl-3-cyclohexene-1-carboxaldehyde Dihydromyrcenol (+)-camphene β -myrcene Decanal 2-methyl-2-(4-methylpent-3-enyl)cyclopropane-1-carbaldehyde Cyclofenchene 3,7-dimethyl-7-octenal p-cymene β -trans-ocimene α -phellandrene n-butyl ether	Headspace GC/MS	Nematollahi et al (2019)
Laundry cleaner mix	D,l-isobornyl acetate 4-tert-butylcyclohexyl acetate Tridecane α -pinene Benzyl acetate 1,4-cineole (-)-camphene Acetaldehyde 3-methylene-1,7-octadiene 3-methyldecane Eucalyptol	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
Laundry cleaner mix	Limonene 4-tert-butylcyclohexyl acetate Eucalyptol Tetrahydrolinalool 1,4-cineole δ -undecalactone Dihydromyrcenol α -pinene Ethanol 2-tert-butylcyclohexanol Terpinolene Acetaldehyde D-carvone Camphene 6-methyl-5-hepten-2-one 2-methyl-2-(4-methylpent-3-enyl)cyclopropane-1-carbaldehyde 2-methylundecanal	Headspace GC/MS	Nematollahi et al (2019)
Fabric softener	Ethanol Ethyl methyl ether Octamethylcyclotetrasiloxane Isopropanol Limonene Tetrahydrolinalool 3,5,5-trimethylhexyl acetate 2-tert-butylcyclohexanol Decamethylcyclopentasiloxane p-tert-butyl cyclohexyl-acetate cis 4-tert-butylcyclohexanol trans-rose oxide Acetaldehyde 4-tert-butylcyclohexyl acetate 2-(4-tert-butylbenzyl)propionaldehyde	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
Fabric softener (continued)	Hexyl acetate	Headspace GC/MS	Nematollahi et al (2019)
Ironing spray	Butane Isopentane Limonene Octamethylcyclotetrasiloxane Pentane Decamethylcyclopentasiloxane Tetrahydrolinalool β -myrcene Linalool Dihydromyrcenol (R)-(+)- β -citronellol 2-carene Terpinolene Linalyl acetate β -phellandrene Eucalyptol α -pinene Cyclopropane, 1,1-dimethyl-2-(3-methyl-1,3-butadienyl)- 6-methyl-5-hepten-2-one γ -terpinene	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
Fabric conditioner	Isopropanol Methanol Methyl isopropyl ether Tetrahydrolinalool Dihydromyrcenol Eucalyptol Terpinyl acetate Linalool Diisopropyl ether Limonene α -isomethyl ionone (-)-camphor β -pinene p-anisaldehyde 2-methoxyethyl acetate Toluene Camphene Acetaldehyde β -myrcene	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
Fabric softener	Isopropanol Limonene Ethyl 2-methylbutyrate Myrtanyl acetate Ethyl 2-methylpentanoate Methyl isopropyl ether Methanol Dihydromyrcenol 2,6-dimethyl-2-octanol α -pinene (Z)-rose oxide Eucalyptol Methyl phenylcarbinyl acetate Terpinyl acetate Benzyl acetate Camphene 4-tert-butylcyclohexyl acetate 2-tert-butylcyclohexanol Benzyl propionate Acetaldehyde	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
Laundry cleaner mix	Limonene Myrtanyl acetate α -pinene Ethyl 2,3-dimethylbutanoate Isopropanol Eucalyptol β -pinene Dihydromyrcenol Camphene 1-pentanol 2-methyl-1-butanol Ethyl 2-methylbutyrate 2,4-dimethylpentane Ethanol	Headspace GC/MS	Nematollahi et al (2019)
Laundry cleaner mix	Limonene Dihydromyrcenol β -myrcene α -pinene 4-tert-butylcyclohexyl acetate Ethanol Hexyl acetate Ethyl 2,3-dimethylbutanoate 2-(1,1-dimethyl-2-propenyl)-1,1-dimethylcyclopropane Cyclopropane, 1,1-dimethyl-2-(3-methyl-1,3-butadienyl)- Terpinyl acetate Acetone Acetaldehyde Heptane	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
'Green' lavender laundry cleaner	Linalool Limonene Eucalyptol β -myrcene Acetaldehyde (+)-camphor Caryophyllene α -pinene α -terpineol m-cymene 2-methylfuran Terpinolene Neryl acetate Lavandulyl acetate 4-terpineol 3-ethyl-2-methyl-1,3-heptadiene 1-octanol Camphene Linalyl anthranilate 3-carene	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
'Green' fabric conditioner	Limonene Ethanol Eucalyptol α -pinene β -myrcene Hexane Benzyl alcohol β -phellandrene Methylcyclopentane 3-methylpentane γ -terpinene 2,4-dimethylhexane β -trans-ocimene Ethyl methyl ether 2-methylpentane α -phellandrene Octanal Undecane Ethyl formate Acetaldehyde	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
'Green' laundry cleaner	Limonene α -pinene β -myrcene Benzyl alcohol Linalool Eucalyptol β -trans-ocimene Linalyl acetate β -phellandrene γ -terpinene (+)-camphor 3-carene Camphene 2-carene Caryophyllene Terpinolene Octanal α -terpineol	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
'Green' laundry cleaner	Eucalyptol Limonene (1R)-(+)- α -Pinene γ -terpinene o-cymene α -thujene β -myrcene β -pinene β -phellandrene 2-carene Terpinolene Toluene Amyl butyrate Ethanol Ethyl butyrate Isoamyl butylate Isoamyl acetate 2-methylpropan-1-ol α -phellandrene Camphene	Headspace GC/MS	Nematollahi et al (2019)
'Green' laundry cleaner	6-methyl-5-hepten-2-one Acetaldehyde Limonene d-verbenol β -citral 1-octanol Acetone β -myrcene	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
'Green' laundry cleaner	Linalyl acetate 5-isopropenyl-1-methyl-1-cyclohexene Linalool Eucalyptol 3-octanone Hexyl acetate β -myrcene (+)-camphor 3-octyl acetate α -pinene Caryophyllene Dodecane α -terpineol Camphene (Z)-7-tetradecene Terpinolene Nonylcyclopropane Cyclopropane, 1,1-dimethyl-2-(3-methyl-1,3-butadienyl)- 3-ethyl-2-methyl-1,3-heptadiene	Headspace GC/MS	Nematollahi et al (2019)
'Green' fabric conditioner	Isopropanol Limonene Acetone Methyl isopropyl ether Eucalyptol 2,6-di-tert-butyl-4-methylphenol Methoxyacetic acid Methanol Dihydromyrcenol γ -terpinene	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
'Green' wool and delicates cleaner	Eucalyptol Limonene o-cymene (1R)-(+)- α -pinene γ -terpinene α -phellandrene β -pinene β -myrcene β -phellandrene 2-carene Acetone β -trans-ocimene Ethanol Terpinolene	Headspace GC/MS	Nematollahi et al (2019)
'Green' laundry cleaner mix	Limonene 1-pentanol Acetone (Z)-7-tetradecene α -pinene ($\pm$)-2-methyl-1-butanol Sabinene 2-octanone 1-octyl trifluoroacetate Acetaldehyde 1-hexanol 1,3,6-trioxocane	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
'Green' laundry cleaner	Limonene α -pinene β -myrcene Acetaldehyde β -phellandrene (Z)- β -ocimene γ -terpinene 2-methylfuran Octanal 1-octanol	Headspace GC/MS	Nematollahi et al (2019)
'Green' fragrance-free laundry liquid	Ethanol 1-octanol	Headspace GC/MS	Nematollahi et al (2019)
'Green' fragrance-free laundry liquid	3-methoxy-3-methylbutanol 2-propylheptanol Nonane Acetaldehyde	Headspace GC/MS	Nematollahi et al (2019)
'Green' fragrance-free laundry liquid	Ethanol 2-methyl-2-propanol	Headspace GC/MS	Nematollahi et al (2019)
'Green' fragrance-free dish liquid	Ethanol Carbon tetrachloride	Headspace GC/MS	Nematollahi et al (2019)
Fragrance-free laundry liquid	Acetone Acetaldehyde	Headspace GC/MS	Nematollahi et al (2019)

Where possible, chemicals are listed in order of abundance.

Table 13 VOCs emitted by electronic equipment

Product(s)	Pollutants detected	Test conditions	Reference
New computer monitor	Acetic acid Cyclopentadiene Isoprene Acrylamide Propylamide Cyclohexadiene Hexene Butanamide Norbornene Pentanamide 4-vinylcyclohexene Propenylbenzene Allylcyclohexane Cyclohexyl methyl ketone Nonene Cyclohexyl acetone Nonanal Octanoic acid Nonanoic acid 1,9-nonenediol 1,1'-bi(cyclohexan)]-3-ene Decanoic acid 4'-methyl-[1,1'-bi(cyclohexan)]-3-ene 4'-ethyl-[1,1'-bi(cyclohexan)]-3-ene 4-(prop-1-en-1-yl)cyclohexyl benzene 4-propylcyclohexyl benzene 4-phenylcyclohexane-1-carboxylic acid 4'-(prop-1-en-1-yl)-[1,1'-bi(cyclohexan)]-3-ene 4-(prop-1-en-1-yl)-1,1'-bi(cyclohexane) 4'-butyl-[1,1'-bi(cyclohexan)]-3-ene	Flow cell system placed directly on the LCD screen	Liu and Abbatt (2021)

Product(s)	Pollutants detected	Test conditions	Reference
Used laptop	Acetic acid Cyclopentadiene Furan Isoprene Acrylamide Butanone Propylamide Cyclohexadiene Cyclohexene Hexene Butanamide Norbornene Methylcyclohexene Pentanamide 4-vinylcyclohexene 3,4-dimethyl-cyclohexene Octene Propenylbenzene Allylcyclohexene Allylcyclohexane Cyclohexyl methyl ketone Nonene Octanal Butylcyclohexene Cyclohexyl acetone Decene Nonanal Octanoic acid 1,8-octanediol Menthone Cyclohexanepropionic acid Nonanoic acid 1,9-nonanediol	Flow cell system placed directly on the LCD screen	Liu and Abbatt (2021)

Product(s)	Pollutants detected	Test conditions	Reference
Used laptop (continued)	1,1'-bi(cyclohexan)]-3-ene Decanoic acid 4'-methyl-[1,1'-bi(cyclohexan)]-3-ene 4'-ethyl-[1,1'-bi(cyclohexan)]-3-ene 4-(prop-1-en-1-yl)cyclohexyl)benzene 4-propylcyclohexyl benzene 4-phenylcyclohexane-1-carboxylic acid 4'-(prop-1-en-1-yl)-[1,1'-bi(cyclohexan)]-3-ene 4-(prop-1-en-1-yl)-1,1'-bi(cyclohexane) 4'-butyl-[1,1'-bi(cyclohexan)]-3-ene	Flow cell system placed directly on the LCD screen	Liu and Abbatt (2021)
New television	Acetic acid Cyclopentadiene Isoprene Acrylamide Butanone Propylamide Cyclohexadiene Cyclohexene Hexene Norbornene Methylcyclohexene Heptene Pentanamide 4-vinylcyclohexene 3,4-dimethyl-cyclohexene Propenylbenzene Allylcyclohexene Allylcyclohexane Cyclohexyl methyl ketone Octanal 1,7-heptanediol Cyclohexyl acetone	Flow cell system placed directly on the LCD screen	Liu and Abbatt (2021)

Product(s)	Pollutants detected	Test conditions	Reference
New television (continued)	Nonanal Octanoic acid 1,8-Octanediol Nonanoic acid 1,9-nonanediol 4-(prop-1-en-1-yl)cyclohexyl)benzene 4-propylcyclohexyl benzene 4-phenylcyclohexane-1-carboxylic acid 4'-(prop-1-en-1-yl)-[1,1'-bi(cyclohexan)]-3-ene 4-(prop-1-en-1-yl)-1,1'-bi(cyclohexane) 4'-butyl-[1,1'-bi(cyclohexan)] 4'-butyl-[1,1'-bi(cyclohexan)]-3-ene	Flow cell system placed directly on the LCD screen	Liu and Abbatt (2021)
Computer	Naphthalene Phenanthrene Fluorene Acenaphthene Fluoranthene Anthracene Pyrene Acenaphthylene Benzo[a]anthracene Chrysene	Gas samples collected from inside computers using passive air samplers.	Seo et al (2022)

Product(s)	Pollutants detected	Test conditions	Reference
Laser printer	Trimethylbenzene Xylenes Decamethylcyclopentasiloxane Butyl acetate Styrene Ethylbenzene Toluene Chlorobenzene Naphthalene Trichloroethylene Benzene Tetrachloroethylene 1,4-dichlorobenzene	0.3 m ³ experimental chamber	Kowalska et al (2015)
Laser printer	Decamethylcyclopentasiloxane Toluene Styrene Trimethylbenzene Ethylbenzene Butyl acetate Chlorobenzene Benzene Xylenes Trichloroethylene Tetrachloroethylene 1,4-dichlorobenzene 1,2-dichlorobenzene 1,2,4-trichlorobenzene	0.3 m ³ experimental chamber	Kowalska et al (2015)

Product(s)	Pollutants detected	Test conditions	Reference
Inkjet printer	Decamethylcyclopentasiloxane Toluene Xylenes Trimethylbenzene Ethylbenzene Naphtalene Benzene Tetrachloroethylene Styrene Trichloroethylene Chlorobenzene 1,4-dichlorobenzene 1,2-dichlorobenzene	0.3 m ³ experimental chamber	Kowalska et al (2015)
Multi-function device	α-methylstyrene Benzene Xylenes Decamethylcyclopentasiloxane Ethylbenzene Trimethylbenzene Toluene Chlorobenzene Naphthalene Tetrachloroethylene 1,4-dichlorobenzene	0.3 m ³ experimental chamber	Kowalska et al (2015)

Product(s)	Pollutants detected	Test conditions	Reference
3D printer using PLA filament	Lactide Propylene glycol Caprolactam Undecane Decanal Nonanal 5-hepten-2-one, 6-methyl- 1,2-benzenedicarboxylic acid, bis(2-methylpropyl) ester n-hexadecanoic acid Tetradecanoic acid 1-hexanol, 2-ethyl Heptane, 2,4-dimethyl- Octane, 4-methyl Nonane, 2,6-dimethyl Decane, 4-methyl	130 l experimental chamber	Finnegan et al (2023)
3D printer using PLA filament	Lactide Propylene glycol Caprolactam Decanal Nonanal 5-hepten-2-one, 6-methyl- 1,2-benzenedicarboxylic acid, bis(2-methylpropyl) ester Linalool 1-hexanol, 2-ethyl Heptane, 2,4-dimethyl- Octane, 4-methyl Nonane, 2,6-dimethyl	130 l experimental chamber	Finnegan et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
3D printer using PLA filament	Lactide Propylene glycol Caprolactam Decanal Nonanal 5-hepten-2-one, 6-methyl- 1,2-benzenedicarboxylic acid,bis(2-methylpropyl) ester Tetradecanoic acid n-hexadecanoic acid Linalool 1-hexanol, 2-ethyl Heptane, 2,4-dimethyl- Octane, 4-methyl Nonane, 2,6-dimethyl	130 l experimental chamber	Finnegan et al (2023)
3D printer using PLA filament	Lactide Propylene glycol Caprolactam Decanal Nonanal 5-hepten-2-one, 6-methyl- 1,2-benzenedicarboxylic acid,bis(2-methylpropyl) ester n-hexadecanoic acid Tetradecanoic acid Linalool 1-hexanol, 2-ethyl Heptane, 2,4-dimethyl- Octane, 4-methyl Nonane, 2,6-dimethyl	130 l experimental chamber	Finnegan et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
3D printer using PLA filament	Lactide Propylene glycol Caprolactam Undecane Decanal Nonanal 5-hepten-2-one, 6-methyl- 1,2-benzenedicarboxylic acid, bis(2-methylpropyl) ester n-hexadecanoic acid Linalool 1-hexanol, 2-ethyl Heptane, 2,4-dimethyl- Octane, 4-methyl Nonane, 2,6-dimethyl	130 l experimental chamber	Finnegan et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
3D printer using PLA filament	Lactide Caprolactam Propylene glycol Undecane Decane Decanal Nonanal Benzaldehyde 5-hepten-2-one, 6-methyl- 1,2-benzenedicarboxylic acid, bis(2-methylpropyl) ester Benzene, 1,2,4,5-tetramethyl-o-xylene n-hexadecanoic acid Tetradecanoic acid Benzyl alcohol Linalool 1-hexanol, 2-ethyl Heptane, 2-methyl Heptane, 2,4-dimethyl- Octane, 4-methyl Nonane, 2-methyl Nonane, 2,5-dimethyl Nonane, 2,6-dimethyl Undecane, 2-methyl Undecane, 2,6-dimethyl	130 l experimental chamber	Finnegan et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
3D printer using PLA filament	Lactide Propylene glycol Caprolactam Undecane Dodecane Decane Decanal Nonanal Octanal 5-hepten-2-one, 6-methyl- 1,2-benzenedicarboxylic acid,bis(2-methylpropyl) ester Benzene, 1,2,4,5-tetramethyl-o-xylene Benzene, 1,3-dimethyl- Linalool Benzyl alcohol 1-hexanol, 2-ethyl Heptane, 2-methyl Heptane, 2,4-dimethyl Octane, 4-methyl Nonane, 2-methyl Nonane, 4-methyl Nonane, 2,5-dimethyl Nonane, 2,6-dimethyl Decane, 4-methyl Decane, 5-methyl Undecane, 2-methyl Undecane, 2,4-dimethyl Undecane, 2,6-dimethyl	130 l experimental chamber	Finnegan et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
3D printer using PLA filament	Lactide Propylene glycol Caprolactam Undecane Decane Decanal Nonanal Octanal Benzaldehyde 5-hepten-2-one, 6-methyl- 1,2-benzenedicarboxylic acid,bis(2-methylpropyl) ester Benzene, 1,2,4,5-tetramethyl- Benzene, 1,3-dimethyl-o-xylene n-hexadecanoic acid Tetradecanoic acid Benzyl alcohol 1-hexanol, 2-ethyl Heptane, 2-methyl Heptane, 2,4-dimethyl Octane, 4-methyl Nonane, 2-methyl Nonane, 4-methyl Nonane, 2,5-dimethyl Nonane, 2,6-dimethyl Decane, 4-methyl Undecane, 2-methyl Undecane, 2,6-dimethyl	130 l experimental chamber	Finnegan et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
3D printer using ABS filament	Styrene Isophorone Ethylbenzene Nonanal Octanal Decanal Benzaldehyde Acetophenone 5-hepten-2-one, 6-methyl- 2-ethylhexyl salicylate Octan-2-yl palmitate Isopropyl myristate Acetic acid, 2-ethylhexyl ester Bis(2-ethylhexyl) phthalate o-xylene Benzene (1-methylethyl)- Benzene, 1,2,4,5-tetramethyl- Benzene, propyl- Tetradecanoic acid 1-octadecanol 1-hexanol, 2-ethyl- 1-hexadecanol Phenol Heptane, 2,4-dimethyl Octane, 4-methyl Nonane, 2-methyl Nonane, 4-methyl Nonane, 2,6-dimethyl Decane, 4-methyl Undecane, 2-methyl Undecane, 2,6-dimethyl	130 l experimental chamber	Finnegan et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
3D printer using ABS filament	Isophorone Styrene Ethylbenzene Undecane Decane Nonanal Benzaldehyde Decanal Octanal Acetophenone 5-hepten-2-one, 6-methyl- Octan-2-yl palmitate Acetic acid, 2-ethylhexyl ester Bis(2-ethylhexyl) phthalate 2-ethylhexyl salicylate 1,2-benzenedicarboxylic acid,bis(2-methylpropyl) ester Benzene (1-methylethyl)-o-xylene Benzene, 1,2,4,5-tetramethyl- Benzene, propyl- n-hexadecanoic acid Tetradecanoic acid 1-hexanol, 2-ethyl- 1-octadecanol 1-hexadecanol Phenol Heptane, 2-methyl- Heptane, 2,4-dimethyl Octane, 4-methyl Nonane, 2-methyl Nonane 2,5-dimethyl Dodecane, 2,6,11-trimethyl	130 l experimental chamber	Finnegan et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
3D printer using ABS filament	Styrene Isophorone Ethylbenzene Undecane Decane Benzaldehyde Nonanal Decanal Octanal Acetophenone 5-hepten-2-one, 6-methyl- Octan-2-yl palmitate 2-ethylhexyl salicylate Bis(2-ethylhexyl) phthalate Isopropyl myristate Acetic acid, 2-ethylhexyl ester 1,2-benzenedicarboxylic acid, bis(2-methylpropyl) ester o-xylene Benzene, (1-methylethyl)- Benzene, 1,2,4,5-tetramethyl- Benzene, propyl Benzene, pentamethyl n-hexadecanoic acid Tetradecanoic acid 1-hexanol, 2-ethyl- 1-octadecanol 1-hexadecanol Phenol Heptane, 2,4-dimethyl Octane, 4-methyl Nonane, 2-methyl Nonane, 2,5-dimethyl	130 l experimental chamber	Finnegan et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
3D printer using ABS filament (continued)	Nonane, 2,6-dimethyl Decane, 4-methyl Undecane, 2-methyl Undecane, 2,6-dimethyl Undecane, 4,8-dimethyl Dodecane, 2,6,11-trimethyl	130 l experimental chamber	Finnegan et al (2023)
3D printer using ABS filament	Styrene Isophorone Ethylbenzene Undecane Decane Nonanal Benzaldehyde Decanal Octanal Acetophenone Octan-2-yl palmitate Bis(2-ethylhexyl) phthalate 1,2-benzenedicarboxylic acid,bis(2-methylpropyl) ester 2-ethylhexyl salicylate Isopropyl myristate Benzene, (1-methylethyl)- Benzene, 1,2,4,5-tetramethyl-o-xylene Benzene, propyl n-hexadecanoic acid Tetradecanoic acid 1-octadecanol 1-hexanol, 2-ethyl- 1-hexadecanol Phenol	130 l experimental chamber	Finnegan et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
3D printer using ABS filament (continued)	Heptane, 2,4-dimethyl Octane, 4-methyl Nonane, 2-methyl Nonane, 2,5-dimethyl Nonane, 2,6-dimethyl Decane, 4-methyl Decane, 5-methyl Undecane, 2,6-dimethyl Undecane, 4,8-dimethyl	130 l experimental chamber	Finnegan et al (2023)
3D printer using ABS filament	Isophorone Ethylbenzene Styrene Undecane Decane Nonanal Decanal Benzaldehyde Octanal 5-hepten-2-one, 6-methyl- Acetophenone Octan-2-yl palmitate 2-ethylhexyl salicylate Bis(2-ethylhexyl) phthalate Acetic acid, 2-ethylhexyl ester Isopropyl myristate o-xylene Benzene, (1-methylethyl)- Benzene, propyl Benzene, 1,2,4,5-tetramethyl- Benzene, pentamethyl n-hexadecanoic acid Tetradecanoic acid	130 l experimental chamber	Finnegan et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
3D printer using ABS filament (continued)	1-hexanol, 2-ethyl 1-octadecanol 1-hexadecanol Heptane, 2-methyl Heptane, 2,4-dimethyl Octane, 4-methyl Nonane, 2-methyl Nonane, 2,5-dimethyl Nonane, 2,6-dimethyl Decane, 4-methyl Undecane, 2-methyl Undecane, 2,6-dimethyl Undecane, 4,8-dimethyl	130 l experimental chamber	Finnegan et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
3D printer using ABS filament	Ethylbenzene Isophorone Styrene Undecane Nonanal Benzaldehyde Decanal Octanal 5-hepten-2-one, 6-methyl- Acetophenone Octan-2-yl palmitate 2-ethylhexyl salicylate Acetic acid, 2-ethylhexyl ester o-xylene Benzene, 1,2,4,5-tetramethyl- Benzene, (1-methylethyl)- Benzene, propyl 1-hexanol, 2-ethyl- 1-octadecanol 1-hexadecanol Heptane, 2-methyl Heptane, 2,4-dimethyl Octane, 4-methyl Nonane, 2-methyl Nonane, 2,5-dimethyl Nonane, 2,6-dimethyl Decane, 4-methyl Undecane, 2,6-dimethyl Undecane, 4,8-dimethyl Dodecane, 2,6,11-trimethyl	130 l experimental chamber	Finnegan et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
3D printer using ABS filament	Ethylbenzene Isophorone Styrene Undecane Nonanal Benzaldehyde Octan-2-yl palmitate o-xylene Benzene, (1-methylethyl)- Benzene, 1,2,4,5-tetramethyl- Benzene, propyl n-hexadecanoic acid 1-octadecanol 1-hexadecanol 1-hexanol, 2-ethyl- Heptane, 2-methyl Heptane, 2,4-dimethyl Octane, 4-methyl Nonane, 2-methyl Nonane, 2,5-dimethyl Nonane, 2,6-dimethyl Decane, 4-methyl Undecane, 2,6-dimethyl	130 l experimental chamber	Finnegan et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Flash Forge 3D printer using ABS filament	Styrene Hexanal Octanal Nonanal Bicyclo[3.1.1]hept-2-ene, 2,6,6-tri Ethylbenzene	3.6 m ³ experimental chamber	Azimi et al (2016)
Flash Forge 3D printer using PLA filament	1,4-dioxane-2,5-dione, 3,6-dimethyl 12-crown-4	3.6 m ³ experimental chamber	Azimi et al (2016)
XYZ 3D printer using ABS filament	Styrene Propylene glycol Hexanal Glycerin Octanal 1-pentanol α -pinene Acetophenone Decane	3.6 m ³ experimental chamber	Azimi et al (2016)
Dremel 3D printer using PLA filament	1,4-dioxane-2,5-dione, 3,6-dimethyl Chloromethyl methyl sulfide 1-Propanol, 2-ethoxy- Nonanal Ethanol, 2-(2-butoxyethoxy)-	3.6 m ³ experimental chamber	Azimi et al (2016)
Dremel 3D printer using PLA filament	Hexanal 1,4-dioxane-2,5-dione, 3,6-dimethyl 12-crown-4 Acetic acid Octanal Toluene Ethanol, 2-(2-butoxyethoxy)- Chloromethyl methyl sulfide Nonanal	3.6 m ³ experimental chamber	Azimi et al (2016)

Product(s)	Pollutants detected	Test conditions	Reference
LulzBot 3D printer using HIPS filament	Styrene 2-butanone Ethylbenzene Hexanal Octanal Decane Trimethylphosphine p-xylene Bicyclo[3.1.1]hept-2-ene	3.6 m ³ experimental chamber	Azimi et al (2016)
LulzBot 3D printer using HIPS filament	Styrene Hexanal Ethylbenzene Decane Acetic acid Octanal Bicyclo[3.1.1]hept-2-ene, 2,6,6-tri Nonanal	3.6 m ³ experimental chamber	Azimi et al (2016)
LulzBot 3D printer using PLA filament	1,4-dioxane-2,5-dione, 3,6-dimethyl Ethanol, 2-(2-butoxyethoxy)- Styrene Isopropyl palmitate	3.6 m ³ experimental chamber	Azimi et al (2016)
LulzBot 3D printer using ABS filament	Styrene Acetophenone Ethylbenzene Benzemethanol, α,α -di α -pinene Octanal Toluene Nonanal 1-butanol	3.6 m ³ experimental chamber	Azimi et al (2016)

Product(s)	Pollutants detected	Test conditions	Reference
LulzBot 3D printer using ABS filament	Styrene Caprolactam Acetophenone Isopropyl palmitate Ethylbenzene Nonanal Octanal Benzemethanol, α,α -di Bicyclo[3.1.1]hept-2-ene, 2,6,6-tri	3.6 m ³ experimental chamber	Azimi et al (2016)
LulzBot 3D printer using ABS filament	Styrene Acetophenone Decane Ethylbenzene Hexanal Benzemethanol, α,α -di Octanal Caprolactam Toluene	3.6 m ³ experimental chamber	Azimi et al (2016)
LulzBot 3D printer using nylon filament	Caprolactam Hexanal Acetic acid Isopropyl palmitate Nonanal Pentanal 1-pentanol Benzyl alcohol	3.6 m ³ experimental chamber	Azimi et al (2016)

Product(s)	Pollutants detected	Test conditions	Reference
LulzBot 3D printer using Laybrick filament	Caprolactam Hexanal Acetic acid Octanal 2-hexenal, 2-ethyl- Nonanal 1-pentanol α -pinene Styrene	3.6 m ³ experimental chamber	Azimi et al (2016)
LulzBot 3D printer using Laywood filament	Caprolactam 2-hexenal, 2-ethyl- Acetic acid 1,3,5,7-cyclooctatetraene	3.6 m ³ experimental chamber	Azimi et al (2016)
LulzBot 3D printer using TGlase filament	Caprolactam Toluene Styrene Propylene glycol	3.6 m ³ experimental chamber	Azimi et al (2016)
LulzBot 3D printer using polycarbonate filament	Caprolactam Styrene	3.6 m ³ experimental chamber	Azimi et al (2016)
LulzBot 3D printer using polycarbonate filament	Decanal Hexanal Nonanal Octanal Phenol Caprolactam 1-pentanol α -pinene	3.6 m ³ experimental chamber	Azimi et al (2016)

Product(s)	Pollutants detected	Test conditions	Reference
LulzBot 3D printer using PCTPE filament	Caprolactam Isopropyl palmitate Hydrazinecarbothioamide Nonanal Styrene Silane, trimethyl(1-methylethoxy)- 2-hexene, 3,5,5-trimethyl- Octanal Hexanal α -pinene	3.6 m ³ experimental chamber	Azimi et al (2016)
MakerBot 3D printer with enclosure	Styrene Acetophenone Isopropyl palmitate Tetrachloroethylene Decane dl-2-phenyl-1,2-propanediol Ethylbenzene Cyclotrisiloxane, hexamethyl- Benzenethanamine, N-[(pentafl 1-butanol	3.6 m ³ experimental chamber	Azimi et al (2016)
MakerBot 3D printer with no enclosure	Styrene Isopropyl palmitate Nonane, 2,2,4,4,6,8,8-heptamet Acetophenone Chloromethyl methyl sulfide Benzemethanol, α , α Nonanal Ethylbenzene Cyclotrisiloxane, hexamethyl- Benzenethanamine, N-[(pentafl	3.6 m ³ experimental chamber	Azimi et al (2016)

Product(s)	Pollutants detected	Test conditions	Reference
3D printer using HIPS filament	Styrene Ethylbenzene Methylstyrene	250 l experimental chamber	Wojtyła et al (2020)
3D printer using ABS filament	Styrene Ethylbenzene Acrylonitrile	250 l experimental chamber	Wojtyła et al (2020)

Where possible, chemicals are listed in order of abundance.

Table 14 VOCs emitted by air fresheners

Product(s)	Pollutants detected	Test conditions	Reference
Candle	4-methoxy-benzaldehyde γ-decalactone	1 m ³ experimental chamber	Uhde and Schulz (2015)
Palm-based scented candles	Limonene Formaldehyde Acetaldehyde Toluene Styrene Butanal Benzene Acrolein Xylenes	8 m ³ experimental chamber	Salthammer et al (2021)
Palm-based unscented candle	Formaldehyde Toluene	8 m ³ experimental chamber	Salthammer et al (2021)
Paraffin-based scented candles	Limonene Formaldehyde Acetaldehyde Acrolein Propanal Butanal Benzene Toluene Styrene Xylenes Benzo[a]pyrene	8 m ³ experimental chamber	Salthammer et al (2021)
Paraffin-based unscented candle	Formaldehyde Toluene	8 m ³ experimental chamber	Salthammer et al (2021)

Product(s)	Pollutants detected	Test conditions	Reference
Soy-based scented candles	Limonene Formaldehyde Acetaldehyde Toluene Acrolein Butanal Benzene Styrene Xylenes Benzo[a]pyrene	8 m ³ experimental chamber	Salthammer et al (2021)
Soy-based unscented candle	Limonene Formaldehyde Toluene	8 m ³ experimental chamber	Salthammer et al (2021)
Stearin-based scented candles	Limonene Formaldehyde Acetaldehyde Acrolein Propanal Butanal Benzene Toluene Styrene Xylenes Benzo[a]pyrene	8 m ³ experimental chamber	Salthammer et al (2021)
Stearin-based unscented candle	Formaldehyde Toluene	8 m ³ experimental chamber	Salthammer et al (2021)

Product(s)	Pollutants detected	Test conditions	Reference
Brown scented candle	Formaldehyde Acetaldehyde Butyraldehyde Benzaldehyde Benzene Ethylbenzene Toluene Phenanthrene Fluoranthene Benzo(a)anthracene Pyrene Anthracene	Cylindrical experimental chamber (0.07 m diameter x 1.5 m height)	Derudi et al (2012)
Blue scented candle	Formaldehyde Acetaldehyde Benzaldehyde Butyraldehyde Ethylbenzene Benzene Toluene Phenanthrene Benzo(a)anthracene	Cylindrical experimental chamber (0.07 m diameter x 1.5 m height)	Derudi et al (2012)
Green scented candle	Formaldehyde Propionaldehyde Acetaldehyde Butyraldehyde Benzaldehyde Ethylbenzene Toluene Xylenes Fluorene Phenanthrene Fluoranthene	Cylindrical experimental chamber (0.07 m diameter x 1.5 m height)	Derudi et al (2012)

Product(s)	Pollutants detected	Test conditions	Reference
Navy blue scented candle	Formaldehyde Acetaldehyde Benzaldehyde Butyraldehyde Ethylbenzene Benzene Toluene Phenanthrene Pyrene Fluoranthene Naphthalene Fluorene	Cylindrical experimental chamber (0.07 m diameter x 1.5 m height)	Derudi et al (2012)
Red scented candle	Formaldehyde Acetaldehyde Propionaldehyde Toluene Ethylbenzene Benzene Chrysene Benzo(a)pyrene Pyrene Fluoranthene Phenanthrene Naphthalene Anthracene	Cylindrical experimental chamber (0.07 m diameter x 1.5 m height)	Derudi et al (2012)
Uncoloured, unscented pure paraffin candle	Xylenes Ethylbenzene Toluene Naphthalene Anthracene Phenanthrene Pyrene	Cylindrical experimental chamber (0.07 m diameter x 1.5 m height)	Derudi et al (2012)

Product(s)	Pollutants detected	Test conditions	Reference
Uncoloured, unscented pure paraffin candle	Toluene Benzene Xylenes Ethylbenzene Naphthalene Anthracene Phenanthrene Fluorene Pyrene Fluoranthene	Cylindrical experimental chamber (0.07 m diameter x 1.5 m height)	Derudi et al (2012)
Uncoloured, unscented pure paraffin candle	Xylenes Toluene Benzene Ethylbenzene Naphthalene Anthracene Benzo(a)pyrene Phenanthrene Pyrene Chrysene Benzo(a)anthracene Fluorene Fluoranthene	Cylindrical experimental chamber (0.07 m diameter x 1.5 m height)	Derudi et al (2012)

Product(s)	Pollutants detected	Test conditions	Reference
Container candle	Toluene o-xylene Benzene Ethylbenzene (m+p)-xylenes Naphthalene Benzo[k]fluoranthene Anthracene Benzo[a]pyrene Phenanthrene Acenaphthylene Acenaphthene Fluoranthene Fluorene	Cylindrical experimental chamber (0.07 m diameter x 1.5 m height)	Derudi et al (2014)
Container candle	Toluene Benzene Ethylbenzene (m+p)-xylenes o-xylene Naphthalene Anthracene Fluorene Phenanthrene Acenaphthene Acenaphthylene Fluoranthene Chrysene	Cylindrical experimental chamber (0.07 m diameter x 1.5 m height)	Derudi et al (2014)

Product(s)	Pollutants detected	Test conditions	Reference
Container candle	Toluene (m+p)-xylenes o-xylene Benzene Ethylbenzene Naphthalene Anthracene Phenanthrene Benzo[k]fluoranthene Benzo[b]fluoranthene Benzo[a]pyrene Acenaphthene Acenaphthylene Chrysene Fluorene Pyrene Fluoranthene	Cylindrical experimental chamber (0.07 m diameter x 1.5 m height)	Derudi et al (2014)
Undyed hand poured scented candle composed of vegetable oils and beeswax	Limonene α -pinene β -pinene Formaldehyde	32.3 m ³ experimental room	Manoukian et al (2013)

Product(s)	Pollutants detected	Test conditions	Reference
Incense stick	Acenaphthene Acetaldehyde Acetone Acrylonitrile Benzaldehyde Benzene Biphenyl Butadiene Butyraldehyde Ethanol Ethylbenzene Formaldehyde Furfural Furfuryl alcohol Hexaldehyde Isoprene Linalool 5-methylfurfural Monoterpenes Naphthalene Pentanal Pentatone Propionaldehyde Styrene Toluene Xylene	32.3 m ³ experimental room	Manoukian et al (2013)

Product(s)	Pollutants detected	Test conditions	Reference
Incense cone	Benzene Furan Formaldehyde Acetaldehyde Toluene Isoprene Furfural Acrolein Styrene Phenol 2-furyl methyl ketone	1.0 m ³ experimental chamber	Silva et al (2021)
Incense stick	Formaldehyde Acetaldehyde Benzene Furan Acrolein Toluene Isoprene Furfural Styrene (E)-2-butenal	1.0 m ³ experimental chamber	Silva et al (2021)
Incense stick	Formaldehyde Isoprene Toluene Benzene Furan Acetaldehyde Acrolein Furfural Styrene Phenol Naphthalene	1.0 m ³ experimental chamber	Silva et al (2021)

Product(s)	Pollutants detected	Test conditions	Reference
Incense stick	Formaldehyde Furan Acetaldehyde Acrolein Benzene Isoprene Toluene Furfural Styrene Naphthalene	1.0 m ³ experimental chamber	Silva et al (2021)
Incense stick	Formaldehyde Acetaldehyde Furfural Furan Benzene Toluene Acrolein Styrene Phenol (E)-2-butenal	1.0 m ³ experimental chamber	Silva et al (2021)
Incense stick	Furan Formaldehyde Benzene Isoprene Acetaldehyde Acrolein Toluene Furfural Styrene (E)-2-butenal Phenol Naphthalene	1.0 m ³ experimental chamber	Silva et al (2021)

Product(s)	Pollutants detected	Test conditions	Reference
Incense stick	Formaldehyde Furfural Furan Acetaldehyde Isoprene Acrolein Benzene Toluene Styrene 2-furyl methyl ketone Naphthalene	1.0 m ³ experimental chamber	Silva et al (2021)
Incense stick	Formaldehyde Furan Benzene Isoprene Toluene Furfural Acrolein Styrene Acetaldehyde Phenol 2-furyl methyl ketone Naphthalene	1.0 m ³ experimental chamber	Silva et al (2021)

Product(s)	Pollutants detected	Test conditions	Reference
Incense cone	Furan Formaldehyde Acetaldehyde Benzene Acrolein Furfural Toluene Isoprene Styrene (E)-2-butenal Phenol Naphthalene	1.0 m ³ experimental chamber	Silva et al (2021)
Incense stick	Benzene Formaldehyde Furan Isoprene Toluene Acetaldehyde Acrolein Furfural Styrene (E)-2-butenal Naphthalene	1.0 m ³ experimental chamber	Silva et al (2021)

Product(s)	Pollutants detected	Test conditions	Reference
Incense cone	Isoprene Furan Acetaldehyde Toluene Formaldehyde Benzene Furfural Acrolein Styrene (E)-2-butenal Naphthalene	1.0 m ³ experimental chamber	Silva et al (2021)
Incense cone	Furan Formaldehyde Benzene Isoprene Furfural Toluene Acrolein Acetaldehyde (E)-2-butenal 2-furyl methyl ketone Styrene Phenol	1.0 m ³ experimental chamber	Silva et al (2021)

Product(s)	Pollutants detected	Test conditions	Reference
Incense stick	Formaldehyde Benzene Acetaldehyde Toluene Acetone Ethylbenzene Propionaldehyde Diethylhexyl phthalate (DEHP) Diisobutyl phthalate (DIBP) Diethyl phthalate (DEP)	916 l experimental chamber	Manoukian et al (2016)
Incense stick	Benzene 1,3,5-trimethylbenzene 1,2,4-trimethylbenzene Toluene	85.8 m ³ experimental clean room	Di Fiore et al (2023)
Incense stick	Benzene	85.8 m ³ experimental clean room	Di Fiore et al (2023)
Incense stick	Benzene	85.8 m ³ experimental clean room	Di Fiore et al (2023)
Incense stick	Benzene	85.8 m ³ experimental clean room	Di Fiore et al (2023)
Incense stick	Benzene 1,3,5-trimethylbenzene Toluene	85.8 m ³ experimental clean room	Di Fiore et al (2023)
Incense stick	Benzene Toluene	85.8 m ³ experimental clean room	Di Fiore et al (2023)
Incense stick	Benzene Toluene Xylenes Ethylbenzene	85.8 m ³ experimental clean room	Di Fiore et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Incense stick	Benzene Toluene	85.8 m ³ experimental clean room	Di Fiore et al (2023)
Incense stick	Benzene Toluene	85.8 m ³ experimental clean room	Di Fiore et al (2023)
Incense stick	Formaldehyde Xylene Toluene	1 m ³ experimental chamber	Thịnh et al (2022)
Incense stick	Formaldehyde Xylene Toluene	1 m ³ experimental chamber	Thịnh et al (2022)
Incense stick	Formaldehyde Xylene	1 m ³ experimental chamber	Thịnh et al (2022)
Incense stick	Formaldehyde Xylene Toluene	1 m ³ experimental chamber	Thịnh et al (2022)
Reed diffuser	Linalool acetate Linalool α -pinene Eucalyptol Limonene β -myrcene β -pinene α -terpineol γ -terpinene 3-carene	29.75 m ³ experimental chamber	Zhang et al (2024)
Electric diffuser (transient)	4-terpineol γ -terpinene α -terpinene Eucalyptol α -pinene	40 m ³ experimental room	Angulo-Milhem et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Capillarity diffuser (continuous)	γ -terpinene α -terpinene 4-terpineol Eucalyptol α -pinene	40 m ³ experimental room	Angulo-Milhem et al (2023)
Passive diffuser	Limonene Benzyl acetate Dihydromyrcenol Linalool Linalyl acetate γ -terpinene Myrcene β -pinene Eucalyptol Butyric acid ethyl ester 2-methyl-2-octanol α -pinene Bornyl acetate Menthol p-cymene Camphor Geranyl acetate Neryl acetate Benzylacetone 2,6-dimethyl-5-heptenal Terpinolene Decanal 3-octanone 4-methoxy-benzaldehyde 2-methyl-undecanal Camphene Dihydrodicyclopentadienyl acrylate	3 m ³ experimental chamber	Uhde and Schulz (2015)

Product(s)	Pollutants detected	Test conditions	Reference
Passive diffuser (continued)	Coumarine Ocimene Octanal 2-phenylethanol Piperonal 2-methyl-butyl butyrate 2-methyl-2-hepten-6-one Nonanal 3-carene Benzylalcohol Menthone Benzaldehyde Hexanal α-damascone Cyclamal beta-citronellene α-citronellene Fenchyl acetate cis-3-hexen-1-ol 2-propanol iso-pentane Benzoic acid methylester DPGMME Isomers Diethyl phthalate (DEP) n-butanol Acetic acid Methylmethacrylate	3 m ³ experimental chamber	Uhde and Schulz (2015)

Product(s)	Pollutants detected	Test conditions	Reference
Wood stick diffuser	Limonene Benzyl acetate Dihydromyrcenol Linalool Linalyl acetate Myrcene β-pinene Eucalyptol α-pinene Trivertal trans-geraniol Terpinolene Camphene 2-phenylethanol Citral Acetic acid tert-butanol Diethyl phthalate (DEP) Methyldihydrojasmonate cis-3-hexenyl acetate Pentanal Ethanol n-pentane	3 m ³ experimental chamber	Uhde and Schulz (2015)

Product(s)	Pollutants detected	Test conditions	Reference
Wood stick diffuser	Linalool Dihydromyrcenol Limonene β-pinene α-pinene Benzyl acetate 2-phenylethanol 2,6-dimethyl-5-heptenal α-methylbenzyl acetate Ethyl-2-methylpentanoate 3-methoxy-3-methyl-1-butanol Methyldihydrojasmonate Decamethyl cyclopentasiloxane α-isomethyl-ionone cis-3-hexenyl acetate cis-3-hexenyl acetate iso-alkanes Hexamethyl cyclotrisiloxane	3 m ³ experimental chamber	Uhde and Schulz (2015)

Product(s)	Pollutants detected	Test conditions	Reference
Wood-top diffuser	Limonene β-pinene 4-methoxy-benzaldehyde Butyric acid ethyl ester 3-hydroxy-2-butanone Methyl acetate 3-methoxy-3-methyl-1-butanol Decamethyl cyclopentasiloxane iso-alkanes Hexamethyl cyclotrisiloxane Acetic acid Dipropylene glycol mono methyl ether acetate DPGMME Isomers Ethanol Isoprene 3-methyl-3-buten-1-ol Acetophenone Methylisobutylketone (MIBK) Dodecamethyl cyclohexasiloxane Octamethyl cyclotetrasiloxane	3 m ³ experimental chamber	Uhde and Schulz (2015)

Product(s)	Pollutants detected	Test conditions	Reference
Wood stick diffuser	Butyric acid ethyl ester 3-hydroxy-2-butanone Methyl acetate Coumarine Piperonal γ-nonalactone Propanal 3-methoxy-3-methyl-1-butanol Decamethyl cyclopentasiloxane Hexamethyl cyclotrisiloxane Dipropylene glycol mono methyl ether acetate DPGMME Isomers Ethanol Isoprene 3-methyl-3-buten-1-ol Methylisobutylketone (MIBK) 1,2-propanediol diacetate Ethyl acetoacetate	3 m ³ experimental chamber	Uhde and Schulz (2015)

Product(s)	Pollutants detected	Test conditions	Reference
Jar with wood balls diffuser	Piperonal γ-nonalactone Limonene β-pinene Linalool Dihydromyrcenol α-pinene Myrcene Linalyl acetate Geranyl acetate Caryophyllene Neryl acetate 3-carene Camphene Bornyl acetate Ocimene β-ocimene 3-methoxy-3-methyl-1-butanol Decamethyl cyclopentasiloxane Hexamethyl cyclotrisiloxane Dipropylene glycol mono methyl ether acetate Acetic acid α-guaiene Dipropylene glycol Isomers Seychellene α-patchoulene beta-citronellene α-bulnesene β-patchoulene Santene α-selinene	3 m ³ experimental chamber	Uhde and Schulz (2015)

Product(s)	Pollutants detected	Test conditions	Reference
Bamboo diffuser	Ethanol Propylene glycol 3-ethylbenzaldehyde	Passive sampler placed in bathrooms with the diffuser	Cheng et al (2023)
Electric evaporator	Limonene Benzyl acetate Dihydromyrcenol Linalool Linalyl acetate Myrcene β-pinene Eucalyptol Butyric acid ethyl ester α-pinene Bornyl acetate Camphor Geranyl acetate Benzylacetone 2,6-dimethyl-5-heptenal 4-methoxy-benzaldehyde 2-methyl-undecanal Coumarine Octanal 2-methyl-2-hepten-6-one Nonanal Malonic acid diethyl ester 2-butanone Trivertal Hexanoic acid 2-propenyl ester α-methylbenzyl acetate Ethyl-2-methylpentanoate Prenyl acetate Heptanoic acid ethyl ester	3 m ³ experimental chamber	Uhde and Schulz (2015)

Product(s)	Pollutants detected	Test conditions	Reference
Electric evaporator (continued)	2-methylbutyl acetate Butyric acid pentyl ester Cyclamal Heptanoic acid 2-propenyl ester Nerol trans-geraniol iso-pentyl acetate Menthone Benzaldehyde α -damascone Cyclamal iso-pentane Benzoic acid methylester DPGMME Isomers Acetic acid Dipropylene glycol Isomers tert-butanol Isoprene	3 m ³ experimental chamber	Uhde and Schulz (2015)
Ultrasonic essential oil diffuser with lemon oil	Limonene β -pinene Linalool α -pinene Linalyl acetate Eucalyptol	1.3 m ³ experimental chamber	Schwartz-Narbonne et al (2021)
Ultrasonic essential oil diffuser with lavender oil	Linalyl acetate Limonene Linalool Eucalyptol β -pinene α -pinene	1.3 m ³ experimental chamber	Schwartz-Narbonne et al (2021)

Product(s)	Pollutants detected	Test conditions	Reference
Ultrasonic essential oil diffuser with eucalyptus oil	Eucalyptol Limonene Linalyl acetate α -pinene Linalool β -pinene	1.3 m ³ experimental chamber	Schwartz-Narbonne et al (2021)
Ultrasonic essential oil diffuser with grapeseed oil	Eucalyptol Linalool Linalyl acetate Limonene β -pinene α -pinene	1.3 m ³ experimental chamber	Schwartz-Narbonne et al (2021)
Spray air freshener	Acetone Dodecane, 2,7,10-trimethyl Nonane, 3-methyl-5-propyl Dodecane, 2,2,11,11-tetramethyl- Undecane, 3,8-dimethyl Nonane, 2,2,4,4,6,8,8-heptamethyl Hexadecane, 2,6,10,14-tetramethyl- Dodecane, 2,6,10-trimethyl Nonane, 2-methyl-5-propyl Dodecane, 2,6,11-trimethyl 1-dodecanol, 2-hexyl- Sulfurous acid, 2-ethylhexyl undecyl ester Nonane, 5-methyl-5-propyl Hexadecane, 2,6,11,15-tetramethyl 1-decanol, 2-hexyl Undecane, 3-methyl Dodecane, 4-cyclohexyl Hexadecane, 4-methyl- Tridecane, 6-methyl 9,10-anthracenedione, 1-amino-	31 m ³ environmental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Spray air freshener (continued)	Tridecane, 5-propyl Cyclononane, 1,1,4,4,7,7-hexamethyl- Tricyclo[4.2.1.1(2,5)]dec-3-en-9-ol, acetate, stereoisomer Decane, 2,3,5,8-tetramethyl- 2,3-dimethyldodecane Undecane, 2,9-dimethyl Carbonic acid, eicosyl vinyl ester Cyclohexanecarboxylic acid, 4-heptyl-, 4-fluorophenyl ester Dodecane, 3-methyl Cyclopentane, (2-hexyloctyl)- Cyclohexane, 1,2-dimethyl-3-pentyl-4-propyl Tridecane, 4-methyl Tridecane, 7-methylene Acetic acid Decane, 4-ethyl- Decane, 3,3,8-trimethyl Sulfurous acid, hexyl pentadecyl ester 3-penten-2-one, 4-(2,6,6-trimethyl-2-cyclohexen-1-yl)- Linalool Benzoic acid, 4-ethoxy-, ethyl ester 1-propanol, 2-(2-hydroxypropoxy) Phenol, 2,6-bis(1,1-dimethylethyl)-4-(1-methylpropyl)- Dipropylene glycol Decane, 2,2,3-trimethyl Cyclotetrasiloxane, octamethyl 7-octen-2-ol, 2,6-dimethyl d-limonene Decanal	31 m ³ environmental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Automatic spray air freshener	Limonene Benzyl acetate Linalool Myrcene β-pinene α-pinene Trivertal trans-geraniol 2-phenylethanol 2,6-dimethyl-5-heptenal Nonanal α-methylbenzyl acetate Ethyl-2-methylpentanoate Cyclamal Nerol 3-carene Acetic acid Ethanol n-pentane Benzaldehyde Cyclamal iso-pentane DPGMME Isomers Hexanal 2-propanol α-isomethyl-ionone 2,6-dimethyl-5-heptenal n-butane Dipropylene glycol butyl ether isomers	3 m ³ experimental chamber	Uhde and Schulz (2015)

Product(s)	Pollutants detected	Test conditions	Reference
Spray air freshener	Limonene Linalool Myrcene β -pinene α -pinene Nerol α -terpineol Linalyl acetate Terpinolene Camphene Citral Camphor Geranyl acetate 4-methoxy-benzaldehyde Coumarine Octanal γ -terpinene Menthol p-cymene Neryl acetate Decanal 3-octanone Caryophyllene Borneol β -bisabolene Terpinen-4-ol α -cubebene Farnesene Isomers Dimethylantranilate Undecanal Citronellal n-octanol Acetic acid	3 m ³ experimental chamber	Uhde and Schulz (2015)

Product(s)	Pollutants detected	Test conditions	Reference
Spray air freshener (continued)	Ethanol Benzaldehyde Hexanal 2-propanol Menthone cis-3-hexen-1-ol n-butanol α -caryophyllene Perilla aldehyde Vanilline α -sinensal Lavandulol acetate Nootkatone Heptanal Cinnamaldehyde Limonen-1,2-epoxid	3 m ³ experimental chamber	Uhde and Schulz (2015)
Febreze One spray air freshener	Ethanol Propylene glycol 7-octen-2-ol, 2,6-dimethyl 1-propanol, 2-(2-hydroxypropoxy) 2-propanol, 1-(2-methoxy-1-methylethoxy) Benzenemethanol, α,α -dimethyl- Carbon disulfide Glycerol 1-acetate Linalool Dipropylene glycol Decanal Tricyclo[4.2.1.1(2,5)]dec-3-en-9-ol, acetate, stereoisomer Phenol, 2,6-bis(1,1-dimethylethyl)-4-(1-methylpropyl)- Cyclotetrasiloxane, octamethyl Acetophenone Benzenemethanol	31 m ³ environmental chamber	Temkin et al (2023)

Product(s)	Pollutants detected	Test conditions	Reference
Febreze One spray air freshener (continued)	2-ethylhexanol Nonanal 2-tert-butylcyclohexyl acetate	31 m ³ environmental chamber	Temkin et al (2023)
Potpourri bag	Limonene Linalool Myrcene β-pinene α-terpineol Linalyl acetate Camphor Geranyl acetate 4-methoxy-benzaldehyde Coumarine Neryl acetate Borneol Terpinen-4-ol 3-carene Eucalyptol α-cedrene Acetic acid Vanilline α-guaiene Camphor Ethylvanilline Dipropylene glycol mono methyl ether acetate 3-methoxy-3-methyl-1-butanol Decamethyl cyclopentasiloxane	3 m ³ experimental chamber	Uhde and Schulz (2015)

Product(s)	Pollutants detected	Test conditions	Reference
Potpourri	Linalool Myrcene α -terpineol Linalyl acetate Geranyl acetate 4-methoxy-benzaldehyde Coumarine Caryophyllene Dihydromyrcenol Piperonal α -dihydro-ionon γ -nonalactone Cedryl acetate Acetic acid Vanilline α -guaiene Ethylvanilline Dipropylene glycol mono methyl ether acetate 3-methoxy-3-methyl-1-butanol Benzaldehyde DPGMME Isomers Methyldihydrojasmonate Dipropylene glycol Isomers Benzylalcohol Seychellene Eugenol α -patchoulene	3 m ³ experimental chamber	Uhde and Schulz (2015)

Product(s)	Pollutants detected	Test conditions	Reference
Plug-in air freshener	α -pinene Camphene β -pinene β -myrcene Benzaldehyde 3-carene Limonene Dipropyl glycol methyl ether Terpinolene Benzyl alcohol Thujone Benzyl acetate α -methyl benzy acetate Benzyl propionate Bornyl acetate Isobornyl acetate 4-carene α -cedrene Lilial	29.8 m ³ experimental chamber	Liu et al (2004)
Plug-in scented-oil air freshener	Benzyl acetate Dihydromyrcenol Linalool Bornyl acetate Linalyl acetate d-limonene β -citronellol α -citral	50 m3 experimental chamber simulating a residential room	Singer et al (2006a)

Product(s)	Pollutants detected	Test conditions	Reference
Air freshener	Ethanol Butane Isopentane Pentane Limonene 2-methyl-2-propanol Propylene glycol 2-methylpentane Hexane 3-methylpentane β -trans-ocimene β -pinene Acetone Methylcyclopentane Ethyl isobutyrate	Headspace GC/MS	Nematollahi et al (2019)
Air freshener	Ethanol Butane Isopentane Pentane Limonene 2-methyl-2-propanol 2-methylpentane Hexane 3-methylpentane Cyclohexane 2,2-dimethylbutane Methylcyclopentane Heptane 2-methylhexane Methylcyclohexane 3-methylhexane cis-1,2-dimethylcyclopentane	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
Air freshener (continued)	Acetic acid 2,4-dimethylpentane	Headspace GC/MS	Nematollahi et al (2019)
Air freshener	Limonene Isopentane 2-butene Butane β -pinene γ -terpinene Propyl 2-methyl butyrate Ethyl 2-methylpentanoate o-cymene α -pinene 2,4,4-trimethylpent-1-ene Pentane Ethyl 2-methylbutyrate Linalool Linalyl acetate Terpinolene 6-methyl-1,6-heptadiene Octanal α -terpinene 2,4,4-trimethyl-2-pentene	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
Air freshener	Limonene Ethanol β -myrcene α -pinene β -phellandrene m-cymene 3-carene Dihydromyrcenol Octanal 2-methyl-2-propanol Linalool Decanal α -phellandrene 2-tert-butylcyclohexanol Ethyl 2-methylpentanoate β -trans-ocimene 3,5,5-trimethylhexyl acetate γ -terpinene Terpinolene 1-phenylethanol	Headspace GC/MS	Nematollahi et al (2019)
Air freshener	Ethanol Butane Isopentane 2,6-di-tert-butyl-4-methylphenol Pentane Ethyl butyrate Limonene 2-butene Hexane 2-methylpentane γ -decalactone 3-methylpentane	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
Air freshener (continued)	Methylcyclohexane D,l-isobornyl acetate Methylcyclopentane 3-methylhexane	Headspace GC/MS	Nematollahi et al (2019)
Air freshener	Ethanol Dihydromyrcenol Toluene 4-decyne Ethyl acetate Linalool Benzyl acetate 3-[2-(2-methoxyethoxy)ethoxy]-1-propene 2,4,6-trimethyl-3-cyclohexene-1-carboxaldehyde Octanal dimethyl acetal cis-3,7-dimethyl-2,6-octadien-1-ol 1-(2-methoxy-1-methylethoxy)propan-2-ol 4-hexen-1-ol, acetate 1-(2-methoxypropoxy)propan-2-ol β -ionone 2-methyl-2-(4-methylpent-3-enyl)cyclopropane-1-carbaldehyde α -ionone Decanal Acetaldehyde	Headspace GC/MS	Nematollahi et al (2019)
'Green' air freshener	Ethanol Limonene β -myrcene α -pinene 2-methyl-2-propanol Sabinene Acetaldehyde diethyl acetal β -phellandrene Ethyl formate	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
'Green' air freshener (continued)	β -trans-ocimene Acetone Acetaldehyde (E)-citral β -citral Methanol 2-methyl-1-butene n-octanal diethyl acetal	Headspace GC/MS	Nematollahi et al (2019)
'Green' air freshener	α -pinene ($\pm$)-Citronellal Limonene Methylcyclopentane β -pinene 3-methyl-1-cyclopentene Isopulegol 1-methyl-3-isopropylcyclopentane Eucalyptol (-)-isopulegol (E)-citral 1-methylcyclopentene β -citral 6-methyl-5-hepten-2-one Bornyl acetate Acetaldehyde Camphene Acetone 6-octen-1-ol, 3,7-dimethyl- Caryophyllene	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
'Green' air freshener	Ethanol Methanol (E)-citral β -citral 6-methyl-5-hepten-2-one β -myrcene Acetone Acetaldehyde Ethyl formate Acetaldehyde diethyl acetal Undecane Methyl (S)-2-methylbutanoate Dodecane 3-buten-2-ol, 2-methyl- 2-chlorotoluene	Headspace GC/MS	Nematollahi et al (2019)
'Green' air freshener	Ethanol Limonene Linalool β -myrcene α -pinene β -pinene Methanol Terpinyl acetate (E)-sabinene hydrate Ethyl acetate Camphene γ -terpinene α -terpineol Octanal (E)-citral β -trans-ocimene Linalyl anthranilate	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
'Green' air freshener (continued)	Linalyl acetate β-citral β-phellandrene	Headspace GC/MS	Nematollahi et al (2019)
'Green' air freshener	Ethanol Limonene Methanol Linalool Hexyl acetate β-pinene α-pinene trans-2,2-dimethyl-4-heptenal Benzyl acetate β-myrcene 2-tert-butylcyclohexanol γ-terpinene Dihydromyrcenol β-trans-ocimene Ethyl butyrate Isoamyl acetate 2-methyl-2-propanol Ethyl acetate Camphene Terpinolene	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
'Green' air freshener	Ethanol Linalool Limonene Ethyl acetate Linalyl acetate Menthone Eucalyptol D,l-menthol α -pinene β -myrcene Camphene α -terpineol Caryophyllene Linalyl anthranilate β -pinene m-cymene β -phellandrene 3-ethyl-2-methyl-1,3-heptadiene DI-menthyl acetate Neryl acetate	Headspace GC/MS	Nematollahi et al (2019)

Product(s)	Pollutants detected	Test conditions	Reference
Air freshener	ethanol d-limonene butanoic acid, 2-methyl-, ethyl ester β-pinene propanoic acid, 2-methyl-, ethyl ester prenyl acetate 5-methyl-3-heptanone 2,4-dimethyl-3-cyclohexene-1-carboxaldehyde Acetaldehyde t-butyl alcohol γ-terpinene 1-butanol, 3-methyl-, acetate α-pinene linalool 6-methyl-5-hepten-2-one dimethyl-3-cyclohexene-1-carboxaldehyde o, m, or p-cymene β-phellandrene α-thujene	Headspace GC/MS	Steinemann (2015)

Product(s)	Pollutants detected	Test conditions	Reference
Air freshener	d-limonene α -pinene β -pinene ethanol ethyl butanoate ethyl acetate 3-hexen-1-ol 1-butanol, 3-methyl-, acetate β -phellandrene acetaldehyde benzaldehyde carene isomer 1-methyl-3-(1-methylethyl)-cyclohexene isopropanol 1-butanol, 2-methyl-, acetate camphene acetone methyl butanoate dimethyl ethyl cyclohexene α -thujene	Headspace GC/MS	Steinemann (2015)

Product(s)	Pollutants detected	Test conditions	Reference
'Green' air freshener	d-limonene 3-methoxy-3-methylbutanol linalool carene isomer nonanal 2,4-dimethyl-3-cyclohexene-1-carboxaldehyde 2-methyl-2,4-dimethoxybutane α -phenylethyl acetate β -pinene 3-hexen-1-ol octanal ethanol γ -terpinene decanal acetone cis-limonene oxide limonene oxide cis-rose oxide citronella dimethyl-3-cyclohexene-1-carboxaldehyde	Headspace GC/MS	Steinemann (2015)
'Green' air freshener	linalool 2,4-dimethyl-3-cyclohexene-1-carboxaldehyde 3-hexen-1-ol dimethyl-3-cyclohexene-1-carboxaldehyde d-limonene thujone acetone camphor	Headspace GC/MS	Steinemann (2015)

Product(s)	Pollutants detected	Test conditions	Reference
'Green' air freshener	d-limonene 4-tert-butylcyclohexyl acetate acetaldehyde benzyl acetate 2,7-dimethyl-2,7-octanediol acetone ethanol carene isomer citronellyl acetate hexanal 2,4-dimethyl-3-cyclohexene-1-carboxaldehyde allyl heptanoate 1-methyl-4-(1-methylethyl)-cyclohexane ethyl butanoate 3-hexen-1-ol o, m, or p-cymene α -pinene carene isomer	Headspace GC/MS	Steinemann (2015)

Product(s)	Pollutants detected	Test conditions	Reference
'Green' air freshener	d-limonene 1-butanol, 3-methyl-, acetate hexyl acetate benzyl acetate 4-(1,1-dimethylethyl)-cyclohexanol acetone cis-rose oxide β -pinene ethyl butanoate α -pinene camphor dimethyl-3-cyclohexene-1-carboxaldehyde 1-methoxy-4-methylbenzene carene isomer methyl benzoate trans-rose oxide 2,4-dimethyl-3-cyclohexene-1-carboxaldehyde β -phellandrene camphene o, m, or p-cymene	Headspace GC/MS	Steinemann (2015)

Product(s)	Pollutants detected	Test conditions	Reference
'Green' air freshener	benzyl acetate d-limonene acetone 1-butanol, 3-methyl-, acetate methanol α -pinene ethanol acetaldehyde ethyl butanoate carene isomer 4-(1,1-dimethylethyl)cyclohexene methyl benzoate 2,4-dimethyl-3-cyclohexene-1-carboxaldehyde 5-methyl-3-heptanone 2-methylbenzyl acetate camphor 2,7-dimethyl-2,7-octanediol β -pinene Carene isomer	Headspace GC/MS	Steinemann (2015)

Product(s)	Pollutants detected	Test conditions	Reference
'Green' air freshener	d-limonene benzyl acetate 1-butanol, 3-methyl-, acetate hexyl acetate carene isomer cis-rose oxide camphor β-pinene ethyl butanoate dimethyl-3-cyclohexene-1-carboxaldehyde α-pinene methyl benzoate 1-methoxy-4-methylbenzene acetone trans-rose oxide 2,4-dimethyl-3-cyclohexene-1-carboxaldehyde β-phellandrene camphene o, m, or p-cymene α-terpinene	Headspace GC/MS	Steinemann (2015)

Product(s)	Pollutants detected	Test conditions	Reference
Air freshener	acetone propane d-limonene isobutane β-pinene α-pinene γ-terpinene 2,2-diethoxypropane β-phellandrene butane o, m, or p-cymene 1-propen-2-ol, formate α-terpinene α-phellandrene t-butyl alcohol camphene 2,4-dimethylpentane α-terpinolene 2,3-dimethylpentane e-2-butene cis-ocimene	Headspace GC/MS	Steinemann (2015)
Scented-oil air freshener	Bornyl acetate Benzyl acetate Dihydromyrcenol Linalool 3,7-dimethyl-3-octanol Linalyl acetate d-limonene β-citronellol α-citral	50 m ³ experimental chamber simulating a residential room	Singer et al (2006b)

Where possible, chemicals are listed in order of abundance.

Table 15 VOCs emitted by regular personal care products

Product	Compounds emitted	Test conditions	Reference
Liquid soap	Limonene Eucalyptol Benzyl acetate Linalool β -trans-ocimene Methanol β -Myrcene Toluene Nonadecane (Z)-7-tetradecene m-cymene Linalyl anthranilate	Headspace GC/MS	Nematollahi et al (2019)
Liquid soap	Diethyl phthalate Benzyl acetate Methanol (Z)-7-tetradecene 2-tert-butylcyclohexanol Ethyl butyrate Linalool Nonadecane Dodecane Decyl trifluoroacetate	Headspace GC/MS	Nematollahi et al (2019)

Product	Compounds emitted	Test conditions	Reference
Shower gel	Limonene β -pinene α -pinene Linalool cis-6-nonenyl acetate Ethyl acetate Cyclohexane Linalyl acetate 6-methyl-1,6-heptadiene γ -terpinene Dihydromyrcenol Camphene Nonylcyclopropane (Z)- β -ocimene Ethyl 2-methylpentanoate Sabinene Ethyl linalool β -trans-ocimene 1-Dodecene Benzyl acetate	Headspace GC/MS	Nematollahi et al (2019)
Shower gel	Limonene Benzyl alcohol Ethanol Methanol Isopropanol	Headspace GC/MS	Yeoman et al (2020)

Product	Compounds emitted	Test conditions	Reference
Body wash	Limonene Benzyl acetate Ethanol Linalool Benzyl alcohol Acetone D,l-isobornyl acetate γ-nonanolactone β-trans-ocimene Decyl trifluoroacetate β-myrcene 1-decene	Headspace GC/MS	Nematollahi et al (2019)
Facial gel	Tetrahydrolinalool 4-tert-butylcyclohexanol cis-6-nonenyl acetate Acetaldehyde Nopyl acetate 4-tert-butylcyclohexyl acetate Menthyl acetate Dihydromyrcenol DI-menthyl acetate Carane 4-hexen-1-ol, acetate Undecane	Headspace GC/MS	Nematollahi et al (2019)
Shampoo	Limonene Benzyl alcohol Methanol Ethanol Isopropanol	Headspace GC/MS	Yeoman et al (2020)

Product	Compounds emitted	Test conditions	Reference
Shampoo	Limonene Benzyl alcohol Ethyl 2-methylbutyrate β -pinene Linalool Isopropanol 4-tert-butylcyclohexyl acetate Dihydromyrcenol β -trans-ocimene Ethyl acetate Hexyl acetate Isoamyl acetate Benzyl acetate	Headspace GC/MS	Nematollahi et al (2019)
Shampoo	Hexyl acetate Limonene 4-tert-butylcyclohexyl acetate Linalool Ethyl 2-methylbutyrate Butane Dihydromyrcenol Benzyl acetate Dicyclopentenyl alcohol Octamethylcyclotetrasiloxane Methyl phenylcarbinyl acetate Ethinamate Prenyl acetate γ -terpinene 5-methylheptan-3-one 2-(1,1-dimethyl-2-propenyl)-1,1-dimethylcyclopropane Isoamyl acetate	Headspace GC/MS	Nematollahi et al (2019)

Product	Compounds emitted	Test conditions	Reference
Shampoo	Octamethylcyclotetrasiloxane Cyclohexane 4-tert-butylcyclohexyl acetate Limonene Propyl 2-methyl butyrate Ethyl 2-methylpentanoate Benzyl acetate Ethyl acetate (Z)-7-tetradecene Isoamyl acetate Linalool cis-3-hexenyl acetate β-pinene Cyclododecane Ethyl 2-methylbutyrate	Headspace GC/MS	Nematollahi et al (2019)
Shampoo	Octamethylcyclotetrasiloxane Limonene Hexamethylcyclotrisiloxane Isopropanol Dodecane Decamethylcyclopentasiloxane Linalool Methanol Benzyl acetate Acetaldehyde Tridecane 4-tert-butylcyclohexyl acetate Ethinamate	Headspace GC/MS	Nematollahi et al (2019)

Product	Compounds emitted	Test conditions	Reference
Shampoo	Limonene Ethyl 2-methylpentanoate Octamethylcyclotetrasiloxane Ethyl 2-methylbutyrate Hexyl acetate Butane β -pinene Isoamyl acetate 4-tert-Butylcyclohexyl acetate β -trans-ocimene Ethyl acetate Linalool γ -terpinene Cyclohexane Tridecane β -myrcene (Z)-sabinene hydrate Allyl heptanoate Linalyl anthranilate Acetaldehyde	Headspace GC/MS	Nematollahi et al (2019)
Fragrance-free shampoo	Acetone	Headspace GC/MS	Nematollahi et al (2019)

Product	Compounds emitted	Test conditions	Reference
Shampoo	Limonene Octamethylcyclotetrasiloxane Ethyl 2-methylbutyrate Hexyl acetate Ethyl 2-methylpentanoate Linalool Allyl heptanoate Ethyl acetate 4-tert-butylcyclohexyl acetate Decamethylcyclopentasiloxane Cyclohexane 2,4,6-trimethyl-3-cyclohexene-1-carboxaldehyde Dihydromyrcenol 2-phenoxyethyl isobutyrate Undecane Nonylcyclopropane Toluene Benzyl acetate Allyl hexanoate Nonadecane	Headspace GC/MS	Nematollahi et al (2019)
Conditioner	Isopropanol Benzyl alcohol Limonene Methanol Ethanol	Headspace GC/MS	Yeoman et al (2020)

Product	Compounds emitted	Test conditions	Reference
Conditioner	Isopropanol Limonene Linalool Dihydromyrcenol Benzyl alcohol 4-tert-butylcyclohexyl acetate Ethyl 2-methylbutyrate Hexyl acetate Ethyl butyrate 2-tert-butylcyclohexanol 4-tert-butylcyclohexanol Ethyl acetate Benzaldehyde α -terpineol Methyl isopropyl ether Acetone Methyl phenylcarbonyl acetate Benzyl acetate cis-4-tert-butylcyclohexanol 2,2,6-trimethyl-6-vinyltetrahydropyran	Headspace GC/MS	Nematollahi et al (2019)

Product	Compounds emitted	Test conditions	Reference
Conditioner	Ethyl 2-methylbutyrate Benzyl alcohol Dihydromyrcenol Ethyl 2-methylpentanoate 4-tert-butylcyclohexyl acetate Allyl heptanoate 2,4,6-trimethyl-3-cyclohexene-1-carboxaldehyde α,α -dimethylphenethyl acetate 4-hexen-1-ol, acetate Limonene Ethyl butyrate Benzyl acetate Isopropanol 1,1-dimethylallyl alcohol Allyl hexanoate Hexyl acetate 2-tert-butylcyclohexanol α,α -dimethylphenethyl butyrate Hexyl salicylate Isoamyl acetate	Headspace GC/MS	Nematollahi et al (2019)

Product	Compounds emitted	Test conditions	Reference
Conditioner	Limonene Dihydromyrcenol Ethyl 2-methylbutyrate 4-tert-butylcyclohexyl acetate Octamethylcyclotetrasiloxane Ethyl acetate Linalool Benzyl acetate Ethyl butyrate Hexyl acetate Pentane Butyl acetate 2-tert-butylcyclohexanol Isobutyl isobutyrate Ethyl linalool 2,4,6-trimethyl-3-cyclohexene-1-carboxaldehyde 4-hexen-1-ol, acetate Linalyl anthranilate 2-(4-tert-butylbenzyl)propionaldehyde 2-phenoxyethyl isobutyrate	Headspace GC/MS	Nematollahi et al (2019)

Product	Compounds emitted	Test conditions	Reference
Conditioner	D,L-menthol Benzyl alcohol 2-tert-butylcyclohexanol Dihydromyrcenol Ethyl 2-methylbutyrate Isoamyl butylate 2,4,6-trimethyl-3-cyclohexene-1-carboxaldehyde Menthone 1,1-dimethylallyl alcohol Prenyl acetate Allyl heptanoate Ethyl 2-methylpentanoate Eucalyptol Linalool 4-tert-butylcyclohexyl acetate Phenoxyethanol Hexyl acetate 5-methylheptan-3-one 2-pentyl butyrate trans-3-hexenyl acetate	Headspace GC/MS	Nematollahi et al (2019)
Hair care cream	Propylene glycol Isopropanol	Headspace GC/MS	Lin et al (2022)
Hair styling gel	Ethanol Nonylcyclopropane Dodecamethylcyclhexasiloxane	Headspace GC/MS	Lin et al (2022)

Product	Compounds emitted	Test conditions	Reference
Hair spray	Ethanol Acetaldehyde Acetone propanal Formic acid Benzene 3,5,5-trimethylhexyl acetate Eucalyptol Linalool Dihydro- α -terpineol Propylene glycol Dipropylene glycol	62 m ³ experimental chamber	Wu et al (2024)
Hair styling spray	n-butane Isobutane Propane Ethanol d-limonene Toluene Isopentane	36 L experimental chamber	Lin et al (2022)
Hand cream	Butane Ethanol Benzyl acetate Phenoxyethanol	Headspace GC/MS	Nematollahi et al (2019)
Hand cream	Limonene Diethyl phthalate Ethanol Butane Phenoxyethanol Eucalyptol 4-tert-butylcyclohexyl acetate 2-methyl-1-phenyl-2-propanol	Headspace GC/MS	Nematollahi et al (2019)
Fragrance-free hand cream	Propylcyclopropane	Headspace GC/MS	Nematollahi et al (2019)

Product	Compounds emitted	Test conditions	Reference
Hand lotion	Acetaldehyde Dipropylene glycol Benzene Eucalyptol Linalool Dihydro- α -terpineol 3,5,5-trimethylhexyl acetate Propylene glycol Formic acid Ethanol Acetone propanal	62 m ³ experimental chamber	Wu et al (2024)
Ointment	Butane Phenoxyethanol 1,1'-oxydi-2-propanol Limonene 2-(2-hydroxypropoxy)-1-propanol 2,2'-oxydipropanol	Headspace GC/MS	Nematollahi et al (2019)
Ointment	Butane	Headspace GC/MS	Nematollahi et al (2019)
Moist cream	Butane Isopentane Decamethylcyclopentasiloxane Pentane 1-chloro-2-methylpropane Phenylethyl alcohol Tetrahydrolinalool Benzyl acetate	Headspace GC/MS	Nematollahi et al (2019)
Moisturiser	Limonene Benzyl alcohol Ethanol Isopropanol Methanol	Headspace GC/MS	Yeoman et al (2020)

Product	Compounds emitted	Test conditions	Reference
Body lotion	2,2,4,4,6,8,8-heptamethylnonane 2,6,10-trimethyldodecane Limonene Butane 6-methyltridecane 2,2,4-trimethylhexane 2,2,4,4-tetramethyloctane Acetaldehyde Linalool 2,2,3,3,5,6,6-heptamethylheptane 2,5-dimethylundecane Benzyl acetate 6-ethyl-2-methyl-6-hepten-2-ol	Headspace GC/MS	Nematollahi et al (2019)
Fragrance-free moisturising lotion	Trimethylsilanol Benzyl alcohol Hexamethyldisiloxane	Headspace GC/MS	Nematollahi et al (2019)
Fragrance-free lotion	Ethyl acetate	Headspace GC/MS	Nematollahi et al (2019)
Roll-on deodorant	Acetaldehyde Dipropylene glycol Dihydro- α -terpineol Benzene Eucalyptol Linalool 3,5,5-trimethylhexyl acetate Propylene glycol Formic acid Ethanol Acetone propanal	62 m ³ experimental chamber	Wu et al (2024)

Product	Compounds emitted	Test conditions	Reference
Body spray	Ethanol Dipropylene glycol Acetone propanal Acetaldehyde Formic acid Benzene Propylene glycol Eucalyptol Linalool Dihydro- α -terpineol 3,5,5-trimethylhexyl acetate	62 m ³ experimental chamber	Wu et al (2024)
Body spray	Ethanol Isopentane Pentane Butane 2-methyl-2-propanol 2,2-dimethyloxetane 2-methylpentane Hexane 3-methylpentane	Headspace GC/MS	Nematollahi et al (2019)

Product	Compounds emitted	Test conditions	Reference
Antiperspirant	Isopentane Butane Pentane Decamethylcyclopentasiloxane 2,2-dimethyloxetane Ethanol Phenylethyl alcohol Linalool 2,6-dimethyl-2-heptanol Cyclopentane Tetrahydrolinalool Linalyl anthranilate p-anisaldehyde Eucalyptol 6-ethyl-2-methyl-6-hepten-2-ol	Headspace GC/MS	Nematollahi et al (2019)
Antiperspirant	Isopentane Butane Decamethylcyclopentasiloxane Pentane 2-butene Ethanol Dihydromyrcenol Limonene 2-methyl-2-propanol Linalool 2-methylpentane Hexane β-pinene Phenylethyl alcohol 3-methylpentane γ-terpinene Isopentane	Headspace GC/MS	Nematollahi et al (2019)

Product	Compounds emitted	Test conditions	Reference
Antiperspirant	Isopentane Butane Decamethylcyclopentasiloxane Pentane Methanol 2,2-dimethyloxetane Tetrahydrolinalool Limonene Butyric acid, 2-tridecyl ester Hexyl acetate Benzyl acetate trans-1-methyl-1,2-cyclohexanediol trans-2,2-dimethyl-4-heptenal	Headspace GC/MS	Nematollahi et al (2019)
Liquid foundation	Ethanol Limonene	Headspace GC/MS	Yeoman et al (2020)
Perfume	Ethanol Dipropylene glycol Acetone propanal Acetaldehyde Benzene Formic acid Eucalyptol Linalool Propylene glycol Dihydro- α -terpineol 3,5,5-trimethylhexyl acetate	62 m ³ experimental chamber	Wu et al (2024)
Adult sunscreen	Phenoxyethanol	Headspace GC/MS	Nematollahi et al (2019)
Adult sunscreen	Acetaldehyde Phenoxyethanol Butane	Headspace GC/MS	Nematollahi et al (2019)

Product	Compounds emitted	Test conditions	Reference
Adult sunscreen	Isopropanol Acetaldehyde Phenoxyethanol Cyclohexane	Headspace GC/MS	Nematollahi et al (2019)
Adult sunscreen	Methanol Isopropanol Dimethoxymethane Limonene Acetaldehyde	Headspace GC/MS	Nematollahi et al (2019)
Baby sunscreen	Ethanol Limonene β-pinene Ethyl acetate	Headspace GC/MS	Nematollahi et al (2019)
Baby sunscreen	Benzyl alcohol Acetaldehyde	Headspace GC/MS	Nematollahi et al (2019)
Baby sunscreen	Isopropanol Hexamethyldisiloxane Acetaldehyde	Headspace GC/MS	Nematollahi et al (2019)
Baby sunscreen	Acetaldehyde Hexamethyldisiloxane Tris(trimethylsilyl) borate 3-methylhexane	Headspace GC/MS	Nematollahi et al (2019)
Baby sunscreen	Decamethylcyclopentasiloxane Diisopropyl adipate Isopropanol Phenoxyethanol Acetaldehyde	Headspace GC/MS	Nematollahi et al (2019)
Baby sunscreen	Ethyl butyrate Ethanol	Headspace GC/MS	Nematollahi et al (2019)
Baby sunscreen	Acetaldehyde Hexamethyldisiloxane Phenoxyethanol	Headspace GC/MS	Nematollahi et al (2019)

Product	Compounds emitted	Test conditions	Reference
Baby body wash	Ethanol Ethyl butyrate (Z)-7-tetradecene Cyclododecane Phenoxyethanol Nonadecane	Headspace GC/MS	Nematollahi et al (2018)
Baby body wash	Ethanol Ethyl 2-methylbutyrate Isoamyl acetate β-Pinene Benzaldehyde Limonene Amyl butyrate 1-tridecene Ethyl benzoate Phenoxyethanol 4-tert-butylcyclohexyl acetate Nonadecane	Headspace GC/MS	Nematollahi et al (2018)
Baby body wash	Acetaldehyde Ethanol Ethyl butyrate Hexyl acetate Tridecane (Z)-7-tetradecene Nonadecane	Headspace GC/MS	Nematollahi et al (2018)

Product	Compounds emitted	Test conditions	Reference
Baby body wash	Ethanol Ethyl butyrate Isoamyl acetate 2-methylbutyl acetate Pentyl acetate α -pinene β -phellandrene Undecane β -myrcene Limonene Isoamyl butylate Dipentyl ether Amyl butyrate 2-methylbutyl 2-methylbutyrate Isoamyl isovalerate 2-methylbutyl isovalerate Linalool Phenoxyethanol Benzyl benzoate	Headspace GC/MS	Nematollahi et al (2018)

Product	Compounds emitted	Test conditions	Reference
Baby hair and body wash	2-butene Pentane Isopropanol 2-methyl-1-pentene Ethyl acetate Cyclohexane Hexamethylcyclotrisiloxane cis-3-hexenol 1-hexanol 2,7-dimethyl-1,7-octadiene 3,7-dimethyl-1,6-octadiene Octamethylcyclotetrasiloxane Hexyl acetate 1,4-hexadiene cis-6-nonenyl acetate Phenoxyethanol 4-tert-butylcyclohexyl acetate Piperonal 4-tert-pentylcyclohexanol Nopyl acetate	Headspace GC/MS	Nematollahi et al (2018)
Baby shower gel	Ethanol Butyl acetate Ethyl 2-methylbutyrate cis-3-Hexenol Isoamyl butylate	Headspace GC/MS	Nematollahi et al (2018)

Product	Compounds emitted	Test conditions	Reference
Baby body wash	Ethanol Ethyl acetate Ethyl propionate Ethyl butyrate Ethyl 2-methylbutyrate Ethyl 2-methylpentanoate β -myrcene Ethyl hexanoate Limonene (Z)-7-tetradecene Cyclododecane Phenoxyethanol Ethyl nonanoate 4-tert-butylcyclohexyl acetate 2-tert-butylcyclohexanol Nonadecane	Headspace GC/MS	Nematollahi et al (2018)
Baby shampoo	Acetaldehyde Ethyl butyrate α -pinene β -pinene β -myrcene 2,6-dimethyl-2-heptanol Limonene 3-carene 1-octanol 1,3,4-trimethyl-3-cyclohexen-1-carboxaldehyde Linalool acetate Cyclododecane 1-tridecene Benzyl acetate α -isomethyl ionone	Headspace GC/MS	Nematollahi et al (2018)

Product	Compounds emitted	Test conditions	Reference
Baby ointment	Acetaldehyde α -phellandrene α -pinene Camphene β -phellandrene β -pinene α -thujene β -trans-ocimene Pentylenecyclopentane 4-carene Limonene m-cymene 3-carene Eucalyptol γ -terpinene Terpinolene (E)-3,3-dimethylcyclohexylideneacetaldehyde Camphor DI-menthol	Headspace GC/MS	Nematollahi et al (2018)
Baby ointment	Acetaldehyde Methanol Pentane Ethanol Propanal Acetone 1,5-hexadien-3-ol	Headspace GC/MS	Nematollahi et al (2018)

Product	Compounds emitted	Test conditions	Reference
Baby ointment	Acetaldehyde Ethanol Acetone Tetrahydrofuran 1,1'-oxydi-2-propanol 2-(2-hydroxypropoxy)-1-propanol 2,2'-oxydipropanol Phenylethyl alcohol 7-hydroxycitronellal	Headspace GC/MS	Nematollahi et al (2018)
Baby ointment	Acetaldehyde Methanol Ethanol	Headspace GC/MS	Nematollahi et al (2018)
Baby oil	Isobutyl cyanate Acetaldehyde Pentane Hexane 3-methylhexane 3,4-dimethylheptane Benzyl alcohol Phenylethyl alcohol	Headspace GC/MS	Nematollahi et al (2018)

Product	Compounds emitted	Test conditions	Reference
Detangling conditioning spray	Ethyl methyl ether Ethanol Propanal Isopropanol Dichloromethane Methacrolein Trimethylsilanol Ethyl acetate Ethyl butyrate Tris(trimethylsilyl) borate Ethyl 2-methylbutyrate cis-3-hexenol Octamethylcyclotetrasiloxane Limonene Benzyl alcohol Decamethylcyclopentasiloxane α -isomethyl ionone trans- β -Ionone	Headspace GC/MS	Nematollahi et al (2018)
Fragrance-free baby lotion	Ethyl acetate	Headspace GC/MS	Nematollahi et al (2019)

Product	Compounds emitted	Test conditions	Reference
Baby lotion	Ethanol Ethyl butyrate cis-1,3,5-trimethylcyclohexane Dodecane Isoamyl acetate 1-Ethyl-2-methylcyclohexane 2,6-dimethyl octane α -pinene 2-butyl-1-octanol 1-butyl-2-propylcyclopentane 3-methylnonane 1-ethyl-2-propylcyclohexane 1,2-diethylcyclohexane 1-methyl-2-propylcyclohexan Undecane β -myrcene 2,5,5-trimethylheptane Butylcyclohexane Limonene trans-decahydronaphthalene 1,3,4-trimethyl-3-cyclohexen-1-carboxaldehyde Linalool Benzyl acetate Phenoxyethanol	Headspace GC/MS	Nematollahi et al (2018)

Product	Compounds emitted	Test conditions	Reference
Baby hair spray	Acetaldehyde Methyl isopropyl ether Propanal Isopropanol 2-ethyl-4-methyl-1,3-dioxolane 1,3-dioxane Tris(trimethylsilyl) borate Ethyl 2-methylbutyrate α -pinene Octamethylcyclotetrasiloxane β -pinene β -myrcene cis-3-hexenyl acetate Limonene γ -terpinene Dihydromyrcenol Benzyl alcohol Decamethylcyclopentasiloxane Tetrahydrolinalool Linalool 2,4,6-trimethyl-3-cyclohexene-1-carboxaldehyde Allyl heptanoate Benzyl acetate (Z+E)-2-methyl-2-(4-methyl-3-pentenyl) cyclopropane carbaldehyde 4-tert-butylcyclohexyl acetate p-anisaldehyde 2-tert-butylcyclohexanol	Headspace GC/MS	Nematollahi et al (2018)

Product	Compounds emitted	Test conditions	Reference
Baby body spray	Acetaldehyde Ethanol Ethyl acetate Ethyl butyrate Ethyl 2-methylbutyrate Ethyl isovalerate Isoamyl acetate 2-methylbutyl acetate 2,2-dimethyldecane Ethyl hexanoate Limonene Isoamyl butylate 3,5,5-trimethylhexyl acetate Benzyl acetate Phenoxyethanol 2,6-dichlorobenzyl alcohol 2,6-di-tert-butyl-4-methylphenol	Headspace GC/MS	Nematollahi et al (2018)

Product	Compounds emitted	Test conditions	Reference
Baby cream	Butane Acetaldehyde Ethanol Acetone Isopropanol Isobutyraldehyde Ethyl acetate Tetrahydrofuran Isovaleraldehyde 2-methylbutyraldehyde 2-pentanone Toluene cis-3-hexenol α -phellandrene α -pinene β -phellandrene β -pinene β -myrcene α -thujene 4-carene Limonene o-cymene 3-carene Eucalyptol γ -terpinene Terpinolene Bicyclo[3.1.0]hexan-2-ol, 2-methyl-5-(1-methylethyl)-, (1. α .,2. β .,5. α .)- (-)-terpinen-4-ol α -terpineol	Headspace GC/MS	Nematollahi et al (2018)

Product	Compounds emitted	Test conditions	Reference
Baby cream	α -pinene (+)-camphene Camphene β -pinene m-cymene Eucalyptol Dihydromyrcenol Tetrahydrolinalool Camphor Isoborneol 2,9-dimethyl-5-decyne	Headspace GC/MS	Nematollahi et al (2018)
Baby cream	Acetone Benzyl alcohol Phenylethyl alcohol	Headspace GC/MS	Nematollahi et al (2018)
Baby cream	Ethanol Acetone α -pinene Camphene β -pinene Limonene Eucalyptol Linalool Phenylethyl alcohol Benzyl acetate Phenoxyethanol	Headspace GC/MS	Nematollahi et al (2018)

Product	Compounds emitted	Test conditions	Reference
Personal care product	d-limonene 2,4-dimethyl-3-cyclohexene-1-carboxaldehyde Ethanol (z)-3,4-dimethyl-3-hexen-2-one α -pinene β -pinene γ -terpinene 2,7-dimethyl-2,7-octanediol Isocineole 2,4-dimethyl-1,3-cyclopentanedione Camphor Linalool Benzyl acetate Methanol Camphene α -terpinolene Acetone β -terpinene o, m, or p-cymene α -terpinene Carene isomer	Headspace GC/MS	Steinemann (2015)

Product	Compounds emitted	Test conditions	Reference
Personal care product	Ethanol α-pinene d-limonene β-pinene Ethyl acetate Camphene 1,1-diethoxy-ethane Acetaldehyde α-fenchene 1-methyl-1,4-cyclohexadiene Cyclohexane 2-butanone Tricyclene β-phellandrene	Headspace GC/MS	Steinemann (2015)
Personal care product	Ethanol Isopropanol 3-hexen-1-ol, acetate, (z)- 2,4-dimethyl-3-cyclohexene-1-carboxaldehyde Butanoic acid, 2-methyl-, ethyl ester Eucalyptol Ethyl butanoate Acetic acid, butyl ester 2-methyl-2,4-dimethoxybutane Prenyl acetate Formaldehyde Dimethyl-3-cyclohexene-1-carboxaldehyde Hexanoic acid, ethyl ester Acetaldehyde Acetone Carene isomer t-butyl alcohol	Headspace GC/MS	Steinemann (2015)

Product	Compounds emitted	Test conditions	Reference
Personal care product	2,2,4,4,6,8,8-heptamethylnonane Methanol Acetaldehyde n,n-dimethyl acetamide 2,2,3,3,5,6,6-heptamethylheptane Benzyl acetate d-limonene Formaldehyde 2,6,10-trimethyldodecane Ethyl butanoate 3-methoxy-3-methylbutanol Ethanol 4,4-dimethylcyclooctene	Headspace GC/MS	Steinemann (2015)
Personal care product	d-limonene γ-terpinene 2,7-dimethyl-2,7-octanediol β-pinene α-pinene 3-octanol, 3,7-dimethyl Ethanol 1-methyl-3-(1-methylethyl)-cyclohexene 3-isopropyl-5-methyl-hex-4-en-2-one Acetone Carene isomer o, m, or p-cymene α-terpinene Isocineole Propene, 2-methyl- Ethylmethyl pentane	Headspace GC/MS	Steinemann (2015)

Where possible, chemicals are listed in order of abundance.

Table 16 VOCs emitted by 'green' personal care products

Product	Compounds emitted	Test conditions	Reference
Liquid soap	Ethanol Pentane α -pinene Limonene β -pinene Eucalyptol Linalool β -myrcene Linalyl anthranilate Camphene trans-2-pentene Butane 3-methylhexane Acetaldehyde 1-heptene 2,3,4-trimethylhexane 1-octene Terpinolene β -trans-ocimene Caryophyllene	Headspace GC/MS	Nematollahi et al (2019)

Product	Compounds emitted	Test conditions	Reference
Liquid soap	Eucalyptol Limonene α -pinene α -cymene 3-carene β -pinene α -phellandrene β -myrcene β -phellandrene γ -terpinene Pentane Camphene (Z)- β -ocimene	Headspace GC/MS	Nematollahi et al (2019)
Facial wash gel	Butane Undecane Acetaldehyde	Headspace GC/MS	Nematollahi et al (2019)
Facial scrub	Limonene Benzyl alcohol 3-(neopentyloxy)-2-butanol Eucalyptol Methyl 2-ethylhexanoate β -trans-ocimene Acetaldehyde Linalool β -pinene 4-tert-butylcyclohexyl acetate	Headspace GC/MS	Nematollahi et al (2019)

Product	Compounds emitted	Test conditions	Reference
Cleansing foam	Limonene Camphene Eucalyptol Cyclofenchene Benzyl alcohol β -myrcene α -pinene Isomenthone 6-methyl-5-hepten-2-one (-)-isopulegol 3-carene Benzaldehyde Acetaldehyde Linalool 1-octanol Caryophyllene Sabinene DL-menthyl acetate 2-methylfuran Isoamyl alcohol	Headspace GC/MS	Nematollahi et al (2019)
Body wash	Tetrahydrolinalool Limonene β -pinene Isopropanol Benzyl acetate Linalool Hexane γ -terpinene Methylcyclopentane	Headspace GC/MS	Nematollahi et al (2019)

Product	Compounds emitted	Test conditions	Reference
Hand and body wash	Limonene β -myrcene α -pinene γ -terpinene Linalool Ethanol (R)-(+)- β -citronellol β -trans-ocimene cis-3,7-dimethyl-2,6-octadien-1-ol Acetaldehyde β -phellandrene 1-octanol 3-isopropenyl-5-methyl-1-cyclohexene Neryl acetate β -trans-ocimene α -phellandrene Piperonal	Headspace GC/MS	Nematollahi et al (2019)
Shampoo	Limonene β -pinene β -trans-Ocimene β -myrcene γ -terpinene Benzyl alcohol Linalool Eucalyptol Phenoxyethanol Sabinene Linalyl acetate Ethanol β -phellandrene α -phellandrene	Headspace GC/MS	Nematollahi et al (2019)

Product	Compounds emitted	Test conditions	Reference
Shampoo	Ethanol α-pinene p-cymene Eucalyptol γ-terpinene β-pinene Camphene 4-terpineol α-phellandrene Limonene 6-methyl-1,6-heptadiene (+)-camphor Linalool 2-carene Ethyl formate β-phellandrene Linalyl anthranilate Ethyl acetate Terpinolene Acetone	Headspace GC/MS	Nematollahi et al (2019)
Fragrance-free shampoo	Ethanol (E)-3-tetradecene (4E)-4-tetradecene (Z)-7-tetradecene trans-7-tetradecene	Headspace GC/MS	Nematollahi et al (2019)
Fragrance-free shampoo	Toluene	Headspace GC/MS	Nematollahi et al (2019)

Product	Compounds emitted	Test conditions	Reference
Shampoo	Octamethylcyclotetrasiloxane Hexamethyldisiloxane 2,2,4,6,6-pentamethylheptane 2,8-dimethyl-5-nonanol Propanal Tris(trimethylsilyl) borate Trimethylsilanol Decamethylcyclopentasiloxane Hexamethylcyclotrisiloxane Diethyl phthalate 2,2,4,4-tetramethyloctane Chloromethane Acetaldehyde	Headspace GC/MS	Nematollahi et al (2019)
Conditioner	Linalool Eucalyptol β -trans-ocimene Limonene (R)-(+)- β -citronellol α -terpineol	Headspace GC/MS	Nematollahi et al (2019)
Conditioner	Decamethylcyclopentasiloxane Limonene Dodecamethylcyclohexasiloxane Methanol Octamethylcyclotetrasiloxane Hexanal Phenoxyethanol Acetone D-carvone	Headspace GC/MS	Nematollahi et al (2019)

Product	Compounds emitted	Test conditions	Reference
Shampoo	Ethanol γ-terpinene β-trans-ocimene 2-carene o-cymene Limonene Eucalyptol 4-terpineol α-phellandrene Terpinolene β-pinene β-myrcene β-phellandrene Isobutyraldehyde α-thujene Ethyl formate Ethyl acetate Camphene Linalool 2-methylbutyraldehyde	Headspace GC/MS	Nematollahi et al (2019)
Body lotion	Limonene Benzyl alcohol Ethanol β-myrcene β-trans-ocimene Acetaldehyde Benzyl acetate	Headspace GC/MS	Nematollahi et al (2019)

Product	Compounds emitted	Test conditions	Reference
Body lotion	(1R)-(+)- α -pinene Benzyl alcohol Eucalyptol m-cymene α -phellandrene β -pinene Limonene Isoamyl acetate 2,4-dimethylpentan-3-one Acetone Isovaleraldehyde γ -terpinene Linalool Methyl isobutyl ketone	Headspace GC/MS	Nematollahi et al (2019)
Fragrance-free moisturising lotion	Benzyl alcohol Isopropanol	Headspace GC/MS	Nematollahi et al (2019)

Product	Compounds emitted	Test conditions	Reference
Hand and body lotion	Ethanol Limonene Eucalyptol Linalool Ethyl acetate β -trans-ocimene β -myrcene Linalyl acetate (-)-camphor β -phellandrene Acetone 3-octanone Acetaldehyde Artemesia triene Sabinene 2-methyl-1-butene Hexyl methyl ether Ethanol Limonene Eucalyptol	Headspace GC/MS	Nematollahi et al (2019)
Hand cream	Ethanol Limonene β -pinene Linalool β -trans-ocimene Ethyl acetate Acetaldehyde o-cymene γ -terpinene β -myrcene	Headspace GC/MS	Nematollahi et al (2019)

Product	Compounds emitted	Test conditions	Reference
Hand cream	Ethanol Linalool Eucalyptol Linalyl anthranilate Limonene Toluene Benzenepropanol Acetaldehyde (-)-camphor	Headspace GC/MS	Nematollahi et al (2019)
Hand cream	Ethanol Acetaldehyde	Headspace GC/MS	Nematollahi et al (2019)
Fragrance-free body, hand and face cream	Benzyl alcohol Ethanol Acetaldehyde	Headspace GC/MS	Nematollahi et al (2019)
Facial moisturiser	Limonene Benzyl alcohol Phenoxyethanol γ-terpinene Linalool β-myrcene β-trans-ocimene β-pinene Eucalyptol Linalyl anthranilate	Headspace GC/MS	Nematollahi et al (2019)
Deodorant	Piperonal	Headspace GC/MS	Nematollahi et al (2019)

Product	Compounds emitted	Test conditions	Reference
Deodorant	Ethanol Limonene α -pinene β -myrcene β -pinene γ -terpinene 2,3,3-trimethylhexane α -phellandrene (Z)- β -ocimene 2-methylpentane Ethyl acetate 2,3,4-trimethylhexane	Headspace GC/MS	Nematollahi et al (2019)
Deodorant	Ethanol Limonene β -pinene γ -terpinene α -pinene Eucalyptol α -phellandrene β -phellandrene Linalool Linalyl acetate Terpinolene Camphene 2-carene Ethyl acetate Sabinene cis-3,7-dimethyl-2,6-octadien-1-ol α -thujene 4-terpineol 3-carene Decanal	Headspace GC/MS	Nematollahi et al (2019)

Product	Compounds emitted	Test conditions	Reference
Fragrance-free deodorant	Ethanol	Headspace GC/MS	Nematollahi et al (2019)
Daily control head lice spray	Ethanol Ethyl acetate Acetaldehyde Phenoxyethanol	Headspace GC/MS	Nematollahi et al (2019)
Makeup remover	Benzyl alcohol Limonene Ethanol	Headspace GC/MS	Nematollahi et al (2019)
Adult sunscreen	Decamethylcyclopentasiloxane Isopropanol Ethanol Dodecamethylcyclohexasiloxane Phenoxyethanol Hexanal Hexamethylcyclotrisiloxane Pentane Acetone Acetaldehyde	Headspace GC/MS	Nematollahi et al (2019)
Adult sunscreen	Pentane Hexanal	Headspace GC/MS	Nematollahi et al (2019)
Baby sunscreen	Pentane Butane	Headspace GC/MS	Nematollahi et al (2019)
Baby sunscreen	Ethanol Hexanal Pentane	Headspace GC/MS	Nematollahi et al (2019)

Product	Compounds emitted	Test conditions	Reference
Baby shampoo and body wash	Acetone Isopropanol Methylcyclopentane 2,4-dimethylpentane Octane Ethyl butyrate 2,4-pentanedione α -pinene Camphene Undecane 3-carene β -myrcene α -phellandrene Ocimene Terpinolene Limonene β -phellandrene Eucalyptol γ -terpinene Benzyl alcohol Linalool Tridecane	Headspace GC/MS	Nematollahi et al (2018)

Product	Compounds emitted	Test conditions	Reference
Baby hair and body wash	Acetaldehyde Acetone Isopropanol Methylcyclohexane Hexanal β -trans-ocimene β -Myrcene Limonene Ocimene 1-octanol Linalool Phenylethyl alcohol 3,5,5-trimethylhexyl acetate Ethyl linalool Linalyl anthranilate 1-undecanol α -terpineol Linalool acetate 2-carene	Headspace GC/MS	Nematollahi et al (2018)

Product	Compounds emitted	Test conditions	Reference
Baby hair and body wash	Acetaldehyde Pentane Acetone Isopropanol 3-methylhexane 2,4-dimethylhexane Isobutyl isobutyrate α -phellandrene α -pinene β -phellandrene β -pinene β -myrcene Limonene 3-carene γ -terpinene 1-octanol Benzyl alcohol Decamethylcyclopentasiloxane Amyl senecioate	Headspace GC/MS	Nematollahi et al (2018)
Baby body wash	Acetaldehyde Hexane 2-methylfuran Cyclohexane 2,4-dimethylhexane 2,2-dimethyldecane Benzyl alcohol Dodecane	Headspace GC/MS	Nematollahi et al (2018)

Product	Compounds emitted	Test conditions	Reference
Baby body wash	Acetaldehyde Ethanol 3-methylfuran Toluene Methyl hexyl ether Butyl acetate Isobutyl isobutyrate α -phellandrene α -pinene Isobutyl 2-methyl-2-propenoate Camphene β -pinene β -myrcene Hexyl butyrate 3-octanone β -trans-ocimene Hexyl acetate Limonene 3-carene (Z)- β -ocimene Ethyl 2-methylcyclopropanecarboxylate γ -terpinene 2,6-octadiene, 2,4-dimethyl- Terpinolene Benzyl alcohol 1-octen-3-yl-acetate Linalool 3-octyl acetate 4,4,6,6-tetramethylbicyclo[3.1.0]hex-2-ene 2-methyl pentyl isobutyrate Amyl senecioate Octyl butyrate Camphor	Headspace GC/MS	Nematollahi et al (2018)

Product	Compounds emitted	Test conditions	Reference
Baby body wash cont.	4-terpineol Ocimenol Linalool acetate Lavandulyl acetate Neryl acetate Geraniol acetate (Z)- β -farnesene Bicyclo[5.2.0]nonane, 4-ethenyl-4,8,8-trimethyl-2-methylene-	Headspace GC/MS	Nematollahi et al (2018)
Baby hair and body wash	2-methyl-1-propene Acetaldehyde Acetone 2-methylpentane 2,3,4-trimethylhexane Ethyl butyrate Ethyl 2-methylbutyrate Ethyl 2-methylpentanoate β -pinene Hexyl acetate Dihydromyrcenol 3,7-dimethyl-3-octanol Benzyl acetate Linalool Methyl phenylcarbinyl acetate 3,7-dimethyloctan-3-yl acetate Phenoxyethanol 2-tert-butylcyclohexanol	Headspace GC/MS	Nematollahi et al (2018)

Product	Compounds emitted	Test conditions	Reference
Baby shampoo and body wash	Acetaldehyde Ethanol Acetone 2-methylfuran 1,1-dimethylallyl alcohol Toluene Ethyl butyrate Ethyl 2-methylbutyrate α -pinene Prenyl acetate β -pinene β -myrcene 4-hexen-1-ol, acetate Hexyl acetate Limonene 3-carene Dihydromyrcenol 1-octanol Linalool 1-methyl-3-cyclohexene-1-carbaldehyde Allyl heptanoate Benzyl acetate Ethyl linalool 4-tert-butylcyclohexyl acetate 2-tert-butylcyclohexanol trans- β -ionone 2-phenoxyethyl isobutyrate	Headspace GC/MS	Nematollahi et al (2018)

Product	Compounds emitted	Test conditions	Reference
Baby body wash	Methanol Ethanol Acetone 2,4-dimethylhexane α -thujene α -pinene Camphene Undecane β -trans-ocimene β -myrcene 3-octanone 3-carene Hexyl acetate Limonene β -phellandrene Eucalyptol γ -terpinene 2-methylenehexanal Ocimene 1-octanol Linalool Methyl octanoate Dodecane Camphor α -terpineol Linalool acetate Phenoxyethanol Neryl acetate	Headspace GC/MS	Nematollahi et al (2018)

Product	Compounds emitted	Test conditions	Reference
Baby hair and body wash	Isopropanol 2-butenal Ethyl acetate Cyclohexane 3-methyl-1-octene 3-carene 1-decene β -pinene β -myrcene Limonene 1-octanol Linalool Benzyl acetate	Headspace GC/MS	Nematollahi et al (2018)
Baby shampoo and conditioner	Acetaldehyde Isopropanol 2,4-dimethylheptane α -pinene β -pinene β -myrcene Limonene Eucalyptol Tridecane Linalool 1-undecanol Cyclododecane Benzyl acetate	Headspace GC/MS	Nematollahi et al (2018)

Product	Compounds emitted	Test conditions	Reference
Baby hair and body wash	Acetaldehyde Ethanol Acetone Pentanal 2,4-dimethylhexane Hexanal β-pinene α-phellandrene α-pinene Camphene Sabinene 3-carene β-myrcene Ocimene β-trans-ocimene 3-octanol Limonene β-phellandrene Eucalyptol Terpinolene Linalool Camphor α-terpineol Linalool acetate Carvone Neryl acetate Geraniol acetate Piperonal	Headspace GC/MS	Nematollahi et al (2018)

Product	Compounds emitted	Test conditions	Reference
Baby shampoo and conditioner	Acetaldehyde Ethanol Acetone Ethyl acetate Ethyl butyrate Hexanal Ethyl 2-methylbutyrate Isoamyl acetate 2-methylbutyl acetate cis-3-hexenol Amyl acetate β-trans-ocimene β-myrcene Limonene 1-octanol Linalool Benzyl acetate Phenoxyethanol 1-dodecanol	Headspace GC/MS	Nematollahi et al (2018)
Baby lotion	Acetaldehyde Ethanol Acetone 2-methylpentane 3-methylpentane Hexane α-pinene Limonene Eucalyptol Linalool Camphor Linalool acetate	Headspace GC/MS	Nematollahi et al (2018)

Product	Compounds emitted	Test conditions	Reference
Baby lotion	α -Pinene Limonene Eucalyptol Linalool Ocimenol β -citronellol	Headspace GC/MS	Nematollahi et al (2018)
Baby lotion	3,7-dimethyl-3-octanol	Headspace GC/MS	Nematollahi et al (2018)
Baby lotion	2-methyl-1-propene Acetaldehyde Acetone Hexanal Benzaldehyde Benzyl alcohol Phenylethyl alcohol	Headspace GC/MS	Nematollahi et al (2018)
Baby lotion	Pentane Ethanol Isobutyl isobutyrate α -pinene β -pinene β -myrcene Limonene Eucalyptol Benzyl alcohol Linalool Camphor Linalool acetate Phenoxyethanol	Headspace GC/MS	Nematollahi et al (2018)

Product	Compounds emitted	Test conditions	Reference
Baby bath oil	Acetaldehyde 2-methyl-1-butene Ethanol Acetone Methyl hexyl ether Isobutyl isobutyrate α -phellandrene α -pinene Isobutyl 2-methyl-2-propenoate Camphene Sabinene 3-carene β -myrcene 3-methyl-2-butenic acid, octyl ester 3-octanone γ -terpinene Hexyl acetate Octanal Limonene β -phellandrene Eucalyptol Ethyl 2-methylcyclopropanecarboxylate Bromocyclohexane Terpinolene Benzyl alcohol 1-octen-3-yl-acetate Linalool 2,2,6,6-tetramethylcyclohexanol Hexyl butyrate Octyl butyrate Camphor 4-terpineol Borneol	Headspace GC/MS	Nematollahi et al (2018)

Product	Compounds emitted	Test conditions	Reference
Baby bath oil cont.	α -terpineol Dihydrocarveol Linalool acetate 1,1-dimethyl-2-(2-methyl-1-propenyl)cyclopropane Neryl acetate	Headspace GC/MS	Nematollahi et al (2018)
Baby moisturiser	Ethanol α -pinene Camphene β -pinene β -myrcene Limonene m-cymene Eucalyptol γ -terpinene Linalool Camphor Linalool acetate D,l-isobornyl acetate	Headspace GC/MS	Nematollahi et al (2018)
Baby cream	Ethyl acetate Ethyl butyrate Ethyl lactate Ethyl isovalerate Limonene	Headspace GC/MS	Nematollahi et al (2018)

Product	Compounds emitted	Test conditions	Reference
Baby anti-bug	Acetaldehyde Pentane 1,4-pentadiene 2-methyl-2-butene Acetone Dimethyl sulfide Isobutyraldehyde 3-methyl-1-cyclopentene 2-methylfuran Methylcyclopentane 1,1-dimethylallyl alcohol Isovaleraldehyde 2-methylbutyraldehyde 2-ethylfuran Toluene α -phellandrene α -pinene Camphene β -phellandrene β -pinene 3,3-dimethylallyl bromide 2,3-dehydro-1,8-cineole 6-methyl-5-hepten-2-one 4-carene Limonene m-cymene 3-carene Eucalyptol γ -terpinene 4-nonanone Linalool Acetylmethylcyclohexene,4-acetyl-1-methyl-1-cyclohexene (R)-(+)-citronellal	Headspace GC/MS	Nematollahi et al (2018)

Product	Compounds emitted	Test conditions	Reference
Baby anti-bug cont.	4,5,6,7-tetrahydro-3,6-dimethylbenzofuran (1R,4S)-p-menthan-3-one Camphor L-menthol Methyl salicylate β -citronellol cis-3,7-dimethyl-2,6-octadien-1-ol (2Z)-3,7-dimethylocta-2,6-dienal DI-menthyl acetate Citral Neryl acetate β -caryophyllene α -himachalen α -longipinene	Headspace GC/MS	Nematollahi et al (2018)
Personal care product	d-limonene Butanoic acid, 2-methyl-, ethyl ester β -pinene Ethyl butanoate Prenyl acetate Allyl heptanoate Benzyl acetate α -pinene 2,4-dimethyl-3-cyclohexene-1-carboxaldehyde Methanol 1-butanol, 3-methyl-, acetate 4-tert-butylcyclohexyl acetate 2-hexenal 1,4-dioxane γ -terpinene o, m, or p-cymene	Headspace GC/MS	Steinemann (2015)

Product	Compounds emitted	Test conditions	Reference
Personal care product	d-limonene Ethyl butanoate Benzyl acetate β -pinene 2,4-dimethyl-3-cyclohexene-1-carboxaldehyde Ethanol Allyl heptanoate Isopropanol α -pinene Methylene chloride γ -terpinene 2,6-dimethyl-2-heptanol 1,4-dioxane Carene isomer Cis-ocimene	Headspace GC/MS	Steinemann (2015)
Personal care product	Isopropanol d-limonene Ethanol Methanol Acetone β -pinene Butane Acetaldehyde Carbonyl sulfide Pentane	Headspace GC/MS	Steinemann (2015)

Product	Compounds emitted	Test conditions	Reference
Personal care product	d-limonene α -pinene Linalool Ethanol Camphor β -pinene Carene isomer 3-methyl-2-butenic acid, 2-pentyl ester Propanoic acid, 2-methyl-, 2-methylbutyl ester Camphene Propanoic acid, 2-methyl-, 2-methylpropyl ester Methacrolein 2-butoxy-ethanol 2-butenic acid, 3-methyl-, pentyl ester 2(10)-pinen-3-one Trans-ocimene Carene isomer Butane Cis-ocimene Propene, 2-methyl-	Headspace GC/MS	Steinemann (2015)

Product	Compounds emitted	Test conditions	Reference
Personal care product	α -pinene Ethanol Eucalyptol d-limonene Citronella Camphor γ -terpinene 2,7-dimethyl-2,7-octanediol Benzyl acetate o, m, or p-cymene β -pinene Pentane Heptane Octane Acetic acid, 2-phenylethyl ester α -phenylethyl acetate Camphene Carene isomer α -terpinene Butane Hexane	Headspace GC/MS	Steinemann (2015)

Where possible, chemicals are listed in order of abundance.

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