ANSES Opinion
Request No 2012-SA-0236

The Director General

Maisons-Alfort, 29 September 2017

OPINION[1]
of the French Agency for Food, Environmental and Occupational Health & Safety

concerning "the identification and analysis of the various emerging techniques for indoor air purification"

ANSES undertakes independent and pluralistic scientific expert assessments.
ANSES's public health mission involves ensuring environmental, occupational and food safety as well as assessing the potential health risks they may entail.
It also contributes to the protection of the health and welfare of animals, the protection of plant health and the evaluation of the nutritional characteristics of food.

It provides the competent authorities with the necessary information concerning these risks as well as the requisite expertise and technical support for drafting legislative and statutory provisions and implementing risk management strategies (Article L.1313-1 of the French Public Health Code).

Its opinions are published on its website.
This opinion is a translation of the original French version. In the event of any discrepancy or ambiguity the French language text dated..... shall prevail.

1. BACKGROUND AND PURPOSE OF THE REQUEST

In France and in many other countries, the quality of air inside buildings is a public health challenge that the public is increasingly aware of. The indoor environment is characterised by a wide range of exposures to many physical agents as well as chemical or microbiological contaminants. The effects of this exposure on health vary in particular depending on the type of pollutants and the characteristics of exposure, etc. There are many different sources of pollutants in indoor air: sources specific to the building, its environment, its installations or the behaviour of its occupants. The French Environment, Construction and Public Health Codes include provisions that define policies regarding indoor air quality.

To reduce exposure to pollutants in indoor air, current recommendations issued by the public authorities focus primarily on limiting emissions at the source, airing and ventilation.

Over the last few years, a market has developed in the area of indoor air purification with the sale of equipment claiming to have indoor air purification properties in the form of stand-alone units, as well as building and decorating materials offering depolluting properties. These devices and products are intended for the general public, but may target in particular sensitive or sensitised individuals.

However, the issue of their effectiveness and more importantly their safety has been raised.

The scientific watch carried out by ANSES on this topic prompted the Agency to consult its Expert Committee (CES) on Assessment of the risks related to air environments, which drew the Agency's attention to studies regarding the benefits and limitations of photocatalysis, and the measurement of

[1] Cancels and replaces the previous version of 23 June 2017. The nature of the amendments is shown in the appendix.

the intrinsic performance of stand-alone air purifiers for tertiary and residential applications. Certain studies have in fact demonstrated that air purification devices using the principle of photocatalysis have variable effectiveness that is sometimes low, and may result in the formation of potentially hazardous reaction by-products in the air. These results concerned stand-alone photocatalytic air purifiers marketed to the general public and also photocatalytic devices supplied to industry.

The conclusions of a scientific workshop on the degree of scientific knowledge regarding the effectiveness and safety of air purification processes using photocatalysis in indoor environments, and the development potential of these processes, hosted on 2 April 2012 by the French Observatory for Indoor Air Quality (OQAI) in partnership with the University of La Rochelle, emphasised that although the principle of photocatalysis may be potentially effective for many indoor air pollutants, the process also has drawbacks.

In this context, the CES on Assessment of the risks related to air environments highlighted the importance of working on this issue and encouraged ANSES to examine the subject.

In view of this, ANSES issued an internal request on 10 October 2012 concerning the following two topics:

1. Identify air purification techniques used in the indoor environment for the general public and for small volumetric units or as auxiliary treatment in the occupational setting[2] (technical characteristics, implementation conditions, elimination process, claimed effectiveness, spectrum of activity for chemical substances, particles, biological agents, etc.),

2. Collect and analyse available knowledge on the changes in air quality associated with use of these new[3] air purification techniques, particularly in the case of pollutant mixtures (treated, untreated and secondary pollutants) and depending on how the devices are used. The aim is not to assess the effectiveness of the various devices available on the market. Techniques involving filtration are not within the scope of this work.

2. ORGANISATION OF THE EXPERT APPRAISAL

The expert appraisal was carried out in accordance with French Standard NF X 50-110 "Quality in Expert Appraisals – General Requirements of Competence for Expert Appraisals (May 2003)".

2.1. Organisation

The expert appraisal falls within the sphere of competence of the Expert Committee (CES) on Assessment of the risks related to air environments. ANSES nominated three expert rapporteurs *intuitu personae* to assist the Agency's Air Risk Assessment Unit in carrying out the expert appraisal. The methodological and scientific aspects of the work were regularly presented to the CES between October 2012 and December 2016. The report issued by ANSES and the expert rapporteurs takes into account the comments and additional information provided by the members of the CES.

The expert appraisal conclusions were adopted by the CES on Assessment of the risks related to air environments at its meeting held on 30 January 2017.

[2] Devices used in industry and air purification systems integrated into ventilation systems for public buildings are excluded from the scope of this appraisal.

[3] The internal ANSES request covers emerging purification techniques. Changes in air quality related to the use of filtration systems were therefore not dealt with in the framework of this expert appraisal.

ANSES analyses the links of interest declared by the experts prior to their appointment and throughout the work, in order to avoid potential conflicts of interest with regard to the matters dealt with as part of the expert appraisal.

The experts' declarations of interests are made public via the ANSES website (www.anses.fr).

2.2. Methodology

2.2.1. Identification of air purification techniques

A market study commissioned by ANSES was carried out in 2015 by the consultant firm Nomadéis, in partnership with ULR-Valor, an affiliate of the University of La Rochelle specialising in enhancing the value of the establishment's research results, following calls for tender.

The market analysis concerning indoor air purification included:

- A document analysis of catalogues, technical documentation, monographs, operating manuals, and the contents on the websites of manufacturers and distributors,
- Twenty-eight qualitative interviews of experts (research institutes, institutions, etc.), manufacturers and distributors of indoor air purification products, and prescribers (consultant architects, consumer associations, indoor environment advisers, physicians),
- Field visits to businesses and to the annual trade show Pollutec,
- Online consultation of manufacturers and distributors lasting six weeks in order to collect primarily the economic and technical data that had been pre-identified during documentary research.

2.2.2. Collect and analyse available knowledge regarding the change in air quality associated with the use of new air purification techniques

The assessment of the air quality associated with the use of indoor air purification systems was based on a review of the scientific literature.

Searches were carried out in the bibliographic database Scopus for the period 2008 to 2016 with the following groups of key words:

- *Indoor air;*
- *Purification OR treatment OR cleaning OR filtration OR cleaner OR purifier OR filter*

More than 2300 scientific publications were identified. These publications were sorted by analysing the titles and abstracts with the initial aim of excluding those falling outside the scope of the expert appraisal (classified "out of scope"). This approach primarily involved excluding articles concerning:

- energy efficiency, heating, ventilation, and air conditioning (HVAC) systems[4] or devices to be fitted into ventilation ducts (so called "in duct" systems),

[4] The acronym HVAC (heating, ventilation, and air conditioning) commonly used internationally refers to systems bringing together the equipment needed for heating, ventilation and air conditioning within a building: boilers, ventilation devices, extraction ventilators, filters, and piping (US-EPA 1991). However, not all HVAC systems are designed to perform these three functions. The term HVAC covers a wide range of devices from stand-alone machines to centralised systems serving several indoor areas of a building. (US-EPA 1991).

- research and development regarding purification techniques and new materials in the experimental stage,
- specific facilities (e.g. clean rooms, agricultural buildings).

Through this selection process, almost 90% of the publications were classified as “out of scope”, leading to a total of 189 original articles requiring analysis. These articles provided, in particular:

- a description and discussion of air purification technology,
- results of on-site measurements,
- information on the pollutants targeted by the purification technologies.

Publications concerning investigations carried out in real conditions or conditions comparable to actual use with marketed equipment were given priority. In this context, real operating conditions or conditions close to actual use refer to testing performed in residential environments or in "large” test chambers with a pollutant or a mixture of pollutants in concentrations “close” to those found in indoor environments such as housing.

As a result, references dealing with experimental effectiveness tests or modelling concerning both the level of effectiveness and the concentrations were in principle excluded from the scope of this bibliographic review, unless these tests were carried out in conditions close to real use.

3. EXPERT COMMITTEE SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The Expert Committee emphasises that the aim of this appraisal was not to assess the overall usefulness of indoor air purification systems, but rather to assess the effects of several of these devices on air quality, in other words, to analyse the pollutants effectively treated and the pollutants potentially emitted by this equipment.

3.1. Identification of the main air purification techniques currently used

Air purification relies on two main principles: trapping contaminants or eliminating them. Techniques based on these two main principles are implemented in stand-alone devices or HVAC systems. They are described in this report.

3.1.1. Trapping techniques

a) Filtration

Filtration is an operation involving the trapping of particles in the air using physical and mechanical processes: sieving, inertia, interception and diffusion. This operation is performed using a medium which is the substrate required for filtration. There are various types of fibrous filter media: natural organic fibres (cotton, linen, hemp), regenerated cellulose fibres, synthetic fibres (polyester, polyethylene, polyamide or other polymers), or inorganic fibres (mineral/ceramic, fibreglass, metal fibres and carbon fibres).

The filters used in air treatment are mainly intended for dust removal. There are several types of filters depending specifically on the size of the particles to be trapped. With repeated use, the filter

becomes clogged, reducing its effectiveness. Regular maintenance including a change of filters is therefore needed.

b) Ionisation and electrostatic filtration

Ionisation involves the conversion of an electrically neutral atom or molecule into a charged ion through the loss or gain of one or more electrons. The principle behind ionisation is to precipitate charged particles in the air either onto a surface by repulsion of particles with the same charge via electrostatic attraction, i.e. simple ionisation, or onto electrodes carrying the opposite electric charge to that of the ionised particles, i.e. electrostatic precipitation. Particles with opposite charges can also be attracted to one another and form heavier particles that will settle on the surfaces more quickly.

There are several processes that can be used to ionise an atom or a molecule. These include:

- ionisation by electron impact: a beam of accelerated electrons encounters an atom or a molecule and on impact removes one or more electrons,
- ionisation by radiation: an atom or molecule is subjected to the effect of radiation with a sufficiently energetic wavelength to expel a peripheral electron.

Purification systems using the principle of ionisation most commonly involve electron impact ionisation processes, with the two most frequently used techniques being ionisation by corona discharge and ionisation by dielectric barrier discharge (DBD).

If the particles are the main target of the ionisation, an effect on gas molecules can also be observed. Interactions between volatile organic compounds (VOCs) and radicals formed during ion generation lead to a series of chemical chain reactions that should result in mineralisation when the reaction is complete. This is the intention in plasma.

3.1.2. Oxidation or destruction techniques

a) Plasma

Plasma is a state of matter consisting of an ionised gas. The term plasma refers to a gas composed of a mixture of neutral particles with positively charged ions and free electrons. Plasma is formed when a gas is subjected to a high-intensity electric field, to a strong electromagnetic field or to sufficiently elevated temperatures, or when it is bombarded with particles. This leads to ionisation of the gas. When the ionisation is significant enough for the number of electrons per unit volume to be comparable to that of the molecules, the gas then becomes a highly conductive fluid called plasma.
In the area of indoor air purification, “cold” plasma technology or non-thermal plasma (i.e. when the mean gas temperature is close to the initial temperature) is used to generate active species such as free radicals that are able to break down certain pollutants found in the air, by oxidation.

b) Ozone generation

The principle of air purification by ozone involves the emission of ozone in the air by ozone generators.

The ozone molecule (O_3) is highly reactive and relatively unstable and has a natural tendency to break down to dioxygen (O_2) and atomic oxygen (O), which will react with other chemical compounds until they break them down. This ability to readily transfer an oxygen atom gives ozone

a very high oxidation potential. The ozone-generation purification technique makes use of this property of ozone to induce decomposition reactions.

c) Photocatalysis

The principle of photocatalysis revolves around the breakdown of molecules through a series of chemical reactions until mineralisation, following activation of a catalyst by light radiation with sufficient energy.

In short, therefore, the principle of photocatalysis involves an electronic process occurring at the surface of a catalyst that is often titanium dioxide (TiO_2) because of its low cost and high performance. When the catalyst is subjected to sufficiently strong light, a charge is created at its surface. Successive reduction-oxidation reactions then occur between the molecules adsorbed to the photocatalyst and the charged surface until, theoretically, complete mineralisation of the organic pollutant to water and carbon dioxide (CO_2) is achieved. Reactive oxygen species are also formed ($OH^{\bullet}$, $O_2^{\bullet-}$, H_2O_2, etc.) that contribute to degradation of the organic pollutants.

Note: photocatalysis can also be used in building materials or decoration supplies such as paint, tiling, etc.

NB: There are other air purification techniques such as biological filtration or ultraviolet light. Biofiltration is based on the ability of certain microorganisms to metabolise pollutants. This technique is, however, not yet used for indoor air purification. Ultraviolet light can have a germicidal effect and a photolytic effect on VOCs. At present, commercial use mainly involves elimination of microbial aerosols; however, this technology is found in few devices and analysis of the scientific literature was not able to identify studies on this topic in conditions of use similar to real conditions.

3.1.3. Sprays claiming to clean or purify the air

During this appraisal, sprays claiming to clean indoor air were also identified. Two types of products were identified: sprays containing essential oils or other active substances often claiming to have an effect on biocontaminants in indoor air (bactericides, virucides, fungicides, acaricides and insecticides), and deodorisers that claim to neutralise odours beyond simply masking them, but without the principle being clearly defined.

3.2. Conclusions of the CES

❒ **Identification of indoor air purification devices**

The market study carried out as part of this appraisal showed that the market in France is emerging and rapidly changing, with increasing numbers of products on offer by home appliances manufacturers and companies specialising in air treatment.

Nearly 500 indoor air purification devices were identified. Most of these devices were stand-alone air purifiers (64%). Although these products represent the highest number of references, they only account for 0.3% of market share (about 7000 sales/year). These stand-alone devices cost on average 315 euros, but prices vary widely (from less than 50 euros to more than 2000 euros), which could explain their low market penetration compared to other less costly devices such as natural or synthetic “cleaning” sprays, which cost on average 10 to 15 euros per unit. These products have the highest market share with 62% (more than 22 million sales/year), with only 13% of the references identified.

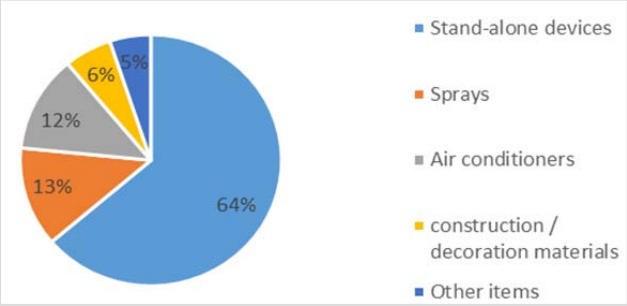
Effectiveness claims are rather disparate and may target a specific substance or a mixture of pollutants. The claims mainly concern volatile organic compounds (75%), viruses, bacteria and mould (68%), particles (58%), and allergens (pollen, mites) (54%). Others concern more generally cigarette smoke, smells, or “air pollutants”.

Concerning the purification technologies used, it is important to note that more than half of the references combine several technologies. The most common technologies on the market include mechanical filtration (35% of references), ionisation (33% of references), and physical adsorption (24% of references). An important point is that this appraisal was undertaken in particular following the emergence of concerns regarding photocatalysis reported in several research studies showing emissions of by-products. However, the market study showed that this technology is not yet widely used and represents less than 17% of references.

Lastly, the market study showed that the technologies used were often poorly described on the purification devices and that the claimed effectiveness had a low level of justification. The manufacturers, prescriber and consumer associations interviewed highlighted the importance of implementing standards to substantiate the effectiveness of products. Moreover, prescribers indicated that they are more in favour of prevention by eliminating the sources of pollutants than an approach involving air purification. If air treatment proves necessary, only mechanical filtration is currently viewed by prescribers as being “without risk”. It is important to emphasise that if these devices are not serviced, they may lead to a deterioration of air quality.

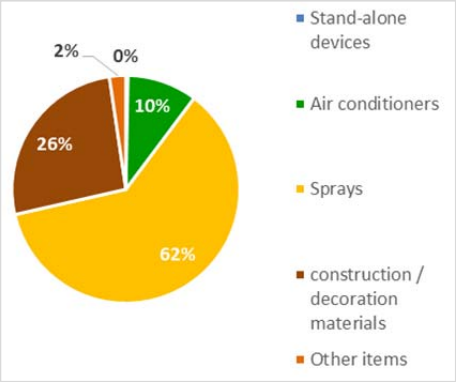
The diagrams below are extracts from the market study and illustrate the findings described here.

Distribution of the products within the five identified families



Number of products per family	
Stand-alone devices	312
Sprays	64
Air conditioners	61
Construction/decoration materials	29
Other items	25
TOTAL	491

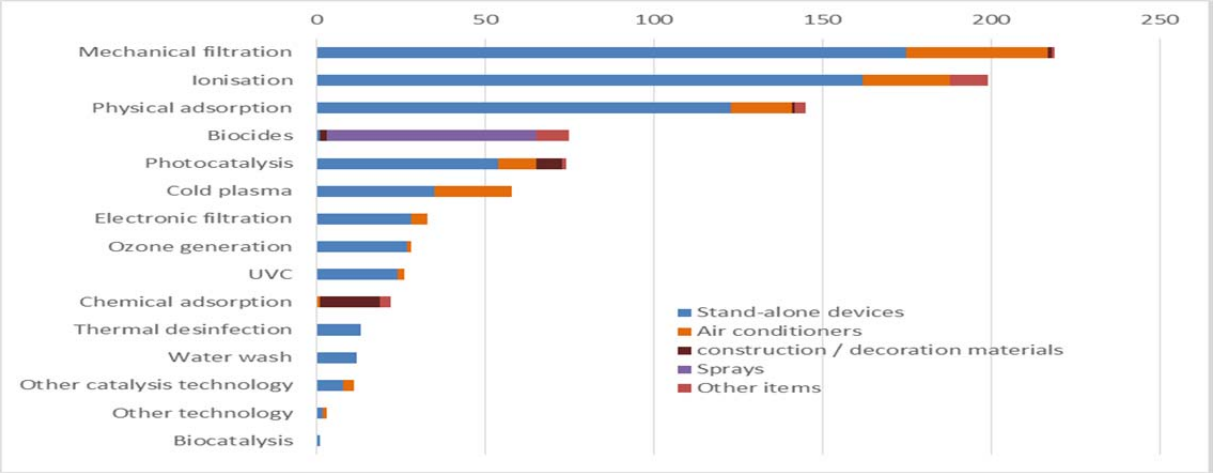
Market share in indoor air purification by family of products



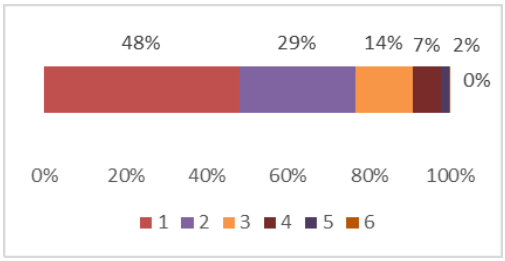
“Despite the predominance of stand-alone devices among the products on offer, sprays account for the highest market value (62%), while stand-alone purifiers represent only 0.3% of market value. The indoor air purification market is valued at about 170 million euros annually, with approximately 26% for construction and decoration materials (primarily paints), 10% for air conditioners fitted with purification functions, and 2% for other items.

Construction and decoration materials appear to still have low diversity (29 references identified in France), with the product offering made up mainly of depolluting paints, plasterboard, and a certain number of more original surfaces, such as tiling, ceiling tiles, paintable textiles, and aerosols giving surfaces depolluting properties). The "other items” are also low in number and cover a very wide range (USB ionisers, deodorisers in the form of gels, blocks, etc.). "

Number of references per purification technology used



Number of technologies used per purification device



❒ Regulations and standardisation

A bibliographic search did not identify any specific regulations on the use or placing on the market of indoor air purification systems in France. In other countries, only the State of California (USA) has regulations on ozone emissions of air purification devices, which must not exceed 0.05 ppm.

Although there are no binding regulations governing air purification systems in France, three standards, two of which are experimental[5], can be used to assess: the intrinsic performances of independent air purification devices (Standard NF B44-200, also applicable to air conditioners), the effectiveness of photocatalytic systems on VOCs (experimental Standard XP B44-013), and photocatalytic materials in terms of breakdown of nitrogen oxides (experimental Standard XP B44-011). It is important to note that tests performed in the laboratory are not always representative of real conditions of use.

[5] After the collective expert appraisal work, these two experimental standards were replaced; the new standards were not appraised:

- the experimental standard XP B44-13 of December 2009 (Photocatalysis - Test and analysis method for determining the efficacy of photocatalytic systems for eliminating volatile organic compounds/odours in recirculating interior air - Confined chamber test) was cancelled and replaced by the standard NF EN 16846-1 in June 2017 (Photocatalysis - Measurement of efficiency of photocatalytic devices used for the elimination of VOC and odour in indoor air in active mode - Part 1 : batch mode test method in closed chamber)
- the experimental standard XP B44-011 of December 2009 (Photocatalysis - Test method for assessing photocatalytic materials with respect to NOx degradation - Tangential mode single pass process) was cancelled and replaced by the experimental standard XP CEN/TS 16980-1 in February 2017 (Photocatalysis - Continuous flow test methods - Part 1 : determination of the degradation of nitric oxide (NO) in the air by photocatalytic materials).

These standards represent real progress because they propose standardised testing protocols that can be used to compare the performances of different devices. They aim at evaluating the effectiveness of the devices and also the emission of certain by-products. However, they can still be improved because they do not all provide for recirculation tests nor ageing tests. These additional tests would nonetheless help to:

- demonstrate the formation of by-products through reactions of indoor air pollutants with emissions from the purifier (for example, the interaction between ozone and terpenes leads to the formation of particles),
- measure a possible decrease in device performance over time.

❒ Effects on indoor air quality of air purification devices

The aim of this expert appraisal was to study the effects of implementing the devices on air quality in real conditions or close to real conditions. A limited number of studies were identified and did not make it possible to demonstrate effectiveness in real conditions of use.

Moreover, these devices may worsen indoor air quality by generating new pollutants. In view of the scientific literature review carried out, the CES notes that there may be:

- intentional or unintentional primary emissions related to device functioning (e.g. ozone emitted by ozone generators and also by plasma),
- formation of by-products related to incomplete breakdown of pollutants (e.g. formation of formaldehyde due to incomplete breakdown of ethanol by photocatalysis),
- formation of secondary pollutants related to interactions between the substances generated by the purifier and the pollutants present in indoor environments (e.g. formation of secondary particles due to reactions between ozone emitted by a plasma purifier and terpenes found in indoor air),
- secondary emissions related to physical, chemical or biological interactions between the pollutants trapped in the purifier and indoor air pollutants (e.g. reactions of indoor air pollutants with the ozone trapped in an active carbon filter).

“Cleaning” sprays containing essential oils or other active substances claim biocidal activity and are therefore subject to Regulation (EU) No 528/2012 concerning the making available on the market and use of biocidal products. They must therefore contain an authorised active substance or a substance currently under investigation at the European level. In time, these products will be subject to marketing authorisation (MA) on the basis of data demonstrating the effectiveness of the product against the claimed targets and an acceptable risk for humans and the environment.

Given that in the coming years these products will be subject to assessment as part of implementation of this regulation[6], this expert appraisal did not include an in-depth literature search concerning the biocidal effectiveness of essential oils or other active substances dispersed in indoor air, nor on the health effects of inhaling essential oils in particular. The appraisal did, however, present two recent studies indicating emission of VOCs at levels of concern.

[6] The products containing active substances that are under examination are not yet subject to MA. The products containing authorised active substances are already subject to MA. The closure of the procedure for examination of active substances included in the examination programme is planned for 2024.

The CES emphasises that, to date, there are few studies on the beneficial or harmful short-term health effects associated with the use of air purifiers, and that no study on the long-term effects was identified in the scientific literature.

Furthermore, the CES notes that the use of indoor air purification systems designed for the general public may not be suitable for use in the occupational setting where the type and level of pollutants may differ from those found in indoor domestic environments.

Table 1 summarises the principles, effectiveness claims and limitations of the main purification techniques identified in the bibliographic analysis.

Table 1: principles, effectiveness claims and limitations of the main purification techniques identified in the bibliographic analysis.

Purification technique	Principle	Effectiveness claims	Limitations/drawbacks identified through the scientific literature analysis
Ionisation/electro-static filtration	Injection of ions in the air that are captured by the particles. The charged particles are captured by the surfaces of the buildings (simple ionisation) or by electrically charged plates located inside the purifier (electrostatic precipitation).	◆ Elimination of biological contaminants ◆ Elimination of chemical contaminants ◆ Improvement of well-being	Effectiveness rarely demonstrated in real conditions of use. Potential emissions: • Ozone → formation of secondary particles in the presence of terpenes • Oxygen reactive species → reactions with pollutants in indoor air that may form secondary pollutants
Ozone generation	Oxidation of pollutants through breakdown of ozone	◆ Elimination of organic compounds ◆ Elimination of odours ◆ Elimination of microorganisms	Ozone may be effective against chemical and biological contaminants but at concentrations in the air that may have an effect on human health. Effectiveness is low at ozone concentrations with no effect on human health. Generation of ozone leads to concentration in the air above 100 $\mu g.m^{-3}$ (WHO guideline value over 8 h in indoor air) Formation of secondary pollutants, e.g.: • Particles in the presence of terpenes • Acetic acid in the presence of formaldehyde
Cold plasma	Mineralisation of organic compounds through oxidation reactions initiated by free radicals produced in an ionising field.	◆ Elimination of biological contaminants ◆ Elimination of chemical contaminants ◆ Elimination of odours	Cold plasma alone has a proven ability to mineralise pollutants to CO_2 and O_2 in experimental conditions, but in practice, we observe: • incomplete mineralisation → generation of secondary pollutants • emission of ozone → formation of secondary particles in the presence of terpenes • emission of nitrogen oxides
Plasma/catalysis	Synergy between plasma and catalysis or photocatalysis helping to limit the generation of secondary pollutants (NO_2 and O_3).	◆ Elimination of biological contaminants ◆ Elimination of chemical contaminants ◆ Elimination of odours	The same limitations as those of cold plasma alone are found, even though the formation of secondary products remains lower.
Photocatalysis	Activation of a heterogeneous catalyst by light radiation, often a UV lamp. Mineralisation of pollutants.	◆ Elimination of biological contaminants ◆ Elimination of chemical contaminants ◆ Elimination of odours	In theory, photocatalysis leads to mineralisation of pollutants to CO_2 and O_2. In practice, mineralisation is incomplete leading to formation of secondary products (e.g. ketones, aldehydes, and organic acids).
Essential oils contained in "cleaning" sprays	Biocidal activity	◆ Elimination of biocontaminants ◆ Elimination of odours	Data on effectiveness were not searched for in the literature. The main limitation is the emission of VOCs in indoor air on use of these products. Moreover, the presence of essential oils in the air may cause or worsen asthma.

3.3. Recommendations of the CES

Considering the results of the expert appraisal, the CES has issued the following recommendations:

➔ **Prevention measures**

The CES emphasises that to prevent the risks related to poor indoor air quality, the main strategies are to:

- Limit all sources of pollution that may affect indoor air quality
- Ventilate and air.

➔ **Assessment of the various air purification devices**

Independently of the theoretical effectiveness of a given technology, it is the actual conditions of use that govern operational effectiveness.

In this context and in order to ensure the safety of users, the CES recommends implementation of certification for **all devices** that claim to purify indoor air.

The corresponding tests should consider:

- the effectiveness of the device in reducing the target pollutant(s),
- the emission of pollutants related to the functioning of the device,
- the emission of by-products originating from incomplete degradation of pollutants,
- the reactions of emissions from the device with pollutants found in the indoor environment,
- the effects of ageing of the device on its effectiveness and the emission of pollutants and degradation by-products.

Lastly, the testing should be conducted in conditions that are as similar as possible to those of actual use, in different target environments.

The CES recommends that claims regarding air cleaning should be assessed/regulated. The cleaning claims must be indicated with the list of target pollutants.

Concerning the specific case of spray products/substances for indoor air cleaning, based on biocidal properties, the assessment of effectiveness within the framework of Regulation (EU) No 528/2012 on the marketing of biocidal products should consider the effectiveness of these substances on airborne microorganisms.

➔ **Information provided to the public on the use of air purification devices**

The CES recommends that the public be informed of the potential risks of degradation of indoor air quality when using certain purification devices. The public should be made aware that degradation of odorous compounds, which may contribute to the impression of poor air quality, may lead to the formation of non-odorous by-products that may in fact be more harmful than the initial compounds.

The CES recommends that users be informed of the importance of complying with servicing instructions for purification devices in order to limit the risks of emitting by-products.

The CES recommends that people with asthma be warned of the possible worsening of their condition related to the use of these devices, particularly those using essential oils and systems that may generate ozone.

➔ **Improving knowledge on the benefit of using indoor air purification systems**

The CES recommends studies on the impact of the use of air purifiers on the quality of indoor air in real conditions of use, and on the absence of harmful health effects, particularly in people with allergies and/or asthma.

4. AGENCY CONCLUSIONS AND RECOMMENDATIONS

The French Agency for Food, Environmental and Occupational Health & Safety endorses the conclusions and recommendations of the CES on Assessment of the risks related to air environments.

In view of the expert appraisal carried out, ANSES emphasises that overall, **the scientific data collected and analysed were unable to demonstrate effectiveness in real conditions of use of indoor air purification devices.**

Further to the recommendations issued by its CES, ANSES has identified two specific watch points:

◆ The question of nanoparticle emissions by certain air purification devices, specifically those using photocatalysis, was raised on several occasions during review of this analysis. Two studies published in the scientific literature aimed to detect nanoparticles in the air but did not identify such substances. However, recent results from the IMP-AIR research project “Impact of photocatalytic materials on air quality in indoor environments” (CSTB – French Scientific and Technical Centre for Building, CEA – French Alternative Energies and Atomic Energy Commission), funded by the PRIMEQUAL programme, point out that abrasion of the nano-additivated surfaces of photocatalytic materials can produce nanometric particles, although no health-related conclusions can be drawn at this stage. Additional research on the emission of nanoparticles in the air by photocatalytic materials, especially as they age, should be carried out, along with an evaluation of their safety.

◆ Concerning “cleaning” sprays that claim to have biocidal activity, and given the findings of this expert appraisal, ANSES recommends that during assessment of these products in the framework of the biocides MA procedure, special attention should be given to scientific data regarding the health effects related to inhalation of natural or synthetic volatile organic compounds (VOCs) emitted by these sprays. This is because several VOCs emitted by these products may have adverse effects on health.

In addition, given the collected information, these types of sprays should not be used by people with asthma.

ANSES points out that the indoor air quality plan included in the third National research programme for environmental and occupational health (PNREST 2015–2019) recommends working on information and labelling for the consumer products that emit the highest levels of volatile pollutants such as deodorising products and cleaning products.

Lastly and more generally, the Agency highlights the need to conduct studies on the health impact of using essential oils that can be found in multiple consumer goods.

Dr Roger Genet

KEYWORDS

Epuration de l'air, purification de l'air, qualité de l'air, pollution de l'air, air intérieur, composés organiques volatils, biocontaminants, photocatalyse, ionisation, ozonation, plasma

Air purification, air cleaning, air quality, air pollution, indoor air, volatile organic compounds, biocontaminants, photocatalysis, ionisation, plasma

REFERENCES

US-EPA. 1991. Building air quality. Washington, DC: U.S. Environmental Protection Agency.

Appendix – Opinion updates

Date	**Page**	**Description of the amendments**
09/19/2017	10	A footnote (#5) is added on page 10, second paragraph, indicating two standards were cancelled and replaced by two new European standards, after the collective expert appraisal work were adopted.