

# The Matrix – a DGK initiative to provide guidance to substantiating anti-pollution claims in cosmetics

Poster ID:  
257



Mehling, Annette<sup>1</sup>, Bicard-Benhamou, Valérie<sup>2</sup>, Bielfeldt, Stephan<sup>3</sup>, Dähnhardt-Pfeiffer, Stephan<sup>4</sup>, Hänni-Ciuel, Katarzyna<sup>5</sup>, Jung, Katinka<sup>6</sup>, Lange, Rainer<sup>7</sup>, Lohan, Silke B.<sup>8</sup>, Meinke, Martina C.<sup>9</sup>, Sandig, Grit<sup>10</sup>, Von Seebach, Astrid<sup>11</sup>, Mai, Fabian<sup>12</sup>, **Campiche, Remo<sup>13</sup>**

<sup>1</sup>BASF Personal Care and Nutrition GmbH, Düsseldorf, Germany; <sup>2</sup>MERCK KGaA, Darmstadt, Germany; <sup>3</sup>SGS prodem GmbH, Schanefeld-Hamburg, Germany; <sup>4</sup>Micrology Services Döhnhardt GmbH, Flintbek, Germany; <sup>5</sup>Welda AG, Arlesheim, Switzerland; <sup>6</sup>DALLI-WERKE GmbH & Co. KG, Stolberg, Germany; <sup>7</sup>Clinic for dermatology, Venerologie und Allergologie, Charité-Universitätsmedizin Berlin, Berlin, Germany; <sup>8</sup>SGS Institute Fresenius GmbH, Hamburg, Germany; <sup>9</sup>SOFW Verlag für chemische Industrie H. Ziolkowsky GmbH, Thornhausen, Germany; <sup>10</sup>DSM Nutritional Products, Kaiseraugst, Switzerland

## Introduction:

The concerns about the adverse effects air pollution can have on our health is on the rise worldwide. Pollutants are very varied in nature, can be of natural or anthropogenic origin with typical pollutants ranging from particulate matter (PM; originating e.g. from exhaust, smoke, pollen or ash) and gaseous compounds (e.g. nitrogen and sulfur oxides, volatile organic carbons or ozone) to light (e.g. UVR or blue light) and heavy metals [1]. The skin is exposed to pollutants daily, and this exposure can lead to signs of premature skin aging, damage to the skin barrier, pigmentation disorders as well as cell damage. In addition, preexisting skin problems such as dry and irritated skin as well as skin impurities can be exacerbated [2-4]. A variety of cosmetic products with different "anti-pollution" claims are already on the market. Due to the varied nature of the pollutants and the effects they can have, efficacy tests and claims need to be relevant and correctly substantiated. There is no single "one size fits all" type claim or test method [5]. There are already various publications summarizing the effects of pollution on the skin [1, 3, 6-8]. However, with regards to cosmetics the scope of effects and claims and claim substantiation much remains unclear.

The goal of this work was to compile knowledge and literature data in an easily accessible way. We chose to create an internet-based interactive matrix which can serve as a starting point and knowledge source for people interested in air pollution, the effects on skin and anti-pollution claims for cosmetics.

## Materials & Methods:

The German Society for Scientific and Applied Cosmetics (DGK) working group [WG] "Anti-pollution", an interdisciplinary WG consisting of experts from industry and academia, was specifically formed to tackle the task to create an interactive matrix on the society's website. After outlining four main categories to be addressed, further subcategories were then assigned to them. The idea was to interlink the main and the subcategories within this matrix, through which users can navigate to gather information including potentially relevant test methods. Current literature was screened, and "one-pagers" (1-2 pages) developed for each subcategory. A standardized reporting outline was used to structure these. A limited number (1-5) relevant references were added as a starting point for delving into the respective topics. After thorough scientific and regulatory assessment, the pages were integrated in a website building tool. The sites were interlinked, tested and put online. The matrix was first created in German and then translated into English.

## Conclusions:

We present here a novel, dynamic and interactive tool serving as a knowledge base for pollution and anti-pollution in the cosmetics industry. The Matrix is accessible via the home page of the working group or directly via the URL <https://dkg-ev.de/antipollution-matrix/> or the QR-Code on the right. Users can switch between a version in English language and a version in German language.



## Acknowledgements:

We thank the DGK presidium and scientific advisory board for their support in the creation of this Matrix.

## References:

1. Araviskulka, E., et al., *The impact of airborne pollution on skin*. *J Eur Acad Dermatol Venerol*, 2019.
2. Kim, K.E., D. Cho, and H.J. Park, *Air pollution and skin diseases: Adverse effects of airborne particulate matter on various skin diseases*. *Life Sci*, 2016. 152: p. 126-34.
3. Krutmann, J., *[Air pollution and the skin]*. *Hautarzt*, 2019. 70(3): p. 156-157.
4. Krutmann, J., et al., *Pollution and acne: is there a link?* *Clin Cosmet Invest Dermatol*, 2017. 10: p. 199-204.
5. Mistry, N., *Guidelines for Formulating Anti-Pollution Products*. *Cosmetics*, 2017. 4(4): p. 57.
6. Krutmann, J., et al., *Pollution and skin: from epidemiological and mechanistic studies to clinical implications*. *J Dermatol Sci*, 2014. 76(3): p. 163-8.
7. Vierkotter, A., et al., *Airborne particle exposure and extrinsic skin aging*. *J Invest Dermatol*, 2010. 130(12): p. 2719-26.
8. Vierkotter, A. and J. Krutmann, *Environmental influences on skin aging and ethnic-specific manifestations*. *Dermato Endocrinol*, 2012. 4(3): p. 227-231

## Results & Discussion:

The Anti-Pollution Matrix consists of a landing page and four main categories of interest. These were 'Categories of Active Ingredients and Product Classes', 'Pollutants', 'Damage', and 'Methods' (Figure 1).



Figure 1: Beehive like structure on the home page of the working group. Users can click on each category to access all the topics with more information.

Upon entering the matrix, users find themselves on a landing page with an overview of each category and their subcategories (Figure 2A). After clicking on a subcategory, readers can see a list with specific topics related to the subcategory. (Figure 2B).

A) Anti-Pollution Matrix

B) 2. Pollutants

| Anti-Pollution Matrix                                 |               | Pollutant list  |
|---|---------------|---|
| 1. Categories of Active Ingredients + Product Classes | Protect       | <ul style="list-style-type: none"> <li>• Particulate Matter</li> <li>• Gases / Exhaust</li> <li>• Solar light</li> <li>• Smoke</li> <li>• Heavy Metals</li> <li>• Pollen</li> <li>• Chemical and volatile Pollutants</li> </ul> |
|   | Remove        |   |
|   | Repair        |   |
|   | 2. Pollutants |   |
|   | 3. Damage     |   |
|   | molecular     |   |
|   | clinical      |   |
|   | 4. Methods    |   |
|   | Methods list  |   |

Figure 2: A) A different view of the four categories with the various subcategories. These fields are clickable and lead to the lists of the individual pages. B) Example of a category (pollutants) and its topics. These unfold by clicking on the link Pollutant list. Readers will find information and selected literature on the respective topic (see Fig. 3).

## Particulate Matter

Anti-Pollution Matrix > Pollutants > Pollutant list > Particulate Matter

**Explanation**  
The skin, as the primary barrier between the environment and the body, is exposed to particulate matter (PM) on a daily basis. Particulate matter consists of small particles that are divided into so-called PM<sub>10</sub>, PM<sub>2.5</sub>, and PM<sub>10-2.5</sub>. The nomenclature refers to its size of 10 µm (large fine particles), 2.5 µm (fine particles) and 2.5-10 µm (fine particles). Fine dust particles are solid and liquid suspended solids that are suspended in the air. They come from vehicle exhaust fumes, industrial emissions, combustion of biomass and forest fires (e.g. wood, biomass, waste incineration), forest fires or road dust. In some bad air (1) Depending on the weather, particulate matter accumulates in the atmosphere and forms the so-called smog. Particulate matter is often loaded with toxic components, such as metals, polycyclic aromatic hydrocarbons (PAHs). An example of this is benzo[a]pyrene. Pollen and sand in the above size can also be counted as particulate matter.

**Effects on the skin**  
It has long been known that particulate matter has negative effects on the lungs, as the particles are inhaled and can lead to disease and increased mortality. For a few years, the effect of particulate matter on the skin has also been investigated. Fine dust particles and the pollutants adhering to them are known to trigger oxidative stress through the formation of reactive oxygen species (ROS) and the activation of pro-inflammatory cytokines. Oxidative stress also leads to oxidation of skin lipids and proteins, which can lead to skin aging. The ROS generated and hydroxyl radicals lead to the reduction of matrix metalloproteinases, which leads to the degradation of the extracellular matrix. In particular, collagen and elastin fibers. These are molecular causes of wrinkles and decreased skin elasticity. Particulate matter correlates with a reduced barrier function of the skin. Another skin aging feature induced by particulate matter is pigment spots (age spots), lentigines and an uneven skin tone. (2, 3)

**Measures**  
Since the dust particles are primarily on the skin, skin cleansing, such as washing or exfoliating, is a good measure. Furthermore, suitable film-forming ingredients that prevent the skin from coming into contact with the dust or facilitate the removal of the dust are possible interventions. Since a good skin barrier is important to prevent the penetration of particulate matter into the skin, barrier-strengthening and moisturizing applications can be effective. Molecularly available ingredients such as antioxidants can protect the skin from oxidative stress. Skin-boosting substances can also help the skin protect itself against the effects of particulate matter.

**Impact detection methods**  
In principle, methods such as imaging methods (e.g. VISIA CR or ColorVision) and color measurement methods such as chromameters are suitable. Often used colorimetric agents are e.g. PMA, AVBAH-A and Catorimeter. Furthermore, the transdermal water loss (TEWL) or the skin moisture can be measured by means of a noninvasive Measurement of cutaneous hydration (mucin/skin pH), aqueous microiontophoresis) and profile after activation by, for example, OC-ME and LC-ME are also suitable. They indicate the moisture loss in skin and in vivo. For example with 100% permeability or other suitable methods. Washing or exfoliation efficiency can also be demonstrated by imaging techniques.

**References**  
[1] E. Araviskulka, et al., *The impact of airborne pollution on skin*, *J EADV* (2019), 10.1111/jad.15683, DOI: 10.1111/jad.15683  
[2] Schirrmacher, T. & Watanabe, J., *Lufthygienebericht (Feinstaub, Stickstoffdioxid und Hausstaub)*, *Umweltbundesamt* (2019) 70:19-162, <https://doi.org/10.1007/978-3-658-4338-8>  
[3] Kim et al., *Air pollution and skin diseases: Adverse effects of airborne particulate matter on various skin diseases*, *Life Sciences* (2016) 152:136-154, <https://doi.org/10.1016/j.lfs.2016.03.038>

Figure 3: Final web page of a specific topic. Here the example of Particulate Matter from the Pollutants category is shown. Links to other matrix sites are highlighted in blue. The DOI links in the Reference section lead to the respective publication.