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Hamont, January 2020

Emissions from high-quality candles are no health issue if used properly

From time to time, the media report about the supposedly high emission of fine particles and other pollutants from burning candles and the alleged health risks connected with that.

Candles, both scented and unscented ones, burn with an open flame and can therefore theoretically emit both substances that are typically formed in all combustion processes (like formaldehyde, fine particles, soot or NO_x for example) and volatile ingredients or contaminants (like fragrance ingredients, solvents or other VOC for example). Supplying safe and well-performing candles is of utmost importance to Spaas Kaarsen. Therefore, we only use the best available base materials and manufacture them into well-burning candles with our 150+ years of experience. We also inform users about the correct use, which is another important factor for safety. We are proud to say that our candles do not pose a health risk if they are used properly.

The following characteristics and basic rules for handling are essential for safe candles:

1) **Quality of base materials + matching wicks = important:**

   By using premium base materials (fuel, fragrance, color, additives) and appropriate wicks tailored to this composition and shape, the emission of potentially harmful substances can be reduced to a minimum.

   As a matter of course, our base materials and finished candles comply with the chemical legislation (e.g. REACH and CLP regulations), product safety legislation and relevant CEN standards (EN 15426, EN 15493, EN 15494, EN 16738, EN 16739 and EN 16740) valid in the European Union. Our team of well-trained compliance and quality assurance specialists checks compliance continuously and carries out both internal and external tests on a regular basis.

2) **Consumer use can have a huge influence**

   Consumers play an important role in keeping the potential risks a candle can have at a safe level, both regarding emissions and fire safety. Even the best-performing candle can fail if it is handled improperly. From an emissions point of view, consumers should follow these rules by all means:

   - ✓ **Do not burn candles in a draught**.
     Air movement, e.g. if the candle is close to an open window or door, can disturb the flame and make it soot for example.
   - ✓ **Do not place candles near a heat source and keep an appropriate distance between them.**
     Apart from a fire safety issue, this could result in an enlarged flame that might result in visible sooting for example.
   - ✓ **Trim wick if it gets too long.**
     If the wick gets too long, the flame might get larger to a point where it starts to soot visibly.

- ✓ **Snuff out the flame. Do not blow it out.**
  If the flame is blown out, it typically continues to emit incompletely burned fuel for some time. This can be avoided by snuffing out the flame or by pushing the wick into the liquid fuel with a pair of tweezers until it extinguishes and putting it straight again.
- ✓ **Do only use candle holders with sufficient ventilation.**
  Lack of oxygen might result in incomplete combustion and visible sooting.
- ✓ **Do not burn too many candles at the same time**.
  The size of the room should be appropriate for the number of candles that burn at the same time. It makes a difference if you burn ten candles in a reasonably large living room or in a tiny bath room.
- ✓ **Ventilate the room after using candles**.
  To let in some fresh air is always good, but not while the candles are still burning.

Most of these instructions can be found on the labels of our candles, either as text or as graphical symbols.

3) <u>Fragrance components: correct communication + restrictions for use:</u>

When burning scented candles, the emission of the fragrance components is an additional emission factor. Fragrances are volatile organic components (VOCs) by definition – and have to be because they would not smell otherwise - so the emission of these substances is inevitable. Nevertheless, the health risks are limited in advance by making an inventory of the potential health risks and clearly communicating them on the label of the candle.

The most common health risk that might be caused by scented candles is a flare-up of an allergy of already sensitized people. Therefore, known allergens are written on the label if they exceed a level that is high enough to cause such a flare-up. The overwhelming majority of users will be able to enjoy such candles without any problems. The few who are sensitive to certain ingredients are usually aware of it and find the information on the label, similar to food or cosmetics. About 95% of people will not have an allergic reaction to the components present in the fragrances used in candles. The group for which there is a potential risk of an allergic reaction is usually aware of this. They can find the information on the packaging and will therefore not buy the product. These few consumers will not buy the candle.

4) <u>Scientific studies already carried out:</u>

The European candle industry has a tradition of committing itself to independent research and standardization in order to constantly improve the quality and safety of candles. The associations have carried out several scientific on the emission of scented and unscented candles already, others are still running or will be published shortly:

- ✓ **Unscented candles:**

  - ➢ **Bayreuth Institute of Environmental Reasearch Ökometric GmbH (Germany); 2007):** Scientific comparison of unscented candles consisting of the most widely used wax types (paraffin wax, stearin, palm, soy, bees wax). The emissions were tested for more than 300 different chemicals. The two main conclusions were:

- The composition and amount of typical pollutants formed during combustion (e.g. toluene, benzene, aldehydes, VOCs, PAHs) are similar for the different wax types.

- The exposure levels calculated based on the emissions and a realistic candle use were far below the strictest guideline and limit values for indoor air.

- **Article by Pagels et al[1]:** The study by the Lund University (Sweden) examined the size, number and composition of emitted particles from steadily burning candles, sooting candles and candles after having been extinguished. It found that candles burning with a steady flame emit a comparably high number of ultrafine particles. In contrast to particles from other typical sources, such as tyre abrasion or dust for example, these particles mostly consist of the inorganic salts used for wick treatment, i.e. they can simply be dissolved and excreted by the body if they are inhaled.

- **Danish Environmental Protection Agency (2018)[2]**: The comprehensive study commissioned by the Danish EPA and performed by the Danish Technological Institute (DTI) confirmed the findings of Pagels et al. for the most commonly used unscented candle types in Denmark and established some additional findings:
  - Candles do indeed emit a comparably high number of fine particles during burning. But as long as the candles are protected from draught as instructed by the manufacturers, virtually all particles emitted by most candles consist of the salts used to treat the candle wicks. These salts dissolve easily in water, i.e. they are not persistent and can be excreted easily by the body.
  - The soot content of the particles is very low and much lower than in diesel exhaust for example.
  - Heavy metals, such as lead or nickel for example, could not be detected in the emissions.
  - The emission of volatile organic compounds (VOC) was unremarkable and at very low levels.
  - Due to these significant differences, particles emitted by candles cannot be compared directly with those emitted by other sources, e.g. by traffic.
  - It is recommended to purchase high-quality candles, protect them from draught during burning and trim the wick if it gets too long.

[1] Pagels, J., Wierzbicka, A., Nilsson, E., Isaxon, C., Dahl, A., Gudmundsson, A., Swietlicki, E., Bohgard, M. (2009). Chemical composition and mass emission factors of candle smoke particles. Aerosol Science 40 (2009), 193-208

[2] https://mst.dk/service/publikationer/publikationsarkiv/2018/dec/environmentally-friendly-candles-with-reduced-particle-emissions/

- ✓ **Scented candles:**

  - ➢ **ECA & NCA study on fragranced candles** (expected publication: July 2020): Most comprehensive scientific study on the gaseous and particulate emissions from fragranced and unfragranced candles to date, performed by Fraunhofer WKI (Germany). The most important findings are:

    - For almost all measured parameters for which there are toxicologically justified indoor-air values (formaldehyde, acetaldehyde, propionaldehyde, benzene, toluene, styrene, xylenes, naphthalene, limonene, carbon monoxide and particles PM2.5) the corresponding short-term and long-term concentrations for indoor air are safely met and, in some cases, are considerably below the established safe levels.
      For one parameter (benzo[a]pyrene), the very strict WHO long-term guideline value was slightly exceeded by some candles. Since the guideline value lied only slightly above the quantification limit, substantial measurement uncertainties must be anticipated.

    - The emissions of nitrogen dioxide, which is a typical combustion product formed by the nitrogen and oxygen in the air if certain temperatures are exceeded, were in line with the WHO and EU long-term values. Only two out of 24 candles slightly exceeded the short-term value.

Conclusion

Despite the fact that well-burning candles, with a nearly complete combustion, emit fine particles, these particles are not a reason for concern according to current knowledge. Scientific studies show that the emission of other pollutants is typically below, sometimes even far below, toxicologically derived limits. Only in rare cases, some candles might slightly exceed the very strict guideline values which is not automatically a health concern however.

For the sake of emissions, incomplete combustion characterized by the visible release of soot or smoldering dust after blowing out the candles must be avoided. For this it is important that the user instructions are clearly communicated to the end consumer. In addition, the quality of the base materials plays an important role.

That is why we only develop candles according to the highest quality and safety standards such as REACH, CLP and RAL. If the candles are used according to our instructions, there is no health risk.