INTERNATIONAL FRAGRANCED CANDLE STUDY SUMMARY

In recent years, there have been concerns about potential health effects from the use of fragranced candles in the home. Much of the information that has appeared in the news and other media is based on either older studies, poor quality studies, but more often is based on no studies or science at all. The same misinformation is repeated over and over again. A good example of this misinformation is the exposure to lead from lead core wicks. Lead core wicks were banned in the United States in 2003 and even before that, their use was very limited. They no longer exist and have not for a long time. Nonetheless, there are still new allegations and reports that candles use lead wicks, most commonly on the internet.

In an effort to generate reliable data and determine if there are any potential health risks associated with the use of fragranced candles, the world’s three largest candle trade associations, the American National Candle Association (NCA), the European Candle Manufacturers Association (ECMA) and the South American Candle Association (ALAFAVE), undertook a major study to measure the exposures to candle emissions and determine if they were within safe limits. This study consisted of burning a series of representative candles inside of a sealed test chamber on order to collect and measure the production of potentially hazardous combustion products and other candle emission such as fragrance.

A series of candles were made for this study to best represent the wide range of candles that are currently sold to consumers in the U.S. and Europe. In order to best replicate these candles, the four most common waxes were chosen for this study. They were paraffin wax, soy wax, palm wax, and stearin. For the fragrances, five different fragrances were developed to represent the most popular families of fragrances on the market. These fragrances families were floral, fresh, fruit, oriental and spice & edibles. The 25 most common fragrance ingredients found in each of these fragrance families were chosen to represent a typical candle of that family. Fragrance ingredients were chosen by asking several large fragrance suppliers what were the most common candle fragrance ingredients and concentrations used in each of these fragrance families. Fragrances were created using the most commonly used ingredients at concentrations that best represented that is currently on the market. With four waxes and five fragrances, a total of 20 different fragrance-wax combinations were chosen. In addition, an unfragranced candle of each wax type was tested to bring the total to 24 different test candles.

The candle format picked was the “glass fill” or “filled candle” type. This is the most common candle type sold and this format is relatively easy to work with in an experimental setting. A 5% fragrance load was used in all candles as it represents an average amount of fragrance use in most candle varieties. Wicks were chosen to produce candles that burn at approximately the same rate of consumption, which represented a normal burn rate for fragranced candles. So not all candles used the same wick.

For the testing, four identical candles were placed inside the 280 ft2 (8 m2) test chamber and were allowed to burn for seven hours with adequate ventilation to keep oxygen levels normal. This test was repeated a total of 24 times, once for each wax-fragrance candle combination. Air samples were taken, and motoring was conducted for known products of combustion including carbon dioxide, carbon monoxide, formaldehyde, nitrogen oxides, benzene, acetaldehyde, acrolein, toluene, styrene, naphthalene, xylenes, benzo(a)pyrene, numerous volatile organic chemicals including fragrance ingredients. Particulates were also measured.

By measuring and determining the rate of these candle emissions, and using standard mathematical models, the concentrations of each of these emissions in a typical room in a house over time can be determined. Using this data, human exposures to each of these candle emissions can be determined and compared to the safe limits established by governments or by organizations that set standards for chemical exposures in indoor air. When possible both short term (peak concentration) and long term (chronic exposure) values were used for comparison because it is both important that exposures do not exceed either of these values. Generally, the most conservative and lowest safe limits that could be found were used for comparison.

Comparing the results to the established safe limits generally showed that exposures were well below the safe limits for all the products of combustion. The only exposure that exceeded the established safe limit was the short-term exposure to nitrogen dioxide. All the candles tested exceeded the lowest safe nitrogen dioxide limit set by the German government but only two of the 24 tested slightly exceeded the slightly higher safe limit set by the World Health Organization (WHO).

Nitrogen oxides are not true combustion products of candles. Candles contain almost no nitrogen. Most, if not all of the nitrogen oxides generated by a candle flame result from the recombination of atmospheric nitrogen (N2) with atmospheric oxygen (O2) caused by the temperatures encountered in a burning candle. This means that the combustion of the candle components has little if anything to do with the production of nitrogen oxides. Other indoor sources of combustion such as gas stoves and portable kerosine heaters also produce nitrogen oxides in a similar manner.

The study demonstrated that with the exception of slight exceedances of the short-term exposure to nitrogen dioxide, typical fragranced candles emissions are below the most conservative safe limits set by regulatory authorities and safety organizations.

A copy of the entire study can be obtained at:

[https://authors.elsevier.com/sd/article/S0160-4120(21)00215-4](https://authors.elsevier.com/sd/article/S0160-4120%2821%2900215-4)

Unfragranced