Human Health Assessment of VOC, SVOC and Particulate Emissions From Scented Candles

Thomas Petry1, Danielle Vitalé1, Lynn Cruse2, Fred J. Joachim1, Reuben Mascarenhas3, Scott Schneider4, Ben Smith1, Madhur Singh5

1 Industrial Hygiene and Environmental Health, Laboratory for Risk Science, University of Connecticut, Storrs, USA. 2National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Cincinnati OH, USA. 3Schneider Consulting, Alexandria, VA, USA. 4Hunt Valley Consulting, Inc., Frederick, MD, USA. 5Department of the Environment, Ministry of Natural Resources and Public Works, Government of Canada, Ottawa, ON, Canada.

ABSTRACT

Airborne compounds in the indoor environment arise from a wide variety of sources such as environmental tobacco smoke, heating, lighting and cooking, construction materials as well as outdoor sources. Some product categories which have received recent attention as a source of indoor air pollution are scented candles. To understand the potential of scented candles to contribute to indoor airborne concentrations, a comprehensive candle emission testing program was undertaken to investigate the emissions of volatile and semi-volatile organic compounds (VOC, SVOC) and particulate matter (PM) from uncleaned scented candles over a period of 18 hours. Emissions were characterized in terms of air concentrations in a standard EU-based dwelling using 3 models: the well-known and widely accepted CAN/CSA-Z126-01 ventilation model and the recently developed models of RIFM 2-box indoor air dispersion model. The output from both models has been used to estimate conservative as well as more realistic consumer exposure concentrations to indoor candle emissions. Potential consumer health risks associated with the candle emissions were characterized by comparing the potential human exposure concentrations with established indoor or in the case of PM ambient air quality guidelines or, where not existent, to establish toxicity thresholds. On the basis of this investigation the study concluded that scented candles do not pose a safety concern to the consumer.

INTRODUCTION

There are limited published studies that have investigated the consumer exposure to fragrance materials as well as VOCs and semi-volatile organic compounds (SVOCs) that result from candle emissions (Santilara et al., 1994; Lai et al., 1997; DeLorenzo-Gomez, 1997; DeLorenzo-Gomez, 1998; UTCA, 2008). Additionally a vented air formaldehyde model developed in the Netherlands (RIVM, 2007) worked in candles (Petit et al., 2008) to evaluate the impact of formaldehyde emissions from candles to indoor air. These studies estimated the human exposure from candle emissions based on data from emission studies and provided an estimation of potential human exposure to health impacts. Both studies concluded that emissions from candles are unlikely to pose any long-term health effects to people. UTCA (2008) pointed out that short term peak exposures rise in regular or irregular symmetrical indoor environments.

The scope of the current investigation is to report on the outcomes of a comprehensive set of candle emission studies, conducted in both small and large chambers. The results of these studies were used to assess the potential consumer health risks associated with exposure to candle emissions. For this purpose, the potential consumer inhalation exposure concentrations were calculated using the test chamber results and the RIFM 2-box indoor air dispersion model. This model was selected for its simplicity and its ability to estimate consumer exposure concentrations based on a range of realistic scenarios. The results of these studies were used to assess the potential health risk associated with the consumer exposure to scented candle emissions.

METHODS

The VOC and particulate emissions of scented candles were investigated in 3 different emission chambers. The first study, conducted at the University of Connecticut (2008) in a small emission chamber (2.2 m x 2.2 m x 2.2 m emission chamber / 2 candle chamber) and the second study was conducted at the University of Connecticut in a medium emission chamber (2.8 m x 2.8 m x 2.8 m emission chamber / 6 candle chamber). The third study was conducted at the University of California at San Diego in a large emission chamber (6.0 m x 6.0 m x 6.0 m emission chamber / 6 candle chamber). The second study at UCSD tested different candles including commercial candles, DIY candles and candle melts. The third study at the University of California at San Diego investigated the emissions of two different candles. To understand the emissions of scented candles, indoor air concentration monitoring was conducted. The RIFM 2-box indoor air dispersion model was used to estimate the potential exposure concentrations of the potential consumer exposure concentrations. The results of these studies were used to estimate the potential health risk associated with the consumer exposure to scented candle emissions.

RESULTS

The measured emissions from the candles were characterized by the following:

- Scented candles emitted a wide range of compounds, including VOCs, SVOCs, and particulate matter.
- The emissions were characterized in terms of air concentrations in a standard EU-based dwelling using 3 models: the well-known and widely accepted CAN/CSA-Z126-01 ventilation model and the recently developed models of RIFM 2-box indoor air dispersion model.
- The output from both models has been used to estimate conservative as well as more realistic consumer exposure concentrations to indoor candle emissions.
- Potential consumer health risks associated with the candle emissions were characterized by comparing the potential human exposure concentrations with established indoor or in the case of PM ambient air quality guidelines or, where not existent, to establish toxicity thresholds.

The study concluded that scented candles do not pose a safety concern to the consumer.

CONCLUSIONS

In all the chamber studies, the VOC and PM emissions from scented candles were clearly detectable at discontinuous sampling. The study also used the RIFM 2-box indoor air dispersion model to estimate the potential indoor air concentrations and thus the potential risk associated with the emissions. The results of these studies were used to estimate the potential health risk associated with the consumer exposure to scented candle emissions.

- The emitted VOCs and SVOCs were characterized by a wide range of compounds, including formaldehyde, acetaldehyde, ethyl acetate, and toluene.
- The emissions were characterized in terms of air concentrations in a standard EU-based dwelling using 3 models: the well-known and widely accepted CAN/CSA-Z126-01 ventilation model and the recently developed models of RIFM 2-box indoor air dispersion model.
- The output from both models has been used to estimate conservative as well as more realistic consumer exposure concentrations to indoor candle emissions.
- Potential consumer health risks associated with the candle emissions were characterized by comparing the potential human exposure concentrations with established indoor or in the case of PM ambient air quality guidelines or, where not existent, to establish toxicity thresholds.