



WELL LIVING LAB RESEARCH: STUDY 2

The impact of scent diffusers on indoor air quality

Scent diffusers are increasing in popularity in homes and businesses. It's not unusual to see steam rising from an essential oil diffuser in bedrooms or living rooms, or to notice a piped-in scent at a hotel, casino or a retail store. Such devices are even in use in offices, senior citizen communities and fitness centers.

Smell is one of the five basic senses that sends powerful signals to the brain. Pleasant scents may improve a person's mood or evoke pleasant memories. No wonder scent marketing is a growing business. Companies are using it to enhance the customer experience and to identify their products with a specific scent.

Could there be any downsides to use of scent diffusers? What impact do they have on indoor air quality? The Well Living Lab decided to put three types of diffusers to the test, measuring the impact of their use on concentrations of volatile organic compounds (VOCs) and particulate matter.

While research has previously addressed other types of devices such as scented plug-ins, this is the first time emissions from scent diffusers that are commonly used in aromatherapy and scent marketing have been quantified. The study was conducted in a residential unit in the lab, set up as an apartment with a kitchen, small living room, bathroom and bedroom. Researchers used d-limonene, a citrus-derived essential oil, in the diffusers.

Diffuser types used:

- **A tabletop nebulizer** designed for use in small to medium sized spaces that emits a fine, scented mist, generating particles that mostly evaporate into gas.
- **A tabletop ultrasonic diffuser**, which uses a mixture of water and scent material (such as an essential oil). It also emits a fine mist and is used in small to medium sized spaces.
- **An air-duct-mounted nebulizer** for use in large spaces that emits a fine mist of scent into the HVAC system. This nebulizer was tested with and without an activated carbon filter. (Such filtration helps reduce VOCs).

DEFINITIONS

Particulate matter

Composed of very small particles suspended in the air, made of solids and/or liquids. Indoors, these invisible particles commonly come from cooking and cleaning, or from occupants themselves. When inhaled, this air pollutant can cause serious heart problems, pneumonia and lung disease and cancer. The World Health Organization says eight million people worldwide die from household air pollution each year. Particulate matter exposure is the number one cause of illness and death for non-communicable diseases.

VOCs

A wide variety of organic gases found in the air, such as formaldehyde and benzene. Depending on the characteristics of the organic molecule and length of exposure, these gases can cause short-term irritation, damage to body systems and organs and lead to diseases such as cancer. Odorous VOCs that are not harmful to humans at typical indoor concentrations include the smell of lemon, called d-limonene, and the smell of pine trees, known as α -pinene.













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- Each device was tested three times. The devices operated for seven hours for each test.
- A separate test monitored emissions at different settings (high, medium, low).
- Air quality in the apartment was tested before and while the diffusers were used, and VOCs and particulate matter were continuously monitored during the experiment. The area monitored was 46.5 square feet.

Results of this study can be used to operate scent diffusers in a way that can reduce their impact on air quality while still generating a noticeable scent and getting the benefits that the scent marketing business desires.

- All the tested devices emitted both gases and particles into the air. For that reason, both particle and gas emissions should be considered when assessing the safety and health impact of inhaling air treated with scent diffusers.
- The air duct nebulizer created the poorest air quality, with particle and VOC concentrations elevated to levels that may negatively impact occupant health.
- The table top ultrasonic diffuser had minimal impact on VOC and particulate matter and only for a short period of time. The emissions occurred only briefly because these diffusers work by having scented oil float on the surface of water, which dilutes its emission strength.
- When installing scent diffusers, emission rates should be set at a level at which the smell is evident, but not excessively so. Ventilation of the room should be carefully considered to maintain, but not over-saturate the level of scenting when using a diffuser. For example, if the ventilation system has a low rate of outdoor air exchange, then the diffuser should be set at a lower emission rate to maintain an enjoyable and safe concentration of scent.
- When thinking about installing a scent diffusion system, consider the impact on people with asthma or chemical sensitivities.

Results of this study were presented by the Well Living Lab at the 2018 Indoor Air Conference, July 24, 2018.

	DEVICE	PARTICULATE POLLUTION	VOCs
	Table top ultrasonic diffuser		
	Table top nebulizer		
	Air duct nebulizer with activated charcoal attachment		
	Air duct nebulizer		



ABOUT THE WELL LIVING LAB

The Well Living Lab, a collaboration of Delos™ and Mayo Clinic, is dedicated to identifying how indoor environments impact human health and well-being. It conducts scientific research with human subjects in a simulated real-world environment and shares practical findings that can be applied to improving indoor spaces where people spent approximately 90 percent of their time. The lab has 5,500 square-feet of sensor rich, reconfigurable space in downtown Rochester, Minnesota.

Learn more at WellLivingLab.com