

## May Indoor Air Investigations LLC, Tyngsborough, MA 01879

### Candle Soot – Unhealthy for People and Buildings ©2015 Jeffrey C. May

The holidays are approaching, so it's tempting to think of those fragrant candles that introduce pleasant odors into your home and that provide soft light on these dark, fall evenings.

Candles introduce more than fragrances, however, into homes.

Thousands of homes suffer cosmetic damage because of soot from jar candles. I know of one homeowner whose insurance company spent \$5,000 having all the rooms in his house repainted. The man continued to burn jar candles, however, and had to repaint the house all over again. And he had to have his carpeting cleaned, because soot particles had deposited near doors where airflow occurred.

Soot particles are also unhealthy to inhale. These particles are small enough to be breathed deeply into the lung, and even pass directly through capillary walls and into the blood stream.

Epidemiology studies have found an association between exposure to soot particles and health symptoms, including an increased risk for heart disease. Soot particles may also contain carcinogens, such as benzo(a)pyrene. And soot on dusty surfaces can become airborne when disturbed, and if those surfaces contained mold or pet dander, the soot can be covered with allergenic substances. The particles can then act as surrogate allergens, just as the powder from latex gloves can carry latex allergens.



*Soot stains on candle-jar rim*  
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Jar candles produce more soot than tapered candles do. And why? To answer this question, we have to

look at a little chemistry - one of my favorite subjects!

Most candles are made from wax – a hydrocarbon - which means a compound containing carbon and hydrogen. During complete combustion, all of the carbon atoms combine with oxygen atoms to produce carbon dioxide (CO<sub>2</sub>). (A carbon dioxide molecule consists of one carbon atom and two oxygen atoms.) The hydrogen atoms combine with oxygen atoms to produce water molecules (H<sub>2</sub>O). (Each water molecule consists of two hydrogen atoms and one oxygen atom.)

If the combustion is incomplete, however, a carbon atom may combine with only one atom of oxygen, resulting in carbon monoxide, or CO (one carbon atom, one oxygen atom). When there isn't enough oxygen, combustion is incomplete. Then some carbon atoms combine with oxygen atoms to create carbon monoxide; other carbon atoms combine with oxygen atoms to create carbon dioxide; and still other carbon atoms combine with each other to produce soot (pure soot consists only of carbon atoms).

When a flame is disturbed by airflow, incomplete combustion occurs. Jar candles produce a lot of soot, because air moves into and out of the jar, disturbing the flame structure.

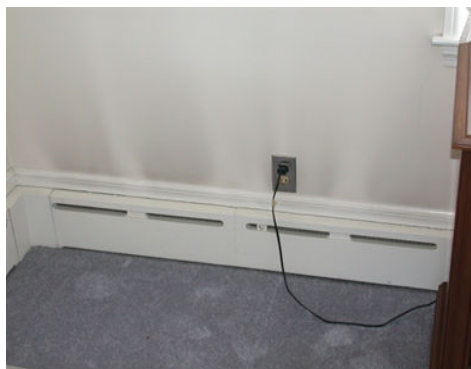
In older homes, soot staining on walls and ceilings can be fairly uniform, sometimes visible only when pictures are removed, revealing whiter surfaces beneath where soot has not deposited. In some Victorians, though, the soot pattern mimics the underlying plaster/lath - darkest at the plaster "keys." In newer, better-insulated homes, soot stains on exterior walls and on ceilings near exterior walls look like stripes on studs or rafters, and black dots at nail heads.



*Soot stains on bedroom wall*  
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Wherever air moves more turbulently due to temperature differentials, the air will impact surfaces more frequently and deposit the soot particles it carries in its flows. This is why when occupants burn jar candles, dark spots develop in bathrooms above light bulbs, and above baseboard heating convectors in houses with hot water heat.



*Soot stains above baseboard heating convector  
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*Soot stains on ceiling above light  
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If you cannot give up your “candle burning” ways as the holidays approach, burn tapered candles instead of jar candles. Just be sure that your tapered candles aren’t placed where there are airflows (such as in front of an open window or near a fan). The airflow can disturb the flame, which again produces soot.

I also discourage families with allergies, asthma and other environmental sensitivities to burn fragranced candles, even if tapered. Such candles may smell pleasant and be soothing, but fragrances are chemicals. Why introduce more chemicals into your indoor environment?

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Refer to our four books for further guidance (available on amazon.com; published by The Johns Hopkins University Press). *Jeff May’s Healthy Home Tips* is a useful workbook for improving the indoor air quality in places where you live and work.

