2016

The Danger of Scented Candles

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Fig. 1. A Collection of Scented Candles, *Scented Candles*; *BabyBoom Candles*; Babyboom Candles Co., Ltd; , n.d. Web. 24 Mar. 2016.

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3-28-2016

Reasons why should you be concerned about scented candles

- ❑ Scented candles are dangerous both before lighting or when lit (Ahn 1).
- ➢ It release different kinds of Organic compounds(Ahn 1).
- Hydrocarbons effects on health(Ahn 2).
- ❑ Scented candles can cause diseases(Hobbs par. 3).
- ❑ Scented candles cause indoor pollution(Ahn 2).

Introduction

- The indoor environment is full of pollutants that can cause health problems, and these pollutants come from different sources, and one of these sources are the scented candles(Ahn 2).
- The combustion of scented candles release(Ahn 2) .

➢ aromatic substances

➢ ultrafine particles

➢ Odors and VOC

(Ahn 2).

→ Are a kind of particulate matter, its size if Nano scale (which is less than 100 nanometers in) (“Ultrafine” par. 1)

Scented candles are dangerous both before lighting or when lit

Different kinds of volatile organic compounds(VOCs) are emitted from scented candles
That has characters of aromatic and toxic that is considered as carcinogens.(Ahn 2)

VOCs Pleasant aromas

VOCs

VOCs

VOCs Pleasant aromas

Fig 3. Yellow Toxic Dangerous Sign; *Vibrant Children;* Vibrant Children*, Web; 24 Mar. 2016.*

Before lit(off)

When lit(on)

Fig 2. Unlit and lit candle; *kitki; Kitki*; Web; 24 Mar. 2016.

The Research and Study

Several experiments conducted in the lab in order to analyze the distinctive characters of the VOCs emitted from the scented candles (Ahn 2).

Analyzing six types(See Table 1) of candles

(Ahn 1)

Name	Code
Clean cotton	CT
Floral	FL
Kiwi melon	KW
Strawberry	SB
Vanilla	VN
Plain	PL

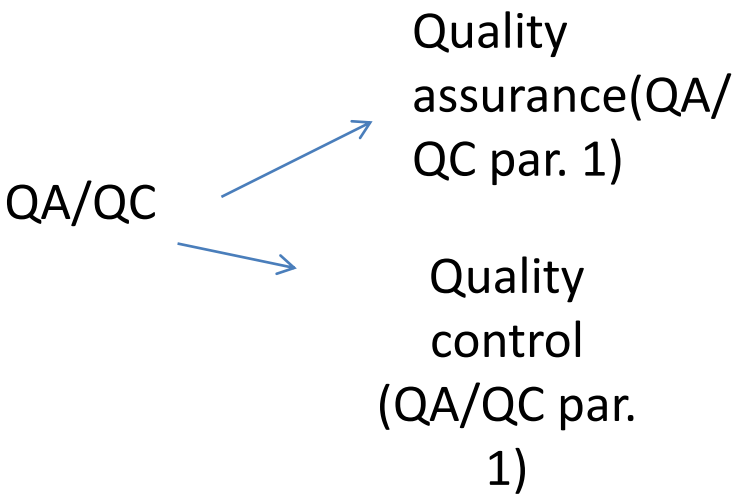
Table 1

Source: Ahn, Jeong H.,et al. "Characterization of Hazardous and Odorous Volatiles Emitted form Scented Candles Before Lighting and After Lit." Journal of Hazardous Materials 286 (April 2015): 242-251. Academic Search Complete. Web. 02 March 2016

The Approach to understand the compounds emitted from scented candles

- The experiment were divided into two steps (Ahn 2)

1. First, they did a standard of 24 target compounds(10 carbonyl; and 14 aromatic hydrocarbons, ketones, esters, alcohol, volatile fatty acids) to do the QA/QC procedures. (Ahn 2)



- The 10 carbonyl compounds were analyzed using a HPLC/UV(see figure 4) analysis (Ahn 2).

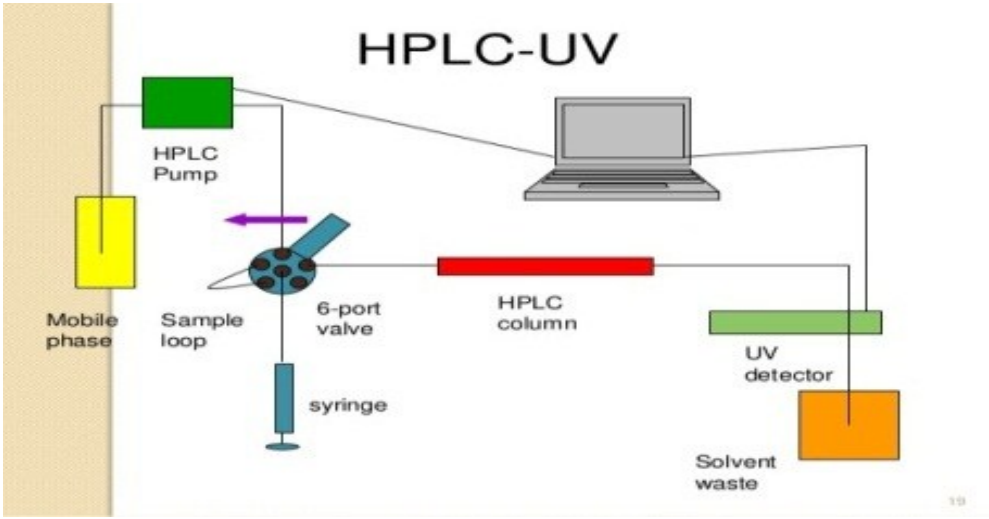


Fig 4. HPLC-UV system; *HPLC-UV; SlideShare;* LinkedIn Corporation; 28 Sep. 2014; Web; 24 Mar. 2016; PowerPoint presentation.

The 14 compounds were analyzed using thermal desorption (TD)-GC/MS)(see figure 5)(Ahn 3).

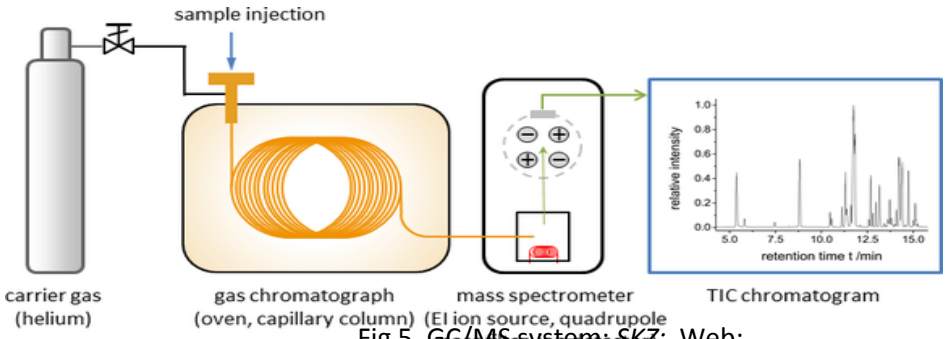


Fig 5. GC/MS system; *SKZ;* Web; 24 Mar. 2016;

2. Secondly, they collected the samples from the scented candles, and they analyzed the candles in two states: On & Off (Ahn 6).

They started by measuring the (g/min) for the candles before and after four minutes of combustion (Ahn 6).

They used an impinger system that collect gasses from the candle (Ahn 6).

A DNPH- cartbridge (see figure 6) was used to collect the carbonyl compounds (Ahn 6).

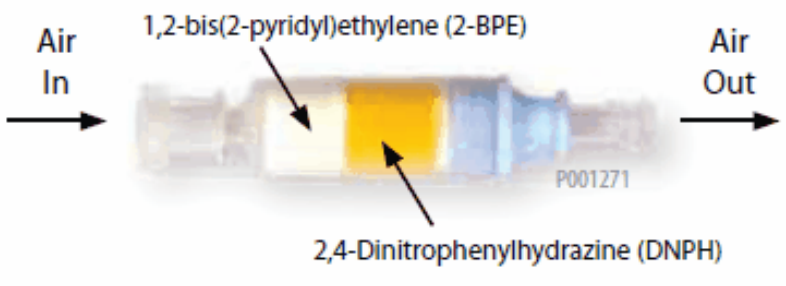


Fig 6. The mean that was used to collect carbonyl compounds; *BPE-DNPH Cartridge*; *Sigma Aldrich;* Sigma-Aldrich Co. LLC; Web; 24 Mar. 2016.

Three bed sorbent in a quartz tube were used to collect the VOCs compounds (Ahn 6).

Some of the types of functional groups that are emitted from scented candles

1. Alcohol

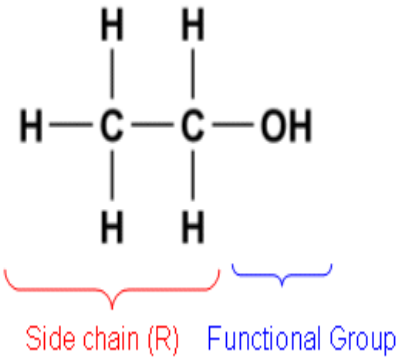


Fig 7. Alcohols; *4college.co.uk; Web; 24 Mar. 2016.*

2. Aldehyde

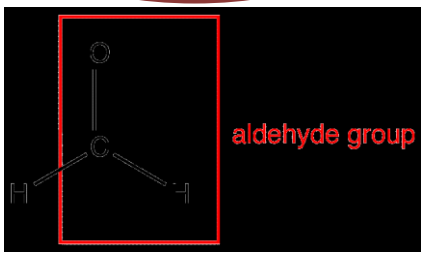


Fig 8. The CHO group in an aldehyde*; Ochempal; Web; 24 Mar. 2016.*

3. Hydrocarbons & PAHs

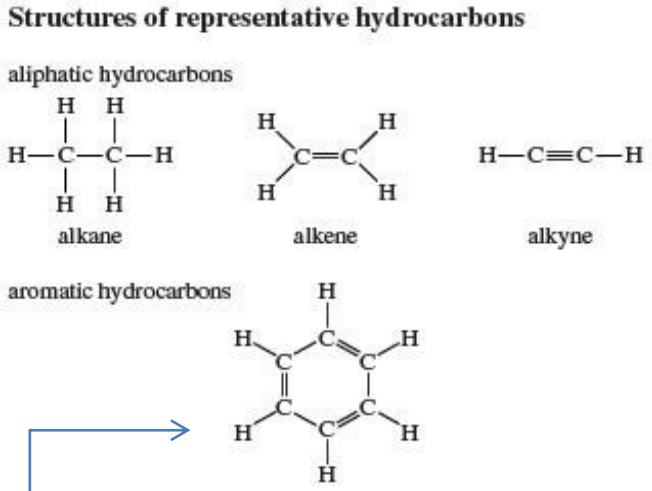


Fig 9. Aliphatic and Aromatic Hydrocarbons; *Encyclopedia Britannica;* Encyclopedia Britannica, Inc*; Web. 24 Mar.2016.*

Polycyclic aromatic hydrocarbons "(PAHs) are a group of more than 100 different chemicals that are released from burning coal, oil, gasoline, trash, tobacco, wood, or other organic substances" (."Polycyclic " par. 1)

Examples of PAHs

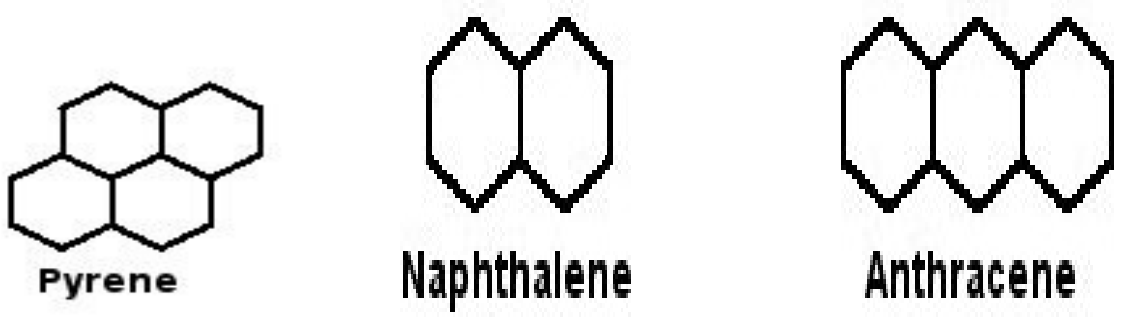


Fig 10 Examples of PAHs; The astrophysics & Astrochemistry Lab at NASA Ames Research Center; 18 Mar. 2016; Web; 24 Mar. 2016.

Hydrocarbons & PAHs

- PAHs impact on human health

According to The Department of Health and Human Services (DHHS), some PAHs can develop cancer(“*Toxic” par. 17)*

Scented candles are mixture of PAHs (Ahn 1)

Fig 11. Touching Candle*; Finger Touching Candle; Fumbling Thru Autism; 29 Jul. 2013; Web; 24 Mar. 2016.*

Or

Fig 12. Brething candle Smoke; *CandleFind;* Candle Find; Web; 24 Mar. 2016.

Long period of time

Cancer

The relationship between low boiling point of candles and its harmful effect

Benzene is one of the hydrocarbons released by scented candles (Ahn 4)

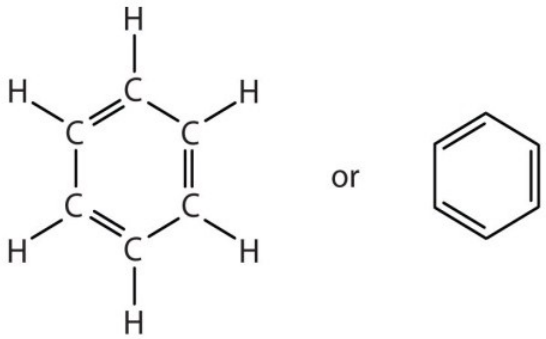


Fig 13. The Structural Formula of Benzene; *Flat world Knowledge;* Flat World Education, Inc; Web; 24 Mar. 2016.

Low ("Benzene")

Fig 14. The boiling Point of Benzene; *What is the boiling point; Research maniacs;* Web; 24 Mar. 2016.

The lower the boiling point → the more concentration of VOCs in the air(Ahn 1). → The more particles of VOCs in the air → the more harmful for human ("Volatile" par. 1)

The Difference between Essential Oils vs. Synthetic Fragrance
Synthetic Fragrance

- The Synthetic production of the fragrance is the reason for it being harmful for humans(“Essential oils” par. 2). It is extracted from petroleum(mixture of hydrocarbons) which include benzene, aldehydes and other toxins (“Essential oils” par. 2).

Fig 15. Fragrance Oils; *Lotus Garden Botanicals;* Lotus Garden Botanicals; 14 Jul. 2012; Web; 24 Mar. 2016.

Can cause

cancer, birth defects, Some nervous system disorders and allergic issues (“Essential oils” par. 2).

The Difference between Essential Oils vs. Synthetic Fragrance
Essential Oil

- Essential oils are extracted from plants, and they are made of concentrated Hydrophobic (non polar molecules that back away from water molecules because water is polar and they don't dissolve in each other("Hydrophobe" par. 1)) liquid that has volatile aroma compounds ("Essential oil" par. 1). Essential oils are considered safe if it used externally ("Are Essential" par. 19).

Fig 16. Essential Oils; *Unstress Yourself;* Lively Green; 29 Jan. 2016; Web; 24 Mar. 2016.

Scented candles cause indoor pollution

One of the VOCs emitted from the scented candles is the hydrocarbons (Ahn 1)
Scented candles release more soot than unscented candles (Bee par. 13). Consequently, make the scented candles more harmful than the unscented candles.

Fragrance oils

Fig 17. Fragrance Oils; *Nature's Garden;* Natures Garden Candle Making & Soap Making Supplies; Web; 24 Mar. 2016.

Fig 18. *Candles; Feature Pics;* Feature Pics; Web; 24 Mar. 2016.

softens the wax ("Are" par.3)

Make the candle's burning time short (Smith Slide 7)

Fig 19. Soot; University Of Illinois Extension; University of Illinois Board of Trustees; Web; 24 Mar. 2016.

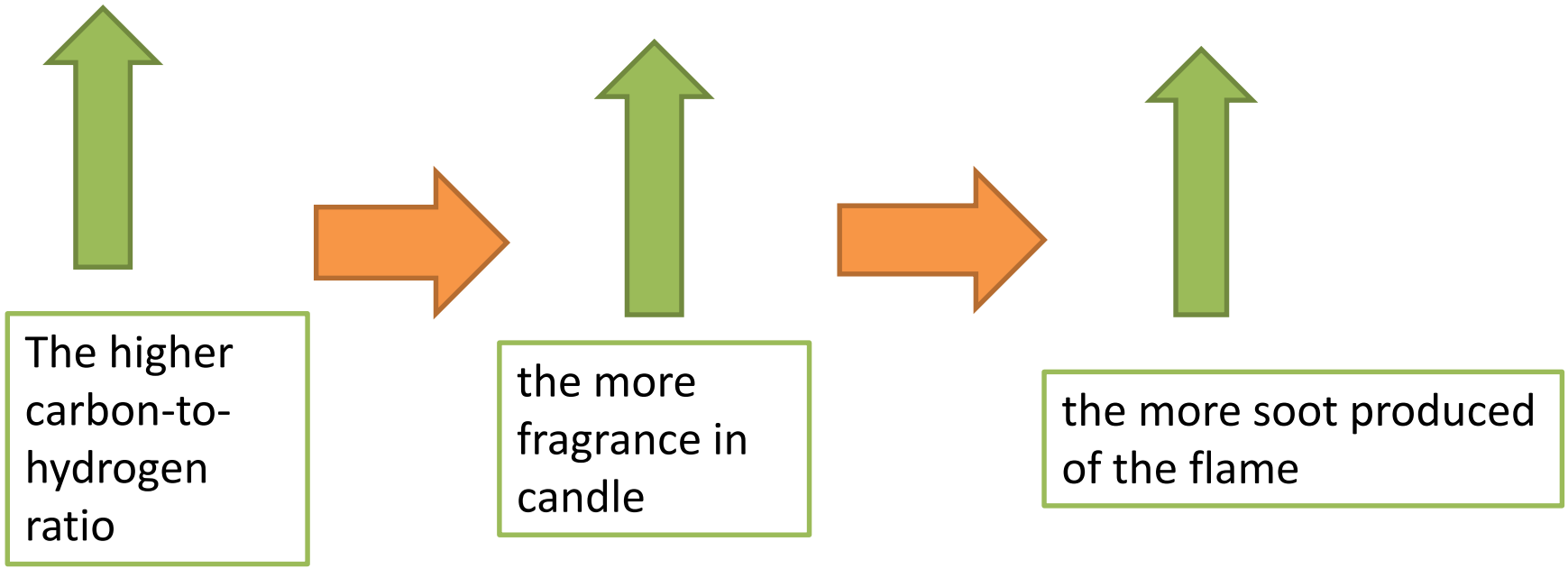
Hydrocarbons + O2 (Priesnitz par. 4)

Incomplete combustion (Priesnitz par. 4)

Soot: (impure carbon particles)("Soot" par. 1)

The relationship between the amount of fragrance and the amount of soot

- The higher the carbon-to-hydrogen ratio, the more fragrance in candle, the more soot produced of the flame (Knight 30). In other words, The more fragrance in waxes the more soot formed.



The bad effects of soot

Some of the dangerous soot compounds are 1)Sulfur Dioxides & 2)Nitrogen Oxides (see figure 1 &2) which can lead to the formation of acid rain if combined with moisture (Keefe par. 9). It can really damage the planet in general(environment, human, building & transport) ("Acid")

Fig 20. Susuwatari; Polyvore; GBeanJuice; Web; 24 Mar. 2016.

1)

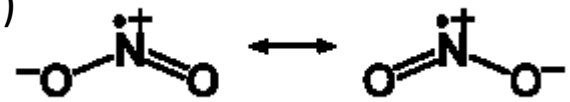


Fig 21. Nitrogen Oxides; Wikipedia; Wikimedia Foundation, Inc.; Web; 24 Mar. 2016

2)

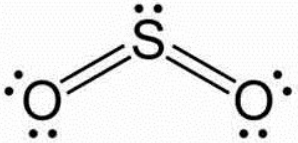


Fig 22. sulfur dioxide; Indiamart; IndiaMART InterMESH Ltd; Web; 24 Mar. 2016

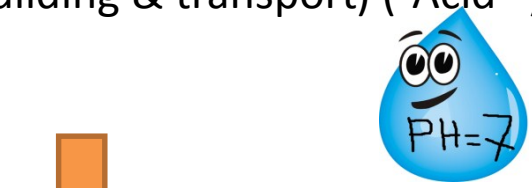


Fig 23. Jessediane; *Jeffery the Water Drop; My Storybook;* My Storybook; Web; 24 Mar. 2016

Moisture

Fig 27. Candle Clip Art; *Clker; Web; 24 Mar. 2016.*

Fig 26. "Acid Rain"; *Slide Share;* LinkedIn Corporation; 23 Apr. 2014; 24 Mar. 2016; PowerPoint file.

Fig 25. Acid Rain and Man. *The Belgravia Centre.* Belgravia Centre, Web. 24 Mar. 2016.

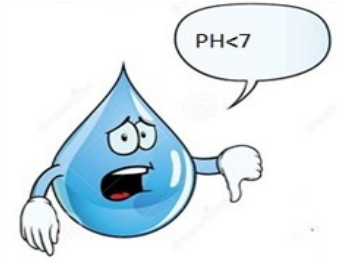


Fig 24. Crying water drop set; 123rf; 123rf; Web; 24 Mar. 2016.

Analysis of one kind of scented candles

According to the study, the kiwi melon emits the most compared to other scents both before lit and when lit(Ahn 1).
For all the tested candles, they release VOCs particles before lit more than when it is lit except for the SB scent (Ahn 9)
The kiwi melon scent is an example of that as that the amount of TVOCs(T refers to total) particles of the unlit candle were a lot more than the amount of the TVOCs when lit (See figure 28) (Ahn 9).

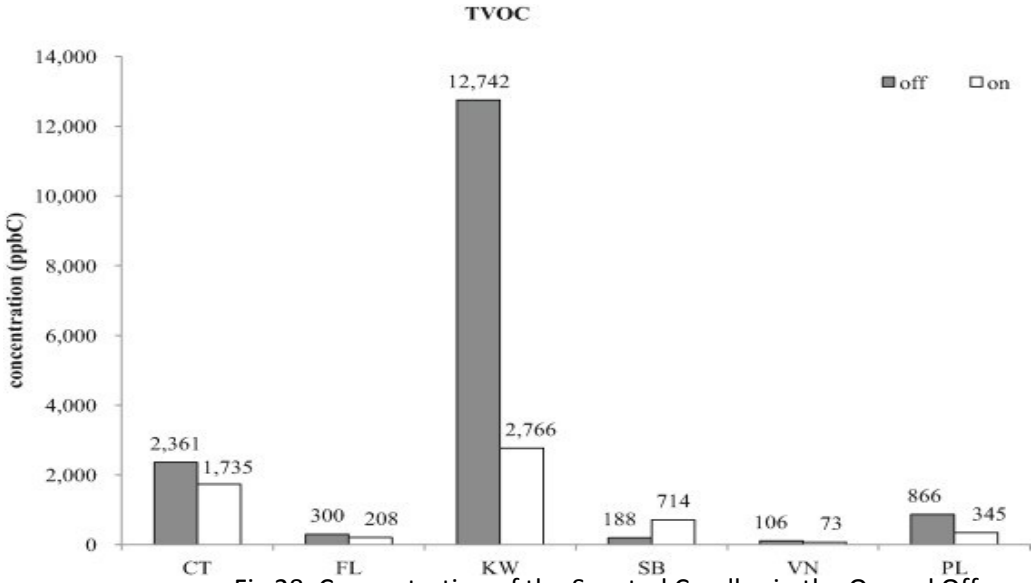


Fig 28. Concentration of the Scented Candles in the On and Off Positions; Characterization of Hazardous and Odorous Volatiles Emitted form Scented Candles Before Lighting and After Lit.; Journal of Hazardous Materials 286 (April 2015): 242-251. Academic Search Complete; Web; 02 March 2016.

Conclusion

- Scented candles release all types of organic compounds (Ahn 1)
- Some of the can cause really bad damage on both humans and environment (“Acid” slide 7,13)
- The lower the boiling point of an organic compound the highest concentration of it in the air (Ahn 1).
- Essential oils are better than Synthetic fragrances.
- Scented candles form soot if its combustion were incomplete (Priesnitz par. 4).
- The kiwi melon scent has a higher concentration in the air before lit compared to unlit candle of kiwi melon scent (Ahn 1)

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