How Do We Redefine Wax Quality for the Candle Industry?

Elizabeth Turner

ExxonMobil

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ALAFAVE

ECMA
European Candle Manufacturers Association

NCA
National Candle Association

Where we left off at NCA'24

Early Manufacturing

Simple process produces a highly pure wax for food wrappers

Manufacturing Evolution

Process changes increase yield and efficiency without altering wax quality

Wax Quality in Candles

Rise in candles creates awareness of wax quality impact on performance

Defining Wax Quality

US Pharmacopeia and ASTM develop wax quality definition and tests

Expanding Wax Quality

Public concern is the catalyst for new tests that confirm wax purity

Future of Wax Quality

What candle trends might shape the next evolution in wax quality?

Potential wax quality & candle industry trends

"Free-From" Claims

Chemical of emerging concern in consumer products

Refillable Container Candles

Emerging candle type driven by changing consumer behaviors

Biodegradability

Presents an alternative waste disposition for consumers

How can we further define candle wax quality?

01 Case for Action

An analysis of

Clean beauty industry

Existing candle claims

Candle producer technical requests

Wax quality standards

02 Considerations

Create Understanding:

What is ‘free-from’

Common chemicals of concern

Advanced wax quality testing

03 Challenges

Bring Awareness:

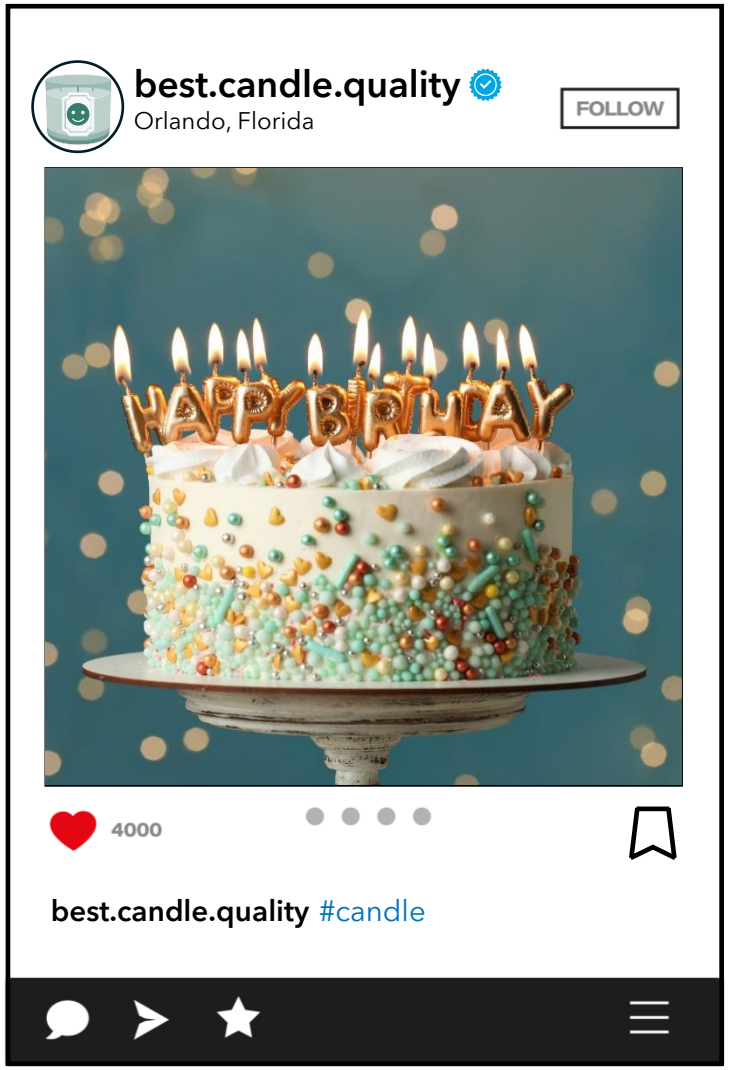
Establishing industry collaboration

Proactive identification of emerging chemicals of interest

04 Collaboration

Let’s Start Today!

Social media and candle quality



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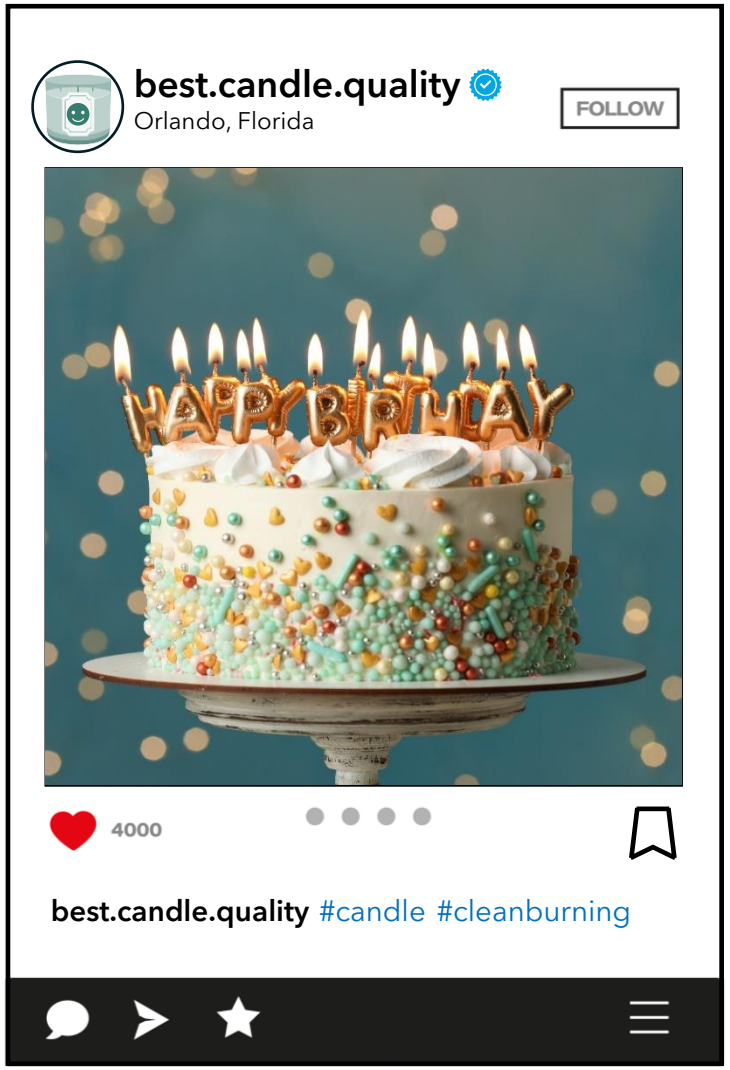
#candle

March 2025 analysis of Instagram hashtags

Social media and candle quality



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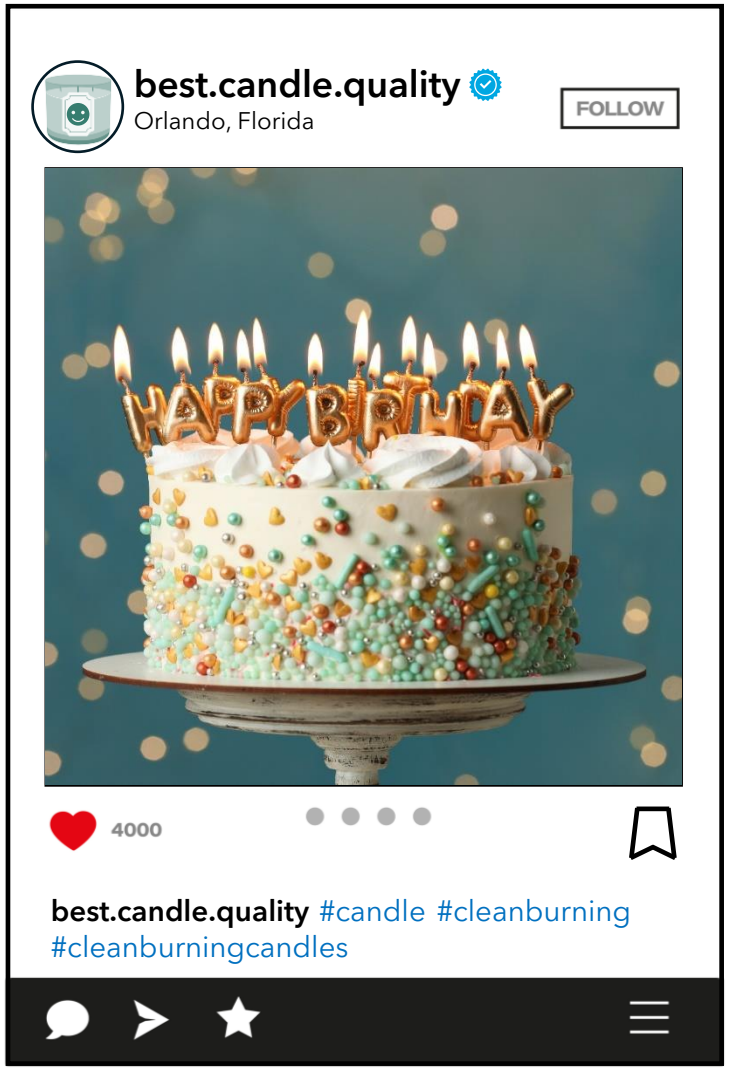
#cleanburning

March 2025 analysis of Instagram hashtags

Social media and candle quality



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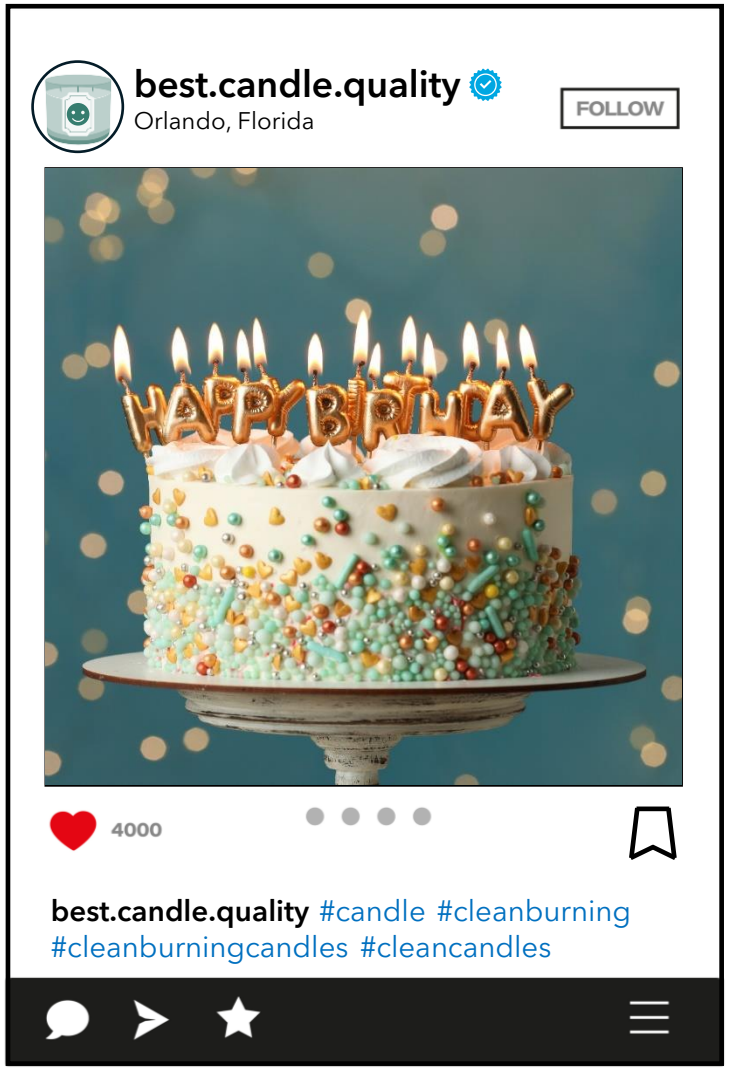
#cleanburningcandles

March 2025 analysis of Instagram hashtags

Social media and candle quality



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#cleancandles

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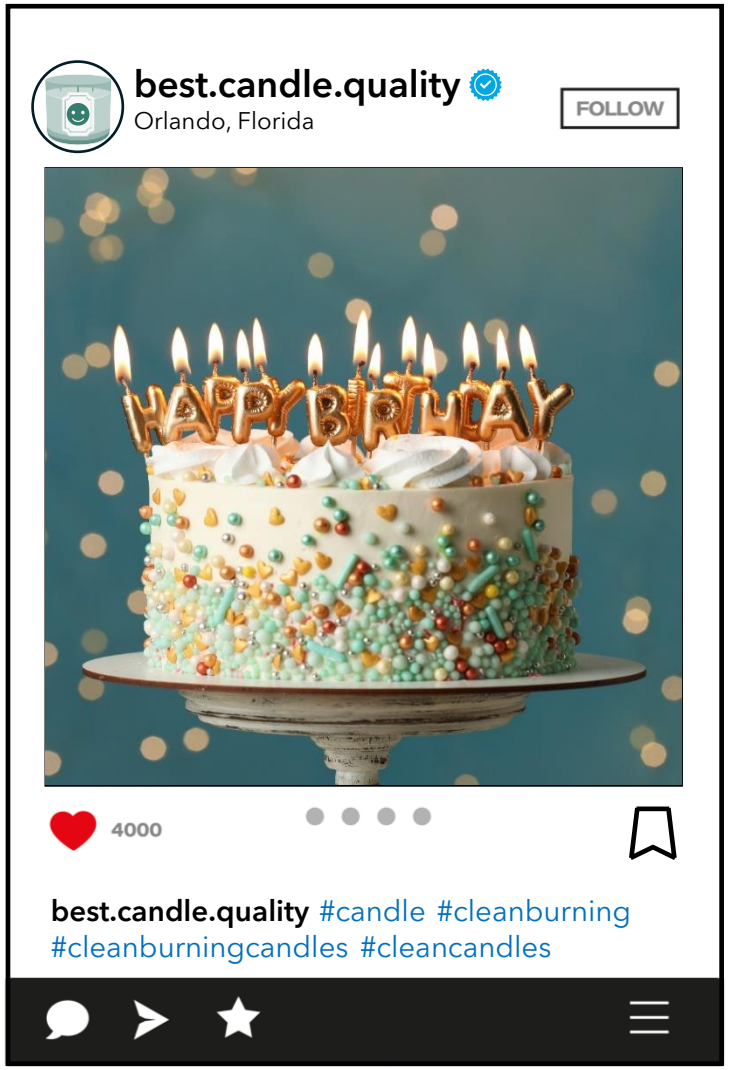


What does "clean" mean to the candle consumer?

How clean beauty came to be

Niche brands emerge

Brands like goop and Detox Market are dedicated to clean beauty formulations

1990s → 2010s → 2020s

The phrase originates

Concept of clean beauty emerges with the ‘clean eating’ and ‘clean living’. Applies to select products primarily at Whole Foods

Self-regulated frameworks

Major beauty retailers like Sephora, Ulta Beauty and Allure create self-determined clean beauty guidelines

How clean beauty came to be

Clean beauty does not necessarily imply natural

1990s → 2010s → 2020s

Evolution of clean beauty definition

Natural based → **Scientifically derived**

How clean beauty came to be

Clean beauty does not necessarily imply natural

Generally Clean Beauty:

1. Applies to **cosmetics** & **personal care**
2. Implies product **ingredient safety**

- Irritants or allergens
- Endocrine disrupters
- Potential carcinogens

How clean beauty came to be

Clean beauty does not necessarily imply natural

Generally Clean Beauty:

1. Applies to **cosmetics** & **personal care**
2. Implies product **ingredient safety**
3. Provides **ingredient transparency**
4. Promote **eco-friendly production** & packaging

The word “clean” and the frameworks for clean beauty **are not industry regulated**

How clean beauty relates to candles

Some **beauty retailers also offer candles** to which clean beauty frameworks are applied

25%

Candles found online are **designated clean*** by respective framework

38%

Candles found online are described as **clean burning***

**March 2025 analysis of a specific beauty retailer*

Navigating clean beauty ingredient landscape

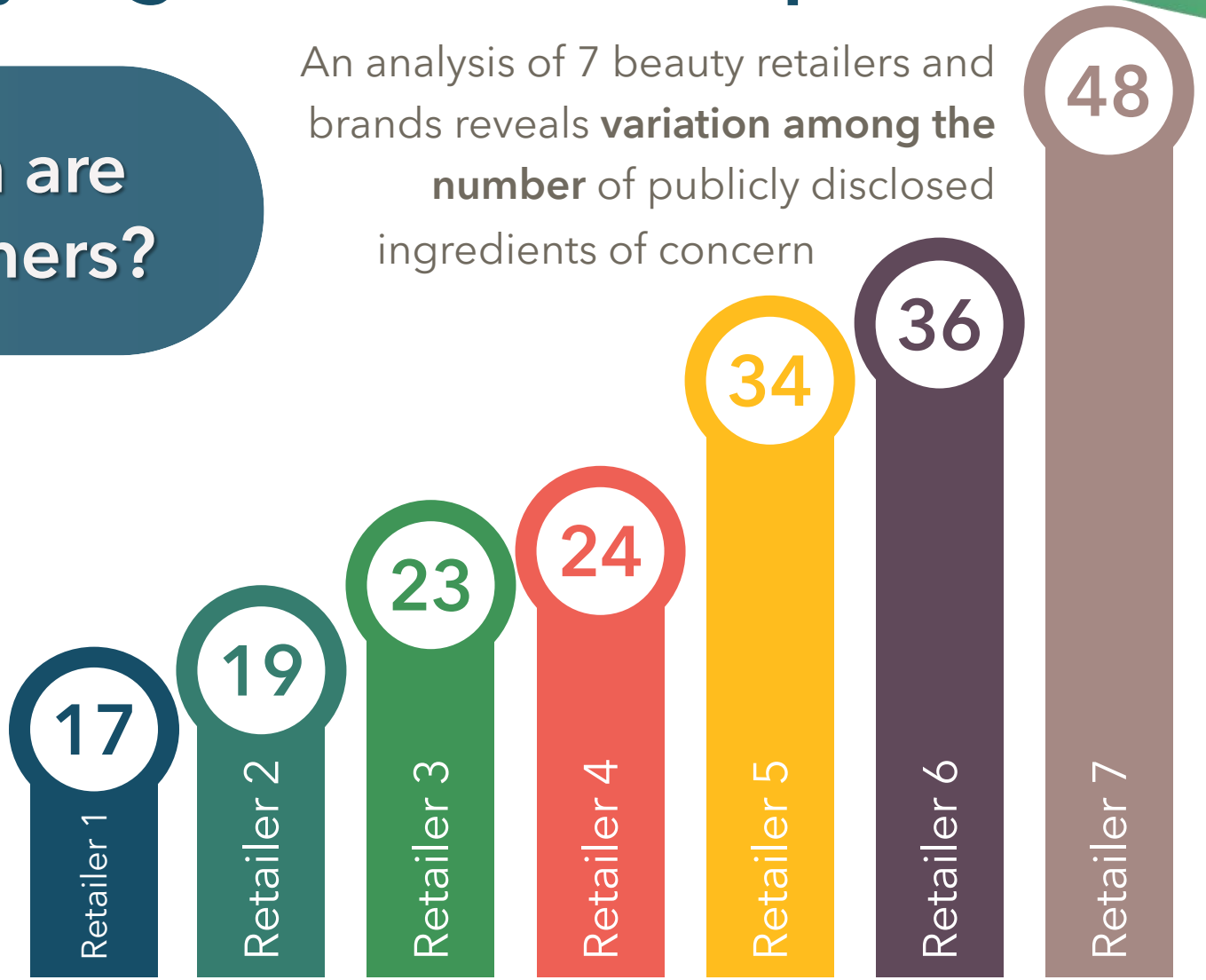
What ingredients of concern are publicly disclosed to consumers?

36

Chemicals of concern identified by the

Campaign for Safe Cosmetics

An analysis of 7 beauty retailers and brands reveals **variation among the number** of publicly disclosed ingredients of concern



Navigating clean beauty ingredient landscape

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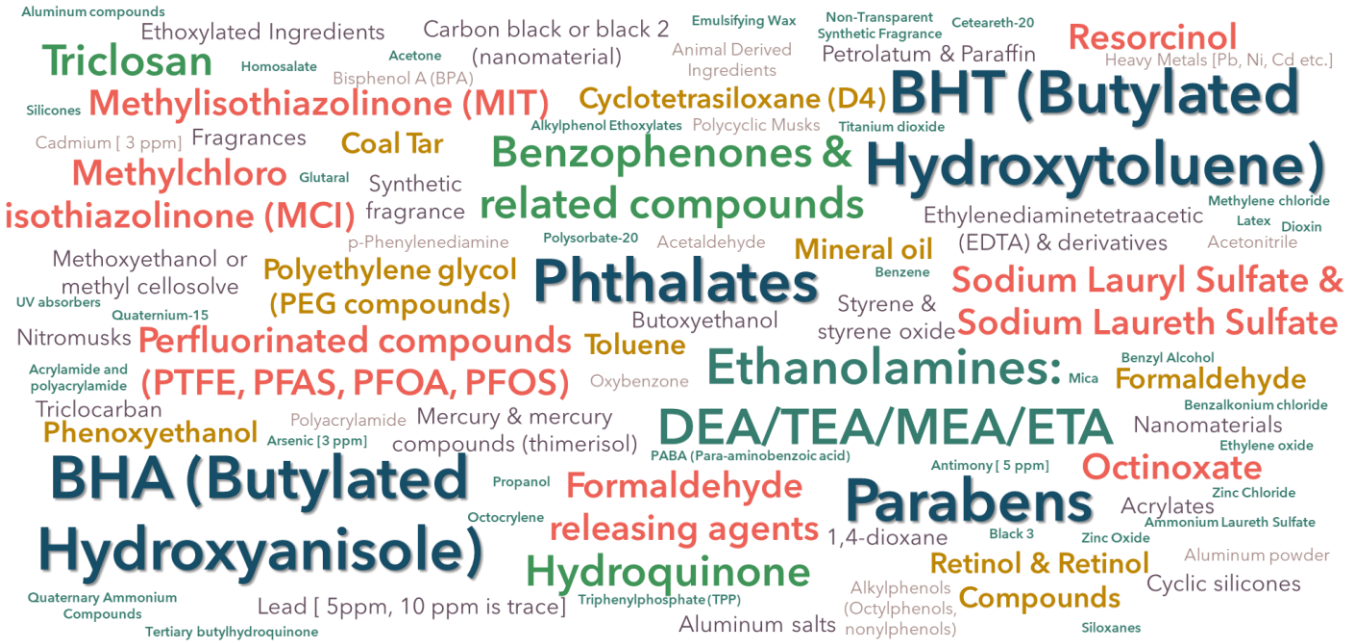
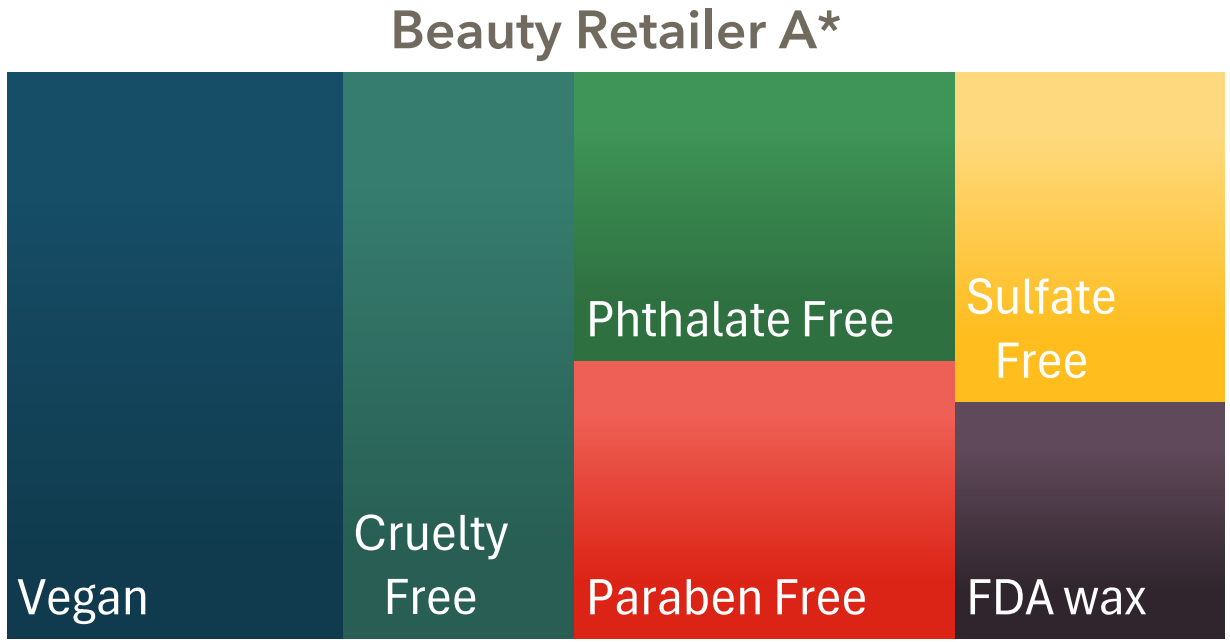


90

Ingredients of concern are **collectively and publicly disclosed** by 7 different retailers with ‘Clean Beauty’ frameworks

Some retailer claims on candles

Regardless of clean designation; candles can also be described with **various formulation attributes**



**March 2025 analysis of a specific beauty retailer*

Based on the candle producing attendees of the 2025 World Candle Congress

24% Define wax ingredient choice as **food-grade approved**

21% Define wax ingredient choice as a **premium wax**

Based on the candle producing attendees of the 2025 World Candle Congress

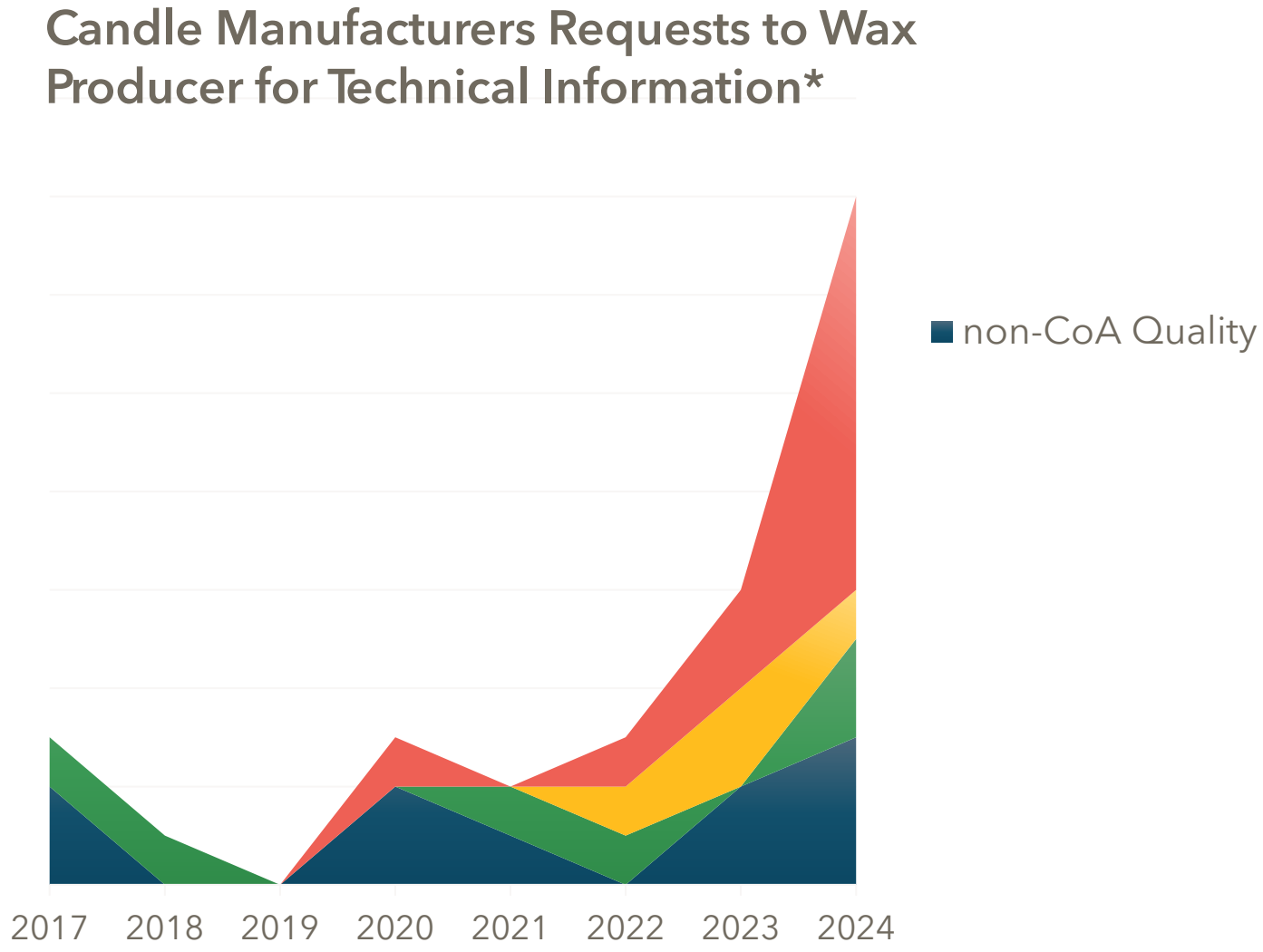
71% That reference using FDA grade wax **do not make any "free-from" claims**

50% That state using a premium wax also **have at least one "free-from" claim**

Based on the candle producing attendees of the 2025 World Candle Congress

What does premium wax mean to the candle consumer?

Candle producer wax quality requests



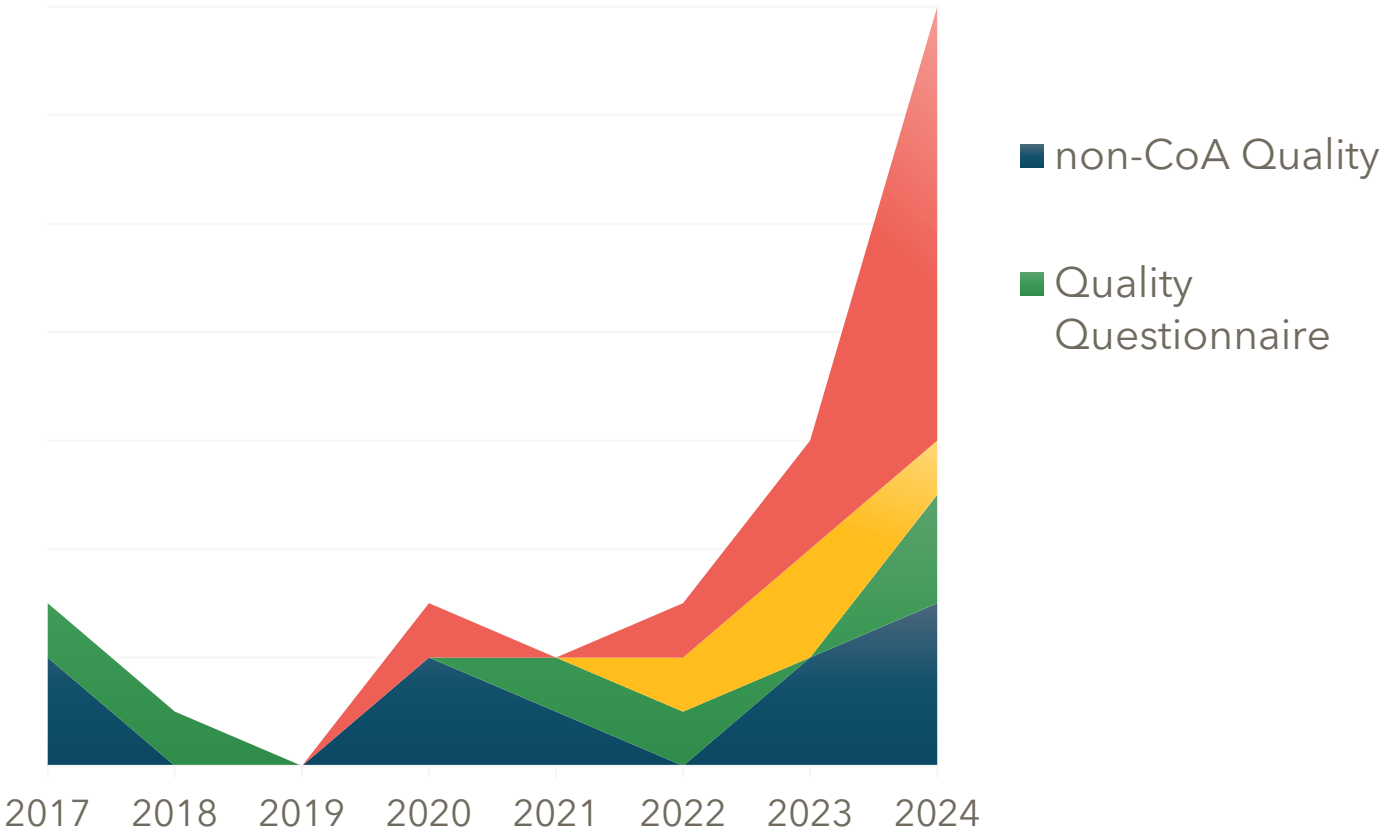
non-Certificate of Analysis Wax Qualities

Generally singular quality or composition request for wax

- Carbon number distribution
- Aromatics
- non-Specific heavy metals
- Sulfur
- Conflict minerals
- Phthalates
- Parabens

Candle producer wax quality requests

Candle Manufacturers Requests to Wax Producer for Technical Information*



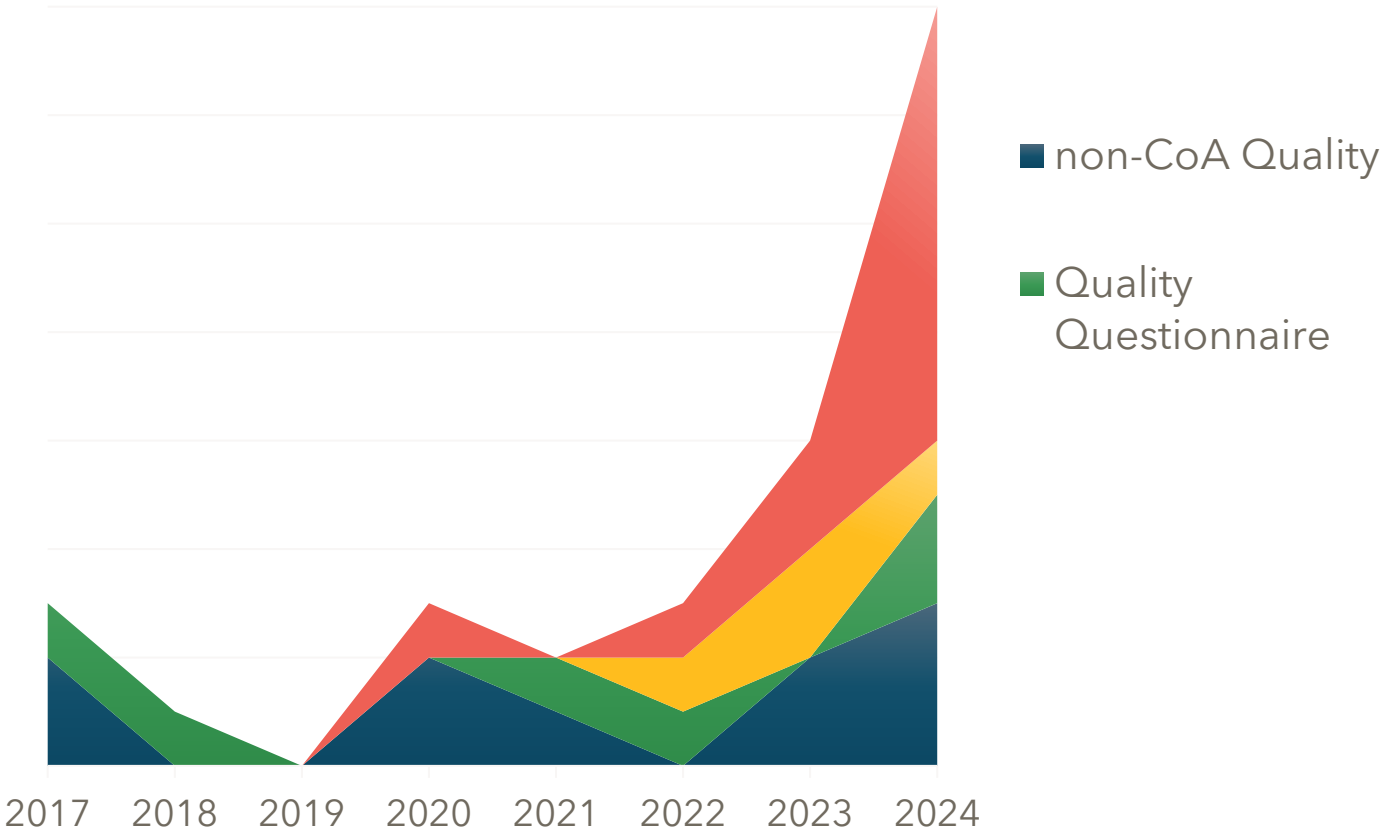
Quality Questionnaires

Vary by customer and cover a wide breath of qualities and ingredients of concern

50 Ingredients or qualities represented collectively among questionnaires

Candle producer wax quality requests

Candle Manufacturers Requests to Wax Producer for Technical Information*



Quality Questionnaires

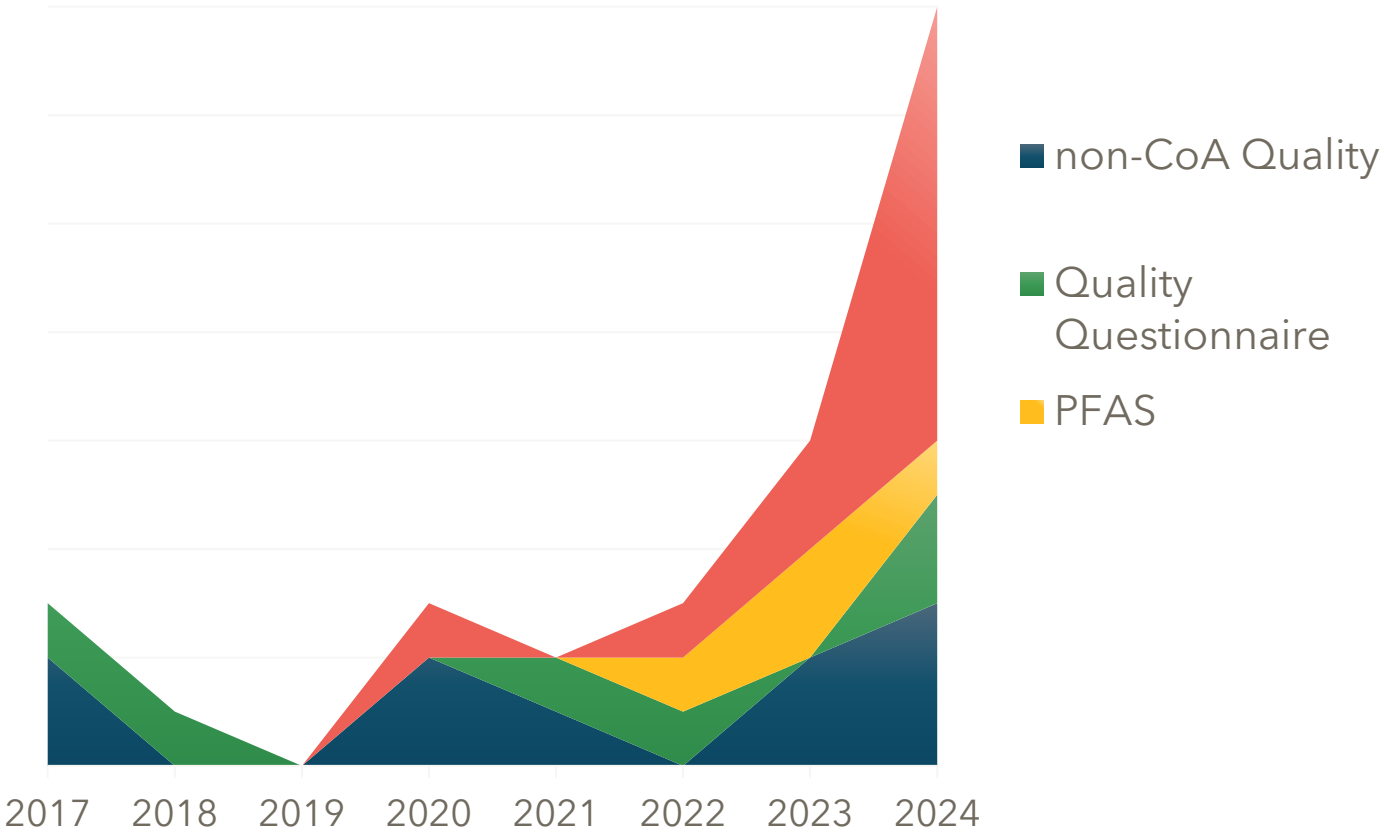
Vary by customer and cover a wide breath of qualities and ingredients of concern

May or may not indicate tolerances for trace contamination

Often include regulatory component

Candle producer wax quality requests

Candle Manufacturers Requests to Wax Producer for Technical Information*



Per- and polyfluoroalkyl substances [PFAS]

Synthetic organofluorine compounds known as 'forever chemicals'

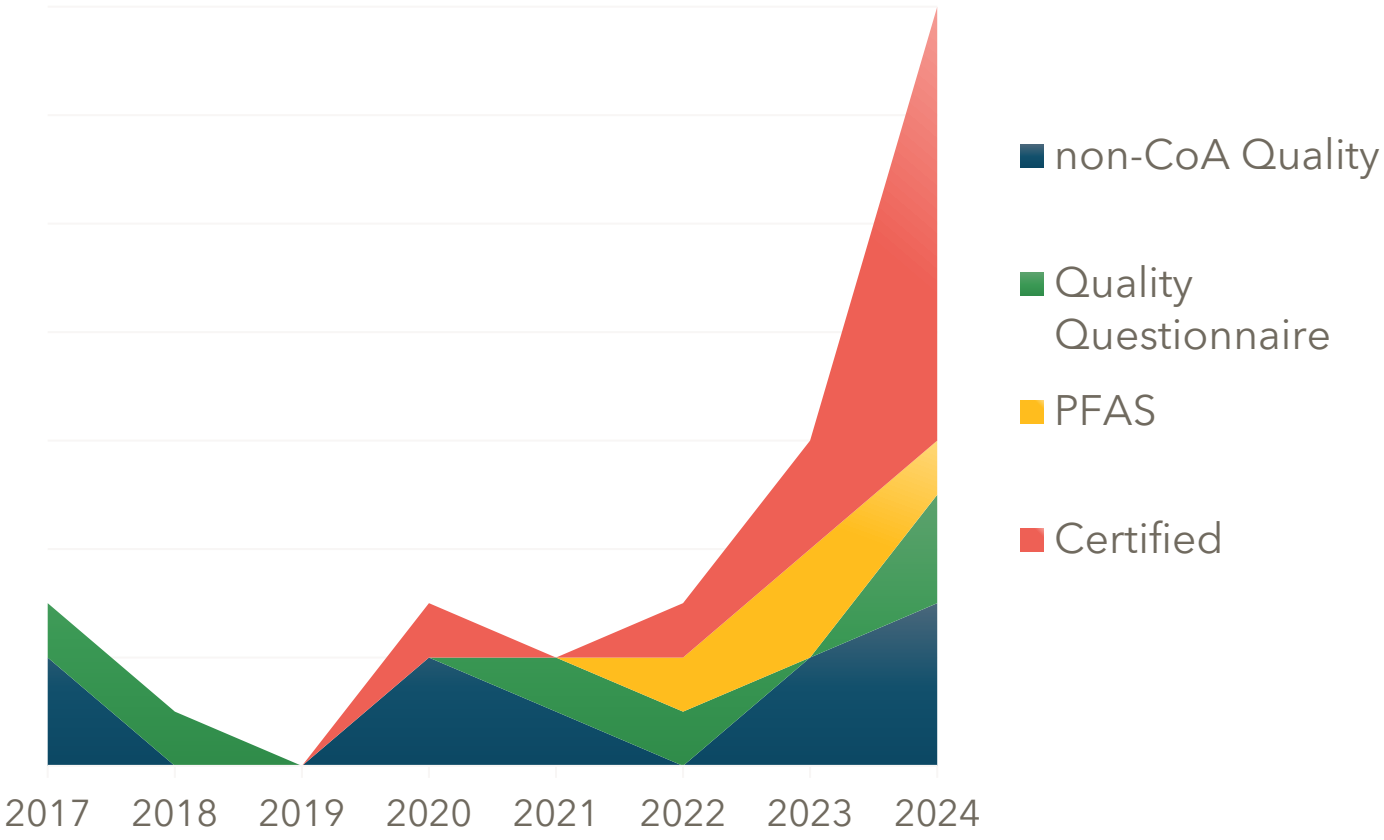
Provide water and oil repellency

Some state regulations were enacted since 2023

No specific PFAS in candle regulations exist today

Candle producer wax quality requests

Candle Manufacturers Requests to Wax Producer for Technical Information*



*Data based on global technical requests to ExxonMobil wax

ROSEN CENTRE HOTEL | MAY 5TH-8TH 2025

Certified Wax Quality

Vegan and Leaping Bunny certification were most requested in 2024

Candle producers are interested in other certifications as well

Existing wax quality standards

US food grade approved wax

21 CFR 172.886 & 21 CFR 178.3710: Petroleum paraffin wax

1. **Composition:** a mixture of solid hydrocarbons, paraffinic in nature
2. **UV Absorbance** does not exceed stated limits

280 – 289 nm	0.15
290 – 299 nm	0.12
300 – 359 nm	0.08
360 – 400 nm	0.02

3. *may* contain a **food grade anti-oxidant**
4. *may* contain a **food grade processing aid**
5. *may* contain <0.01 wt% **UV absorber**
6. *may* contain <1 wt% **residues in processing aids**

Indirect Use Only

Existing wax quality standards

US food grade approved wax

21 CFR 172.886 & 21 CFR 178.3710: Petroleum paraffin wax

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6. *may* contain <1 wt% **residues in processing aids**

Good manufacturing practices also apply

Existing wax quality standards

US Pharmaceutical grade wax

U.S National Formulary: Petroleum paraffin wax

Conforms to Composition

Mixture of solid saturated hydrocarbons, **verified by IR** spectroscopy

May contain **a suitable antioxidant**

Congealing Point:
47 – 65°C

Meets Purity

Passes qualitative tests for **acidity, alkalinity** and **readily carbonizable substances**

Absence of Impurity

Passes qualitative test for absence of **sulfur.** Meets or is lower than UV absorbance requirements for **polycyclic aromatic hydrocarbons**

Existing wax quality standards

RAL candle quality standard

RAL GZ-041

Mark indicates reliable **candle quality** with **no soot or smoke** made with **quality-certified raw materials**

1. Define **burning requirements** for various candle types

2. Define **raw material quality specifications** for all parts of the candle system: paraffin, stearin, beeswax, fat & oils, wicks, dyes, varnish, fragrances

Existing wax quality standards

RAL candle quality standard

RAL GZ-041

RAL quality requirements for paraffin wax

Color	Sulfur	Benzene Toluene	Lead	Ash	PAH	UV Stability
Minimum Saybolt 24	Maximum 20 ppm	Toluene < 5 ppm Benzene <0.5 ppm	Maximum 0.2 ppm	Maximum 0.1 wt%	Less than FDA maxima	Minimum Saybolt 5 or 15

A case for action:

Consumers

becoming increasingly aware of ingredient usage in consumer goods, **including candles**

Ingredients

absence of industry alignment leads to complex ingredients of concern frameworks

Certification

recent increase in requests for additional and **advanced wax quality certification**

Wax Purity

existing **wax quality standards differ** in defining purity and don't include emerging needs

A case for action:

Consumers

Ingredients

Certification

Wax Purity

This supports a collective discussion to better and scientifically define future candle wax purity needs

02 Considerations

What does “free-from” mean?

Can be also be phrased:

1. Free of [X]
2. Absence of [X]
3. Contains no [X]
4. Does not contain [X]
5. Does not include [X]
6. Made without [X]
7. [X] – free
8. 0% [X]

[X] = *ingredient*

What does “free-from” mean?

United States

21 CFR 260.9

specific free-of claim regulations

1. claims should be clearly and prominently **qualified** to avoid deception
2. a truthful claim may be deceptive if the substance is **not associated** with the product
3. claim may be appropriate even for products that **contain a trace amount** of a substance

Europe

Commission Regulation EC 655/2013

common criteria for the justification of claims used in cosmetics

1. Legal Compliance
2. Truthfulness
3. Evidential Support
4. Honesty
5. Fairness
6. Informed Decision Making

What does "free-from" mean?

With growing consumer awareness and existing "free-from" regulations how can we substantiate candle wax quality

What **chemicals of concern are relevant** to candle wax?

Can **trace contamination tolerances** be determined?

Can these potential contaminants be **measured**?

What **testing frequency** is needed for purity?

Considerations when analyzing wax

Few analytical methods can be conducted in the **solid state**

Paraffinic wax has **limited solubility** in organic solvents

Awareness of **proper wax sampling** techniques

Current candle claims vs wax quality

PFAS
Per- & polyfluoroalkyl substances

Tolerance

ECHA "PFAS-free" proposal:

Total organic fluorine < 50 ppm

Individual PFAS < 25 ppb

Sum of individual PFAS < 250 ppb

BPI Composability < 100 ppm Total Fluorine

What are they?

Persistent in the environment

Over 14, 000 chemicals

*"Exposure to certain PFAS may lead to adverse health outcomes"**

EPA has designated PFOA and PFOS as hazardous substances

Measurable

PFAS testing includes targeted analysis & total *organic* fluorine

Wax analyzed for **Total Fluorine**

Requires oxygen combustion of wax prior to ASTM D1179

Limited 3P studies show Total Fluorine values in paraffin wax **between 1 - 3.5 ppm**

Still investigating method for Total Organic Fluorine

*According to the EPA Our Current Understanding of the Human Health and Environmental Risks of PFAS | US EPA

Current candle claims vs wax quality

Phthalates

Tolerance

On-going studies, new limitations may be proposed

REACH SVHC Lists **14 phthalates**

Under REACH must be **<0.1 wt%**

What are they?

Group of chemicals give flexibility to plastics

Named **"everywhere chemicals"** as they can leach from products

Not all phthalates pose a risk to health or the environment

*Some ortho-phthalates are restricted globally**

Measurable

ISO 14389 GCMS**
phthalate method assessed for wax

Analysis of **23 different phthalates** including 11 of the 14 REACH SVHC phthalates

Initial 3P analysis **shows low levels of select phthalates** in some paraffin waxes; applicability still to be verified

** According to ECHA Phthalates - ECHA*

*** Method still being assessed for wax applicability; testing conducted on limited number of samples by 3P lab*

Current candle claims vs wax quality

Parabens

Tolerance

On-going studies new limitations may be proposed

In Europe cosmetics*:

Shorter chain parabens **[Me, Et] 0.4 wt%**

Longer chain parabens **[Pr, Bu] 0.19 wt%**

What are they?

Class of chemicals used as preservatives

Some studies have shown parabens cause low level hormone-like activity

Health risk likely increases with longer alkyl chain

Some longer chain parabens have been restricted in EU

Measurable

Used a chromatography method** for cosmetics

Analysis of **6 different parabens** [R: C1 – C4]

Method has low limit of detection 0.15 – 1.5 ppm

However, matrix interferences of paraffin wax molecules inhibit ability to detect butyl & iso-butyl paraben

** According to citizens_parabens_en.pdf*

*** Method still being assessed for wax applicability; testing conducted on limited number of samples by 3P lab*

Current candle claims vs wax quality

Sulfates

Tolerance

SLS /SLES have not been restricted in cosmetics in EU or US

Can be used in products up to **1 wt%**

What are they?

In clean beauty this commonly refers to **sodium lauryl sulfate** (SLS) and **sodium laureth sulfate** (SLES)

Used as a surfactant

Early study suggested human health concern but since disproven*

Some sulfates may cause irritation

Measurable

Used an aqueous analysis method USP 221** for pharmaceuticals

Qualitative determination of non-specific sulfates

Based on 3P lab analysis no sulfates were detected in all waxes tested

** According to Exploring EU regulations: SLS in cosmetics*

*** Method still being assessed for wax applicability; testing conducted on limited number of samples by 3P lab*

Current candle claims vs wax quality

	Relevant*	Tolerance‡	Measurable**
PFAS Per- & polyfluoroalkyl substances	✓	✓	?
Phthalates	?	✓	?
Parabens	?	✓	?
Sulfates	✗	✓	?

**Relevant* related to consumer and candle producer need; no known studies on candles can be used to inform relevance at this time*
‡Tolerance based on known and /or proposed limits for some consumer goods, does not imply the limit would be applied to candle wax
*** Methods still being assessed for wax applicability*

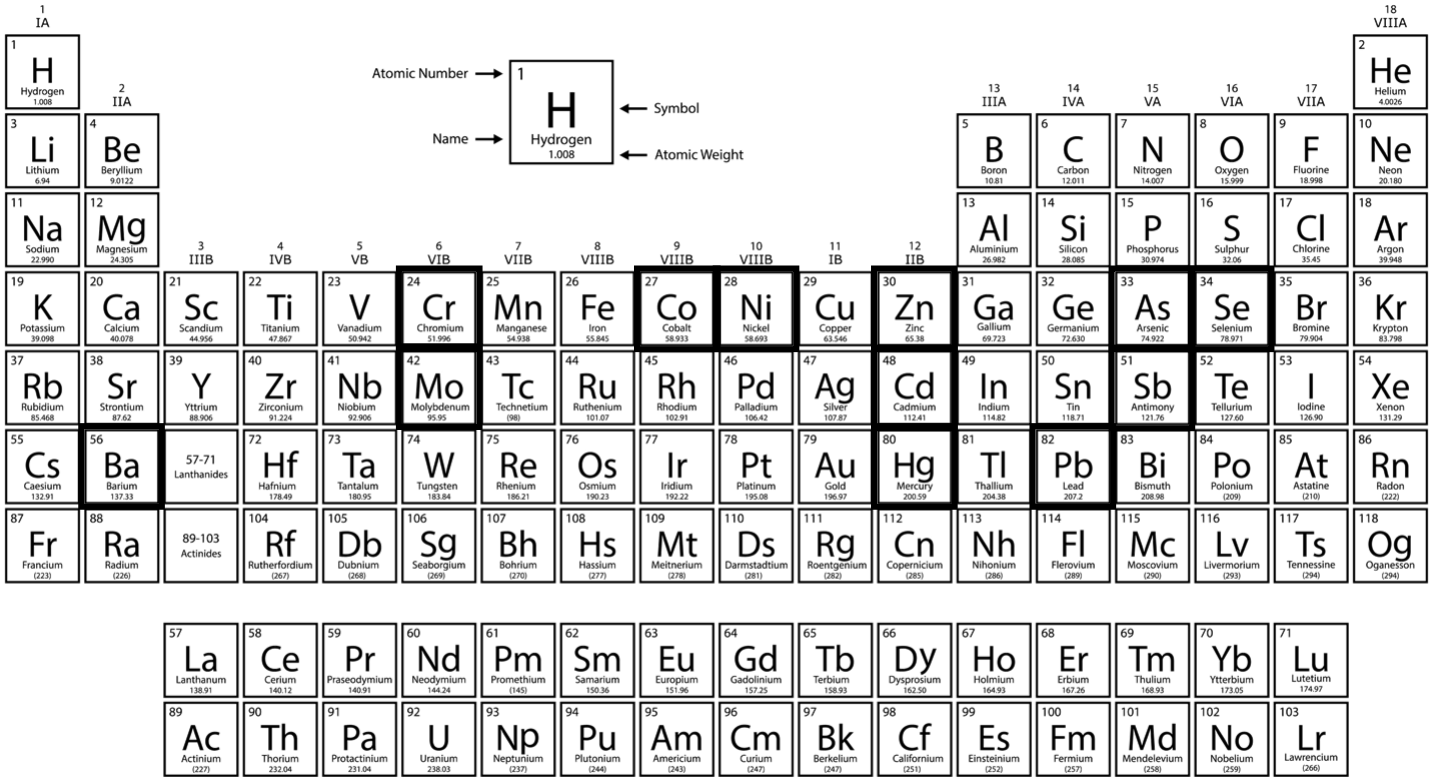
Potential advanced attributes of wax purity

Aspects of clean beauty and candle producer requests **relevant to wax**

Potential advanced attributes of wax purity

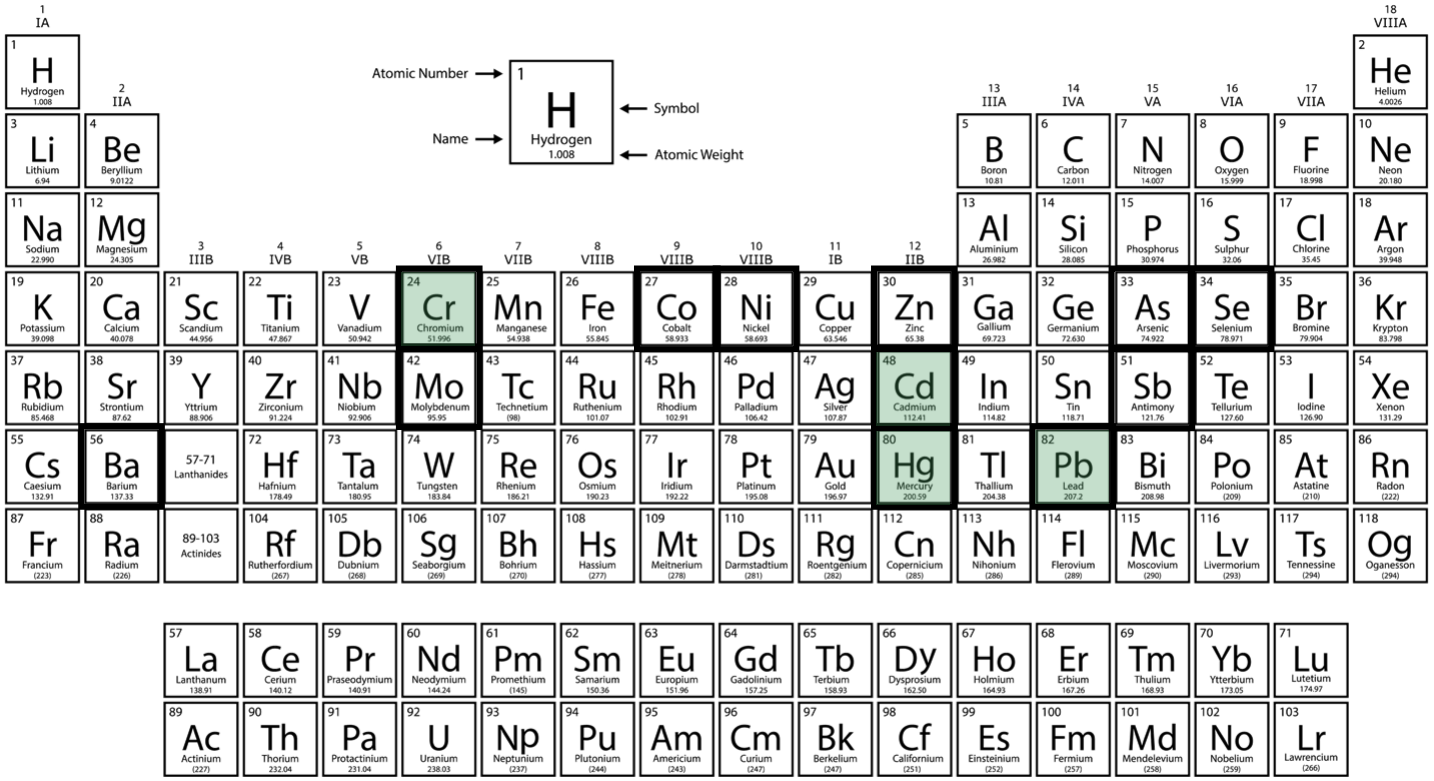
Antimony (Sb)
Arsenic (As)
Ash
Barium (Ba)
Benzene
Butylated Hydroxytoluene
Cadmium (Cd)
Chromium (Cr)
Cobalt (Co)
Heavy Metals
Lead-soluble (Pb)
Lead-total (Pb)
Mercury (Hg)
Mercury compounds (thimerisol)
Methyl Ethyl Ketone
Methyl Isobutyl Ketone
Molybdenum (Mo)
Nickel (Ni)
Odor
Polyaromatic hydrocarbons
Saybolt color
Selenium (Se)
Sulfur
Toluene
UV absorbers
Volatile Organic Compounds
Zinc (Zn)

Metals analysis in paraffin wax



Element of interest based on candle producer requests

Metals analysis in paraffin wax



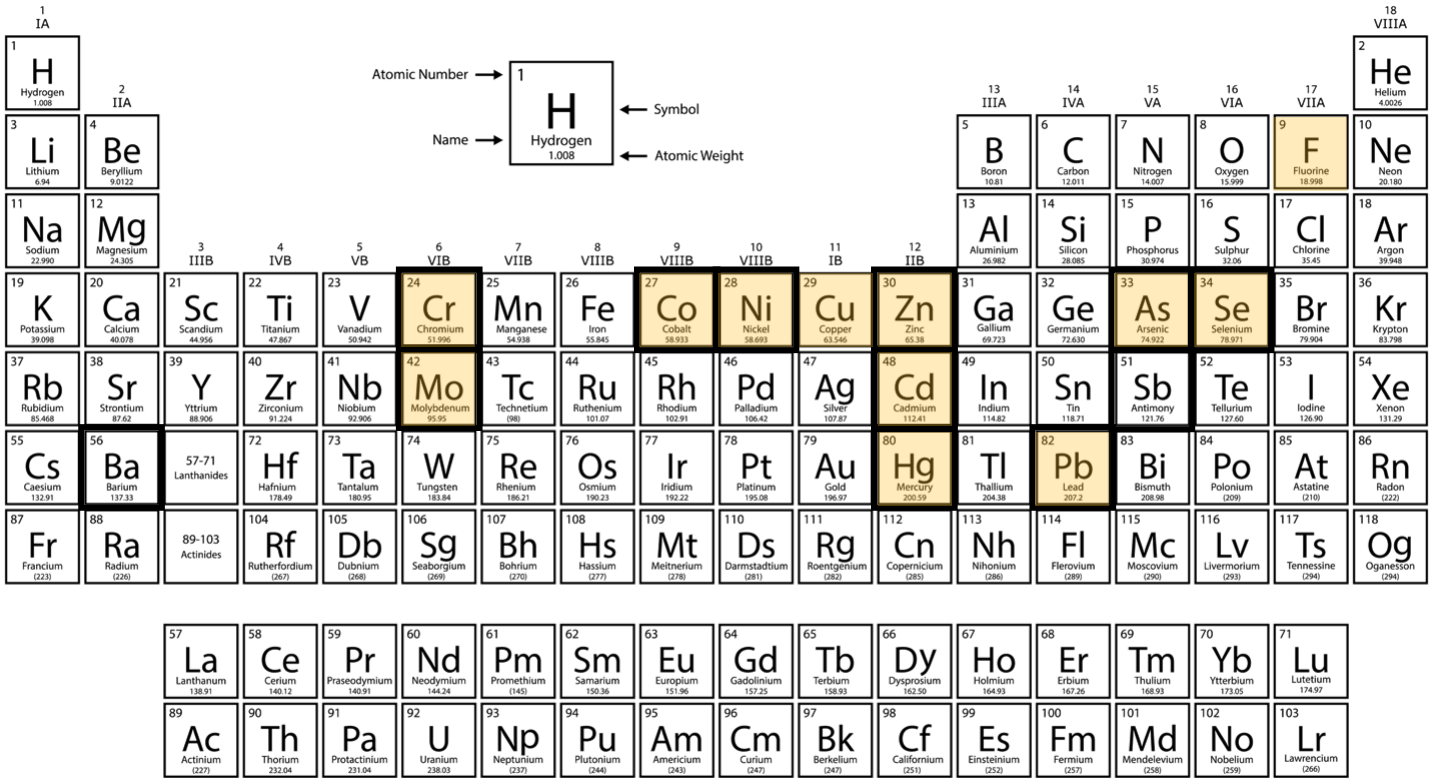
Element of interest based on candle producer requests

Toxics in Packaging Clearinghouse maintains legislation for intentional and incidentally introduced

Mercury [Hg]
Cadmium [Cd]
Lead [Pb]
Hexavalent Chromium [Cr^{6+}]

Shall not exceed 100 ppm

Metals analysis in paraffin wax

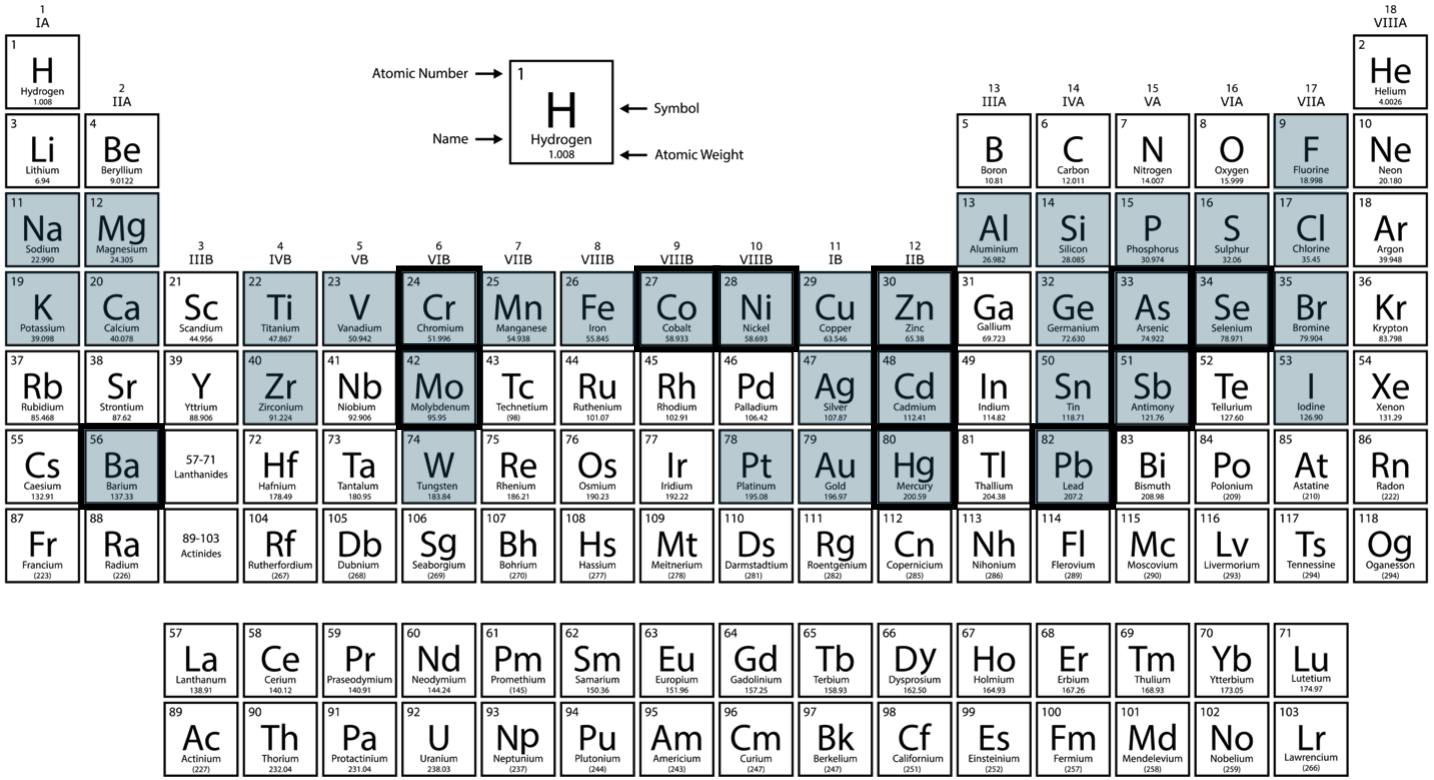


Element of interest based on candle producer requests

BPI Biodegradable by Compost certification includes additional metals testing with the following tolerances:

Arsenic [As]	20.5 ppm
Cadmium [Cd]	10 ppm
Chromium [Cr]	530 ppm
Cobalt [Co]	75.5 ppm
Copper [Cu]	378.5 ppm
Fluorine [F]	100 ppm
Lead [Pb]	150 ppm
Mercury [Hg]	2.5 ppm
Molybdenum [Mo]	10 ppm
Nickel [Ni]	90.5 ppm
Selenium [Se]	7 ppm
Zinc [Zn]	934 ppm

Metals analysis in paraffin wax



Element of interest based on candle producer requests

X-Ray Fluorescence [XRF]

Spectrometry can detect

36 elements at

100 ppm threshold*

Pros:

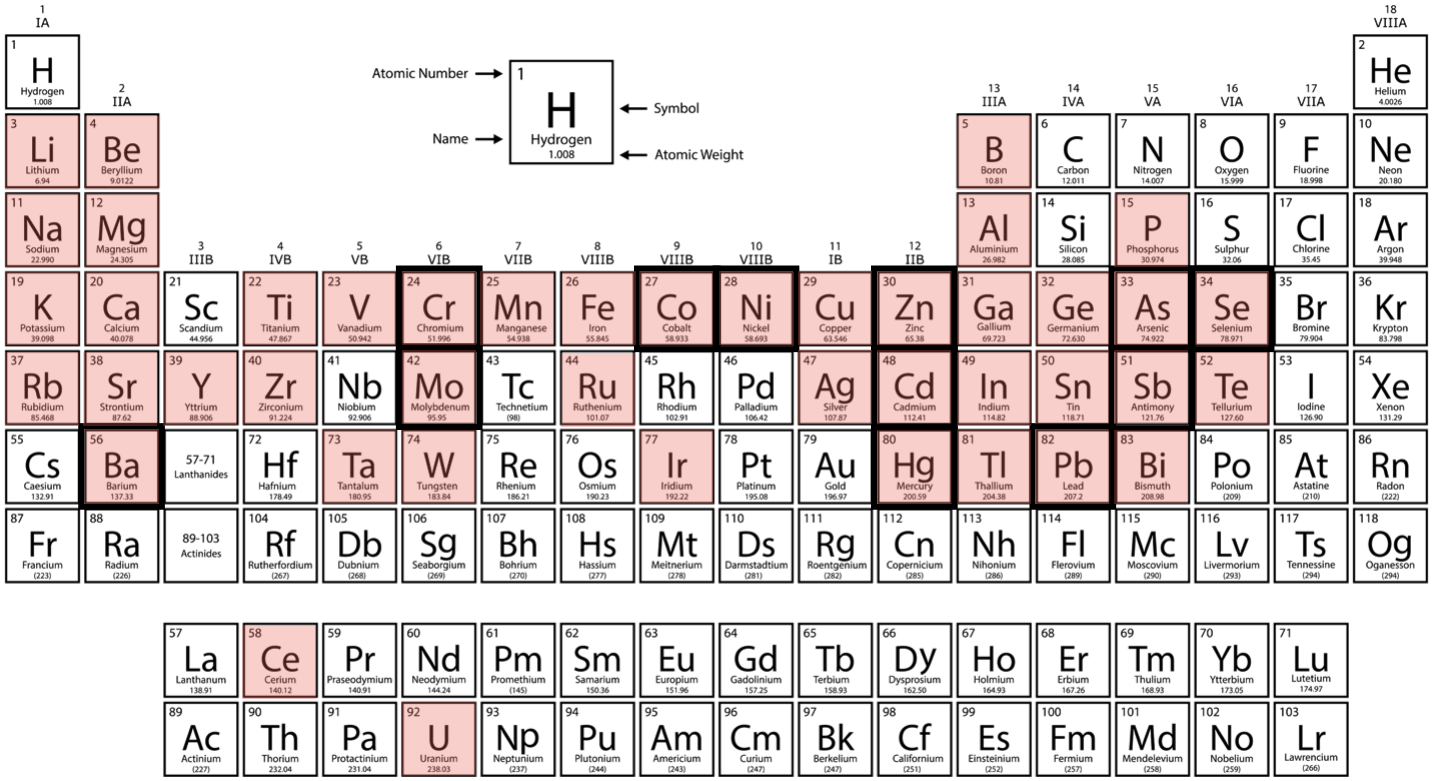
- Distinguishes between trace (<0.01 wt%) and not detected
- Samples analyzed as a solid

Cons:

- Sample film contains Al, Cl and Si

**ExxonMobil developed internal test, not industry standard*

Metals analysis in paraffin wax



Element of interest based on candle producer requests

Inductively Coupled Plasma Mass Spectrometry [ICP-MS] can detect **44 elements** with element specific detection limits*

Advantages:

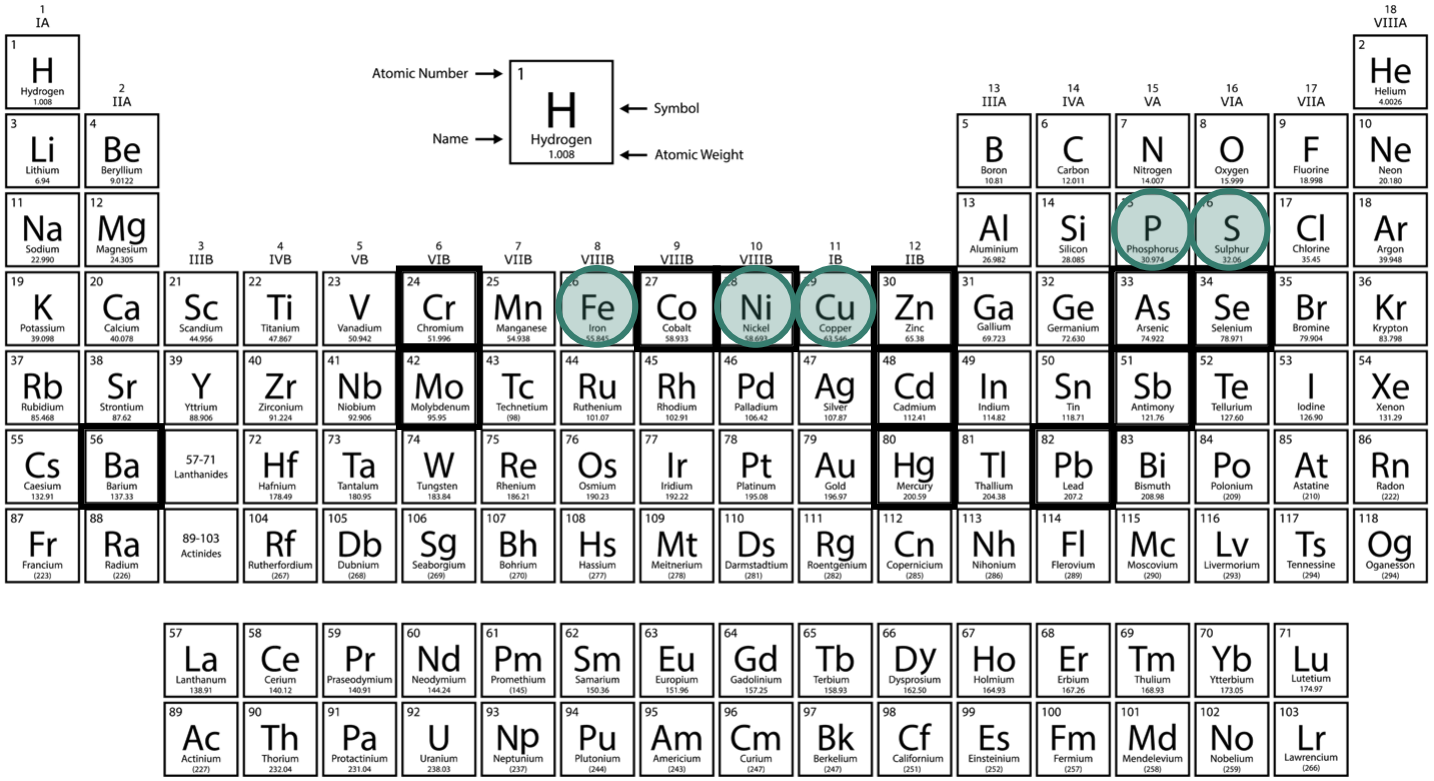
- Lower limit of detection
- **LOD ranges of 0.1 – 10 ppm**

Disadvantages:

- Requires microwave digestion of wax

**3P Lab developed internal test for sample digestion, ISO17294 ICP-MS*

Metals analysis in paraffin wax



Element of interest based on candle producer requests

Based on a 10 years of data, the following **trace levels of metals** have been detected in some paraffin waxes*

Copper [Cu]
Iron [Fe]
Nickel [Ni]
Phosphorous [P]

Based on XRF spectroscopy **Sulfur** is found at trace levels in semi & fully refined waxes and anges from 0.01 – 0.06 wt%* in low melt slack

slack waxes have higher sulfur due to lack of hydrotreating

**ExxonMobil data based on limited samples using internal test*

VOC analysis of paraffin wax

Using ASTM E1868 the mass of volatiles can be determined ***but not the identity***

$$\mathrm{VOC} = \left\{\left[\frac{(m_i - m_f)}{m_i}\right] - \frac{w}{100\%}\right\} \times d \times 1000\ \mathrm{mL/L}$$

1. Loss on drying determined by **thermo-gravimetric analysis** [TGA]
   240 minutes profile to 100 ℃
2. Water weight % determined by **Karl Fischer** analysis
3. **Wax density**

m_i = initial mass [mg]
m_f = final mass [mg]
w = water [%]
d = density [g/mL]

VOC analysis in wax varies year on year **ranging from 0.4 – 1.4 g/L*** depending on the wax

**ExxonMobil data based on limited samples using modified ASTM E1868*

As we define candle wax purity

Recognize the challenges in analyzing waxes as we ask:

Relevant

To wax production and consumer perception

Tolerance

Align on an acceptable trace contamination limits

Measurable

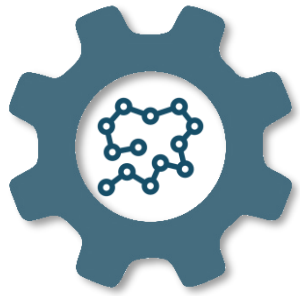
Define suitable industry standards for determination

03 Challenges

How do we work together?

Identifying a forum or working group that enables **effective cross-functional collaboration**

How do we work together?



A

ASTM D02.10 Properties of Petroleum Waxes & Alternative Wax-like Materials

Membership includes Wax Producers; Additive Suppliers and End-Use Manufacturers

B

ASTM F15.45 Candle Products

Development of safety and performance standards for consumer products

C

NCA, ECMA & ALFAVE Technical Response Committees

Potential channels to foster technical advances and innovation in candle-making

Ensuring informed decision making

Representation from both raw material producers and candle manufacturers

Breadth of perspectives in understanding quality needs and technical capability

Set reasonable and measurable **tolerances**

Seek external understanding of science behind emerging qualities in consumer goods

Utilizing sound science and industry perspective can **enable alignment**

Proactive response to evolving quality needs

How do we **remain aware** of potential changes to candle wax quality needs?

Chemicals of Emerging Concern (CEC)

Awareness of **ongoing studies** regarding contaminants that may have potential impacts on ecosystems and human health

Consumer Good Trade Associations

Working with **Household & Commercial Products Association** and the Candle Committee to remain informed

Nongovernmental Organizations (NGOs)

Awareness to activities of advocacy groups like the **Environmental Working Group** that lead to regulation changes

Challenges in further defining wax quality

Will require effective ways to

Collaborate

Best forum for working together on technical front

Align

Collectively determine quality attributes of interest

Understand

Proactively seek awareness in emerging qualities

04 Collaboration

Join at
slido.com
#Candles2025

1. Participation is **voluntary**
2. Responses are **anonymous**
3. Data will be **made available**

Join at
slido.com
#Candles2025

slido

For the rest of your life, you get to smell one candle only. What fragrance is it?

ⓘ Start presenting to display the poll results on this slide.

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Do you see value in further defining wax quality attributes for candles?

ⓘ Start presenting to display the poll results on this slide.

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Is food grade (FDA) quality sufficient for defining premium quality paraffin wax?

ⓘ Start presenting to display the poll results on this slide.

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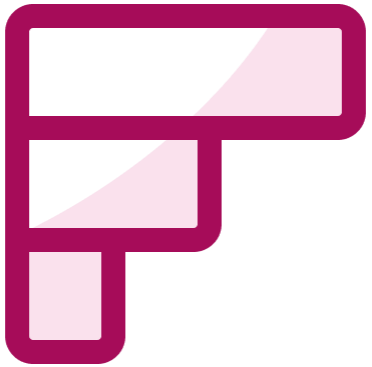
Are there certifications you would like to have or see developed for candle waxes?

ⓘ Start presenting to display the poll results on this slide.

slido



What wax qualities do you most want to understand in the next year?

ⓘ Start presenting to display the poll results on this slide.

slido

What is the best way to work together to align our understanding of candle wax quality?

ⓘ Start presenting to display the poll results on this slide.

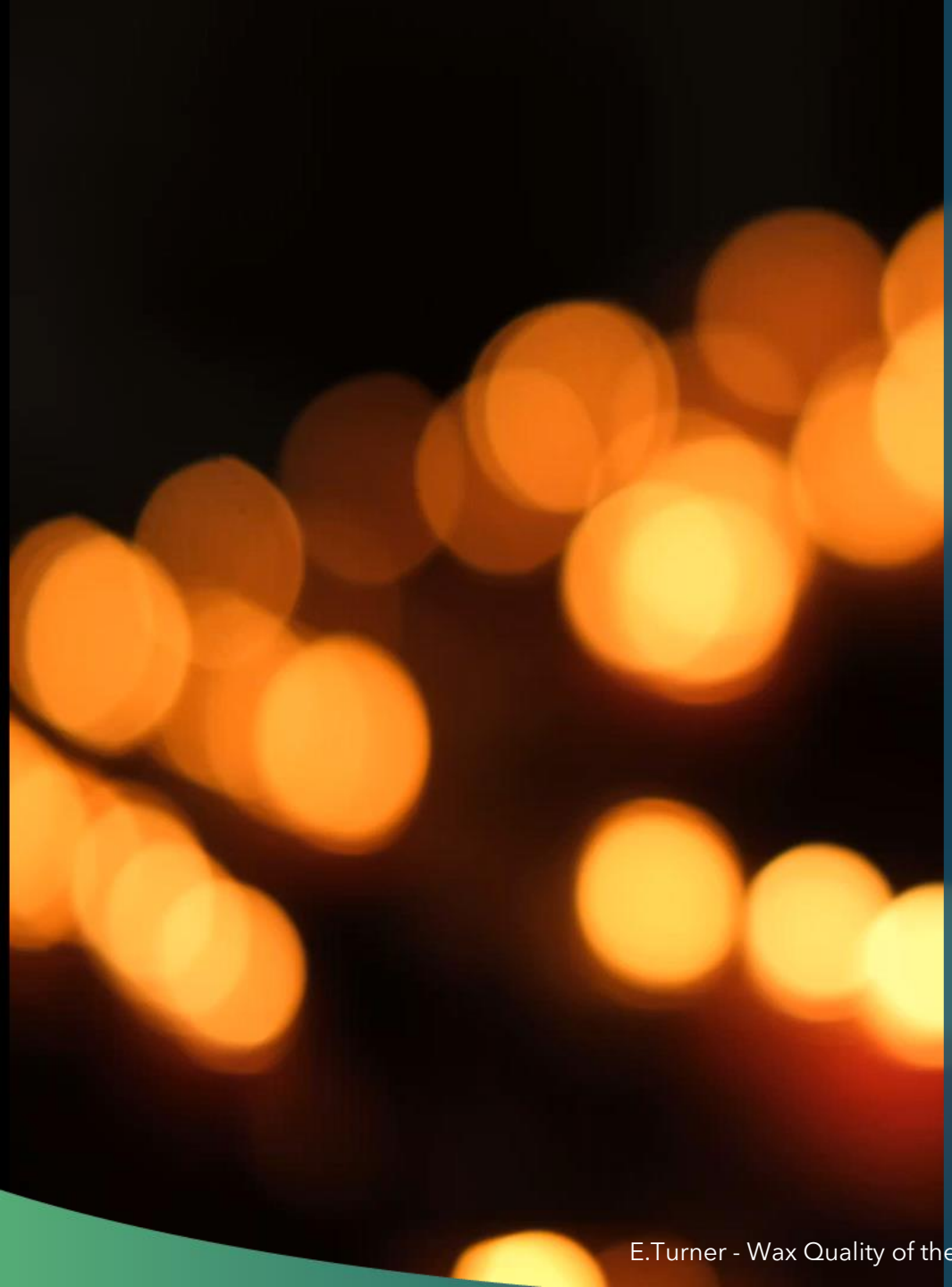
Future candle wax quality will rely on

Debating and **collectively aligning** on what is:

Relevant

Measurable

Emerging



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Thank You

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