Candle dyes: White Paper Document

Abstract:

This whitepaper delves into the historical evolution of dyes, particularly their impact on health, from natural sources to the revolutionary discovery of synthetic aniline dyes in the 19th century. It highlights the inadvertent but groundbreaking creation of the first aniline dye by William Perkin and the subsequent discovery of fuchsine. The paper explores the use of coal tar components for dye production and, in contemporary times, shifts focus to aniline—an integral component in dyes used for coloring candles. The document assesses aniline's toxicity and carcinogenic potential, emphasizing its adverse effects on human health.

The paper scrutinizes safety data sheets from various suppliers, revealing the inclusion of distillates, petroleum, hydrotreated light naphthenic, and shedding light on associated health hazards. It underscores the challenge consumers face in obtaining comprehensive information about dyes, with undisclosed components ranging from 40-80%, posing potential health risks, especially in confined spaces.

Introduction:

The World Health Organization states that about 24% of all diseases are caused by environmental factors. (World Health Organization, n.d)

This whitepaper unfolds the intricate history of dyes with a particular emphasis on their profound implications for human health. It traces the journey from natural colors to the accidental discovery of aniline dyes, emphasizing pivotal moments such as William Perkin's groundbreaking creation. The narrative extends to the industrialization of dye production from coal tar components and seamlessly transitions to contemporary concerns centered around aniline.

The exploration narrows in on aniline's role in contemporary dye formulations and its profound impact on health. The paper scrutinizes safety data sheets, bringing attention to the inclusion of distillates, petroleum, hydrotreated light naphthenic, and the associated health hazards. A critical concern emerges—the lack of transparency regarding undisclosed components in dyes, significantly impeding consumers' ability to make informed decisions about their health. As we navigate this intricate landscape, the whitepaper aims to raise awareness about the potential health implications of coloring candle sand and advocate for greater transparency in the industry.

History of dyes:

Before the first synthetic aniline dye was invented in the 19th century, all colors came from natural sources.

By the mid-1800s, coal gas and solid coke had replaced candles, animal oils, and wood as the most important sources of light, heat, and cooking fuel in many European and American cities. Both coal gas and coke were derived from burning coal at high temperatures in the absence of oxygen, a process that left behind a thick, smelly brown liquid that was called coal tar because it resembled the pine tar used to waterproof wooden ships. But undistilled coal tar was not a very good sealant and was noxious, too, and thus very difficult to get rid of. Burning it produced hazardous black smoke, and burying it killed any nearby vegetation. The two most common disposal practices for coal tar, dumping it into open pits or waterways, were obviously unsavory.

Young William Perkin (eighteen-year-old chemistry student of August Wilhelm von Hofmann from Royal College of Chemistry), choosing a simpler amine called aniline, which was derived from benzene (another coal tar component that would become notorious later), had stumbled upon the molecular magic of **aniline**. Benzene, toluene, and other components of coal tar were colorless because they absorbed ultraviolet light undetectable by the human eye. But if those aromatic hydrocarbons were treated with an acid to create aniline or another amine, after some additional steps the newly synthesized molecules very efficiently absorbed light particles from specific wavelengths in the visible spectrum.

He did not even know exactly what he had created; the precise molecular structure of his new chemical would not be deduced until the 1990s. Within six months, Perkin had patented his dye-making process and resigned from the Royal College of Chemistry (over the objections of his mentor, Hofmann, who thought he was being reckless) to devote himself to the manufacture of the dye he first called Tyrian purple.

The second great **aniline dye** was discovered in 1858. It was a bright red called fuchsine that could be produced even more cheaply than Perkin's mauveine.

Perkin´s success began with the appropriation of his big idea, but it did not end there. An even more important decision was to follow the instinct of his mentor, Hofmann, by pulling apart coal tar and finding uses for all of its constituent parts, not just **aniline**. After the **aniline dyes**, derived from benzene, came magentas made from toluene, reds from anthracene, pinks from phenol, and indigos from naphthalene. These were all hydrocarbons, the abundant and inexpensive building blocks of organic chemistry. (Fagin, 2013)

What is aniline?

Dyes are oil-soluble compounds and work perfectly for coloring candles. Many dyes are made of aniline, a synthetic compound that has been used to make dyes for centuries.

Aniline is predominantly used as a chemical intermediate for the dye, agricultural, polymer, and rubber industries. It is also used as a solvent and has been used as an antiknock compound for gasolines. (US EPA, 2000)

Aniline has been classified as very toxic in humans. The major effects from chronic inhalation exposure to aniline in humans is the formation of methemoglobin, which can cause cyanosis (interference with the oxygen-carrying capacity of the blood). Aniline is severely irritating to mucous membranes and affects the eyes, skin, and upper respiratory tract in humans. EPA considers aniline to be a probable human carcinogen (cancer-causing agent) and has ranked it in EPA's Group B2. (US EPA, 2000)

Aniline is derived from a group of chemicals called benzenamine.

According to the Evaluation statement by the Australian Industrial Chemicals Introduction Scheme from 26 June 2023, there is sufficient evidence of carcinogenicity in experimental animals based on the increased incidence of tumours in two independent studies.

The International Agency for Research on Cancer (IARC) now considers aniline and aniline hydrochloride to both be probably carcinogenic in humans (Group 2A) based on:

• sufficient evidence of carcinogenicity in experimental animals

• strong mechanistic evidence that aniline belongs to a class of aromatic amines for which several members have been classified as carcinogenic to humans.

In humans, aniline is readily absorbed by the dermal, oral and inhalation routes (IARC 2021).

The chemicals are classified as hazardous with the hazard category 'Germ cell mutagenicity', Category 2 'and hazard statement 'Suspected of causing genetic defects (H341)' in the HCIS (SWA). The positive findings seen in several in vitro and in vivo tests are sufficient to support this classification (IARC 2021; NICNAS 2013).

Coloured Candle Sand

Candle sand is inherently available in a natural white colour, requiring the addition of liquid candle dyes to achieve various colours. Commonly observed coloured candle sands in the market encompass shades like black, pink, red, nude, blue, and yellow.

A common ingredient in liquid candle dye is an ingredient called **distillates, petroleum, hydrotreated light naphthenic (CAS-No. 64742-53-6).**

According to Safety Data Sheets by All Australian Candle Making Supplies and Kits, the following dyes contain distillates, petroleum, hydrotreated light naphthenic (CAS-No. 64742-53-6):

- Green Liquid Dye #D880
- Black Liquid Dye #D1972

- Brown Liquid Dye #D883
- Lime Liquid Dye #D1830
- Plum Liquid Dye #D1837
- Purple Liquid Dye #D30137
- Red Liquid Dye #D858
- Yellow Liquid Dye #D879

64742-53-6: Hazard statements (GHS AU) :

- H315 - Causes skin irritation
- H332 - Harmful if inhaled
- H350 - May cause cancer
- H361 - Suspected of damaging fertility or the unborn child

When contemplating the inclusion of a red or pink sand candle for events like baby showers, gender reveals, birthday parties, proposals, hen's parties, or girl's nights/dinners, it's important to bear this in mind.

According to the Safety Data Sheet by Aussie Candle Supplies for Ivory Liquid Dye, it includes 17.875 - 62.875 % of distillates, petroleum, hydrotreated light naphthenic (CAS-No. 64742-53-6). In case of fire: toxic fumes may be released. Remember, this is a dye used to colour candle sand which you will light, i.e., it burns.

Candle Supply Pty Ltd also states in their Safety Data Sheets that the following dyes also contain distillates, petroleum, hydrotreated light naphthenic (CAS-No. 64742-53-6):

- Red Liquid Dye
- Black Liquid Dye GB080
- Yellow Liquid Dye

This list is not exhaustive and Safety Data Sheets for other colours are available from candlesupply.com.au

In EU-Regulations, this ingredient (CAS-No. 64742-53-6) is classified as carcinogen category 1A or 1B and has adverse effects on sexual function and fertility or on development. Denmark regulations recommend that young people below the age of 18 years are not allowed to use the product. (Aussie Candle Supplies, 2019)

In an acute inhalation toxicity study, rats were exposed to an aerosol of the chemical identified by CAS No. 64742-53-6 at concentrations of 1, 1.5, 2.5, 3.5 and 5 mg/L for four hours. All the animals in the two high dose groups, and three males and three females in the 2.5 mg/L dose group died. The LC50 was 2.18 mg/L/4-h. Observed sublethal effects included decreased activity, rapid breathing and congestion, and inflammation of the lungs. The test chemical was

reported to have a DMSO extractable content of >3 % as measured by the IP346 assay (US EPA, 2011; REACH).

Two further acute inhalation studies were available for the chemical identified by CAS No. 64742-53-6. In a single dose study in rats, 80 % mortality was observed at 5.7 mg/L/4-h. (IMAP Group, 2014)

According to Safe Work Australia, this chemical (CAS-No. 64742-53-6) has the following hazard categories:

- Acute toxicity – category 4
- Carcinogenicity – category 1B
- Skin irritation – category 2
- Reproductive toxicity – category 2

And following hazard statements:

- H332 (Harmful if inhaled)
- H350 (May cause cancer)
- H315 (Causes skin irritation)
- H361d (Suspected of damaging the unborn child)

According to the Safety Data Sheet by All Australian Candle Making Supplies and Kits, Turquoise Blue Liquid Dye #D23844:

- Distillates, petroleum, hydrotreated heavy paraffinic (CAS No 64742-54-7)
- Distillates, petroleum, solvent-dewaxed heavy paraffinic (CAS No 64742-65-0)
- Distillates, petroleum, solvent-dewaxed light paraffinic (CAS No 64742-56-9)

Hazard statements:

- Acute toxicity (inhalation)
- Carcinogenicity Category 1B
- Reproductive toxicity
- Skin corrosion/irritation
- Causes skin irritation
- Harmful if inhaled
- May cause cancer
- Suspected of damaging fertility or the unborn child

(All Australian Candle Making Supplies and Kits, 2023)

In Australia, Safety Data Sheets mandate the disclosure of hazardous chemicals, while non-hazardous ingredients are frequently omitted as trade secrets. Consequently, dyes may contain

40-80% undisclosed components, potentially impacting human health, particularly in enclosed spaces during candle burning.

This lack of transparency complicates consumer product assessment, as companies often refrain from providing insights into potential health effects, making informed decisions challenging for consumers.

In Australia, candle production lacks established safety standards. Recognizing the ethical and moral duty to prioritize consumer safety, Chameleon Sand Candle has made a deliberate choice to exclusively provide white-colored candle sand. This decision reflects our commitment to offering products that prioritize safety and well-being for our valued customers until we find a workable solution that is not harmful to human health.

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26.11.2023

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