Candles that kill

by Cate Burton

As our original source of light, candles have played a role in human civilisation for centuries. Initially used to 'prolong the day' and lengthen available working hours, in modern life their use is almost the opposite. Candles are used to facilitate relaxation, create romance, imbue ambience, symbolise celebration, focus meditation and complement décor – and a signal to our frazzled psyche that the day is over.

A brief history of candle-making[1]

In China, beeswax was used for candles as early as the Tang Dynasty (618–907 AD). In Western civilisation, from the Roman times until the 18th century, candles were made from either beeswax or animal fat, known as tallow. Tallow candles are said to have had a strong odour (being animal fat) and to have emitted a lot of smoke. Beeswax was the more expensive because of its superior properties, including its hardness, lack of deterioration with time, brighter burning, slow burning and lack of odour and because it consumed its own wick and did not require snuffing. It was, however, unaffordable for most households.

In the mid 18th century, the whaling industry provided the first serious wax alternative to tallow. In addition to the whale oil and flesh, the head cavity was found to contain a semi-liquid fat that the whalers called "spermaceti". The light from a spermaceti candle was said to be comparable to that of beeswax – bright and odourless.

Spermaceti remained the primary candle wax until the early 19th century when stearine[2] was developed. Candlelight was now almost universally affordable and available.

The discovery of petroleum in Burma in the 1850s transformed candle-making. The crude oil was processed to produce four products: benzene (a volatile liquid marketed

as a leather and furniture cleaner), kerosene (an oil for lamps and stoves), paraffin (a solid wax for candle production) and a heavy lubricating oil. In 1870 only 12% of candles were made from paraffin, but just 30 years later that figure had climbed to 90%.

During the latter half of the 20th century, several synthetic and chemically synthesised waxes, including gels, were developed largely for specialty candle uses. And in the late 1990s, two vegetable based candle waxes – soy and palm – were developed for the commercial use candle market by hydrogenating soybean and palm oils.

The candle-market today

There are four types of wax from which candles are made in modern times. In order of volume of production they are paraffin, soy, palm and beeswax.

Paraffin

The vast majority of candles sold are made from paraffin because it is the cheapest wax available. Paraffin costs around one-fiftieth of the price of 100% pure Australian beeswax when bought in bulk. Unless a candle is otherwise labelled, it will be made from paraffin. That said, even candles labelled "beeswax" might contain up to 90% paraffin.[3]

Paraffin is a toxic, waste product from petroleum refining. This greyish-black sludge is bleached with 100% pure bleach (the bleach used in laundries is about 10%), creating billions of tonnes of dioxins. The discovery of paraffin revolutionised candle-making because it was cheap and readily available. It still is.

As a toxic product, paraffin is shipped to the candle factory with a Material Safety Data Sheet (MSDS).[4] Concerningly, the MSDS says that when handling paraffin (and this is while it is in an 'inert' –unlit – form) you need to wear gloves, a lab coat, goggles and a respirator!

To turn the paraffin into a candle, it is generally dyed (with chemical dyes), fragranced (with synthetic, petrochemical fragrant oils), poured into a mould, over-packaged and shipped out to unsuspecting buyers … and the MSDS is missing.

The toxicity of burning paraffin candles has been known for many years. As with chemicals in cosmetics and skin-care, however, there is little regulation and manufacturing continues unabated. Industry regulations do not require candle manufacturers and retailers to disclose hazardous compounds, or to provide a comprehensive ingredient list, even upon consumer request.

According to recent research by Ruhullah Massoudi and Amid Hamidi, scientists from South Carolina State University, "Each time a candle is burned, if it is paraffin, which is basically petroleum-based, it provides really nasty chemicals in the emissions". As part of the research, candles were burned in a special chamber with the contents of the smoke monitored and measured. They found that benzene, toluene and ketones were present in the smoke.[5] The Environmental Protection Agency (EPA) has determined that benzene and toluene are probable human carcinogens.

In addition, many paraffin candles are made with a lead core or zinc core wick, adding to the toxicity of the smoke emissions. Although lead core wicks have been banned in Australia, there have been several instances of imported candles being found on sale with these wicks, even since the ban. Candles with a zinc core are not banned and continue to be sold in Australia. They are commonly used in scented candles.

A University of Michigan study found that wicks that have either lead or lead cores emit potentially dangerous levels of lead into the air, as well as allergens and carcinogens such as benzene, acetone, mercury and toluene. The effects of these emissions can be damaging to the cardiovascular, neurological and immune systems. The scientist concluded "burning leaded candles can result in extensive contamination of the air and house dust with lead".

A similar study was conducted in Australia by Mike van Alphen from The Lead Group; it summed up: "Modelling of a number of residential scenarios and detailed exposure assessments readily demonstrate that daily candle burning of several hours duration would result in elevated blood lead levels. The burning of multiple candles in a confined space for greater than 3–6 hours daily would readily result in severe Pb [lead] poisoning".

Soy and palm

I have grouped soy and palm candles together because the issues with them are largely the same. Manufacturers of these types of candles will try to differentiate them, and focus on them being "natural waxes", but if you're going to be pedantic about it and play on words, paraffin is a natural wax in that petroleum is 'natural'. It doesn't mean that we want it burning in our lounge rooms. Arm yourself with facts, not marketing.

Both soy and palm are oils when harvested – soyabean oil and palm oil respectively. To turn them into a wax they are bleached (creating billions of tonnes of dioxins) and then hydrogenated. I may be unusual, but to me something is 'natural' when it is used in the form it is harvested, not when it is so altered by chemical processes that it doesn't bear any resemblance to the harvested product.

This hydrogenated soy oil or palm oil is then typically coloured and scented. There is no research that I know of that examines the emissions created by dyeing or colouring a candle. There is, however, research that confirms that scenting a candle creates toxic emissions when burning. This is discussed later in the article.

The other significant issue with soy and palm is that both of them are cash crops primarily grown in third world countries where the lack of corporate governance and incidence of corruption is rife, leading to the clear felling of millions of hectares of virgin rainforest annually.

According to a report by Greenpeace, "The Amazon Rainforest is the largest expanse of tropical rainforest in the world, but it is disappearing at an alarming rate – since the 1970s, an area of rainforest the size of California has been

lost. Few people today realize that the greatest threat facing the Amazon is the production of soy".[6]

In a World Wildlife Fund study on the effects of soybean cultivation in Brazil, environmental analyst Jan Maarten Dros said "Soy – at this moment – is the most important driver for deforestation, directly and indirectly".[7]

The wanton destruction of virgin rainforests is not limited to Brazil, however. According to the National Directorate of Forests, Argentina is experiencing the most intense deforestation in its history due to the replacement of forests with soy plantations: "Over the past decade, as the output of soy rose steadily, the province [of Córdoba] lost an average of three percent of its native forests annually. Of the 10 million hectares of forests found in Córdoba a century ago, only 12 percent are left".[8]

In our own backyard, South-East Asia, the issues are largely duplicated but this time the culprit is palm plantations. As said by the *Sydney Morning Herald*, "Clearing peat forests has made Indonesia the world's third-largest greenhouse gas emitter, sending more than 3000-million tonnes of carbon dioxide into the atmosphere a year. It is driven by greed, with palm oil and timber barons lining the pockets of officials from Kalimantan to Jakarta".[9]

After logging rainforest habitat, palm oil companies often use uncontrolled burning to clear the land. In 1997–98 a devastating fire killed almost 8,000 orangutans in Borneo. Orangutans are predicted to be extinct in the wild in the next 20 years if the palm oil industry, deforestation and burning of peat forest do not change. In February 2007 the situation for the orangutans was called a state of emergency by the United Nations.[10]

Beeswax

The fourth, and least common, wax used to make candles is beeswax. Pure Australian beeswax costs around 50 times the price of bulk paraffin and 20 times the price of hydrogenated soy or palm oil. That said, Australian beeswax is the most expensive beeswax in the world.[11] There are certainly cheaper beeswaxes available.

Beeswax is made by bees to store honey. It is completely natural in the sense that you and I know 'natural' to be – it is used in the form it is harvested. It is not chemically treated and processed to create a wax.

There are a couple of other qualities of beeswax that make it a superior wax for candle-making. The first is that beeswax has the highest melting point of any wax known to humankind. Whereas you will often find that paraffin candles drip or drown the wick, and soy or palm candles typically come in jars or have hardeners such as stearic acid added to the wax, a beeswax candle (when properly made) will not drown the wick and rarely drips.[12] Beeswax also has a natural, light honey aroma without being artificially scented.

The other unique thing about beeswax is that it is purported to be a natural ioniser when burning. Rather than buying an electric ioniser to purify the air you breathe, by simply lighting a pure beeswax candle it emits negative ions.

I must admit to being completely biased. In the interests of complete transparency, I declare that I am a beeswax candle-maker. I am biased because I have researched waxes and candles extensively and my research shows that the only candles that are non-toxic to burn and carbon neutral are 100% pure beeswax candles.[13] This article seeks to share with you only a tiny amount of the research that I have done myself (all of it consistent) in making my decision to stick to making pure Australian beeswax candles.

The main reason why there aren't many beeswax candles available is because running a business making pure Australian beeswax candles is spectacularly unprofitable! While our wax costs 20–50 times the price of paraffin and soy or palm, customers (who are still largely uneducated about candles) aren't prepared to pay for that. That makes beeswax candle-making financially challenging. However, it is incredibly rewarding in a myriad of other ways.

I decided to stand up and be counted. I decided it was worthwhile making candles that were truly non-toxic, that cause no environmental damage, that support Australian beekeepers and the regional communities in which they live, and that create jobs in Australia. I would be financially rich if I took the advice of, or had a dollar for, each well-meaning

accountant, friend, small business expert or business consultant who told me that in order to make Queen B profitable I needed to move production offshore, import beeswax and/or blend the beeswax with a cheaper wax or oil. I am rich in other ways for choosing not to.

Next time you light a candle in your living space, consider what it is doing to you and the planet.

Side note – scented candles

Another phenomenon worthy of close examination is scented candles. With the rise in popularity of aromatherapy in the past decade, candle-makers have begun scenting candles.

The vast majority of candles are scented with *fragrant* oils. Fragrant oils (also known as aroma oils, aromatic oils and flavour oils) are blended synthetic aroma compounds that are then diluted with a carrier such as propylene glycol, vegetable oil or mineral oil.[14] Mineral oil is, of course, another petrochemical. These are fragrances created in a laboratory – there is little that is 'natural' about them. Candle-makers prefer to use fragrant oils because they are considerably cheaper than essential oils and they are also typically less volatile.

Some candle-makers do use essential oils, however. The issue here is that essential oils are naturally high in volatile organic compounds and should not be 'combusted'. It is perfectly safe to use an oil burner whereby you put a few drops of essential oil in water that is then warmed and the essential oil vaporises. It is not safe to combust an essential oil, which is what you are doing when you scent a candle – you pour the oil directly into the molten wax when manufacturing. This wax and oil is then drawn up the wick to fuel the flame where it combusts. The smoke from burning essential oils may contain potential carcinogens, such as polycyclic aromatic hydrocarbons.[15]

Many of the common essential oils such as tea tree, lavender and citrus oils are classed as a HAZMAT Class 3 Flammable Liquid as they have a flash point of 50–60°C.[16]

Cate Burton is the queen bee at Queen B (www.queenb.com.au). She began her working life as a lawyer and had subsequent stints in banking and strategy roles. She began making beeswax candles 10 years ago as a hobby. Queen B was borne out of this passion.

References

1. This brief history was compiled from many sources. Particularly useful was a book by Jon Newman called *Candles*.
2. Stearine was discovered in the 1820s by French chemist, Chevreul, who observed that when a strong alkali was mixed with vegetable or animal fats (such as palm oil or tallow) – saponification – the solution separated into a liquid and a solid component. With glycerine (a non-flammable liquid) and oleine separated out, what remained was a hard, pure fat known as stearine.
3. Indeed, a Melbourne-based candle company produces candles labelled "Beeswax", but when you call and ask what percentage beeswax they are, they advise that it is less than 20%.
4. You can google "paraffin MSDS" to see one for yourself.
5. Benzene has been linked to bone marrow failure disorders like aplastic anaemia, myelodysplastic syndromes, and acute lymphocytic leukaemia. Toluene and ketones are associated with asthma and birth defects.
6. Greenpeace, "Nothing YUMmy About Amazon Destruction", 18 May 2006
7. Quoted in CorpWatch, "Paving the Amazon with Soy", by Sasha Lilley, 16 December 2004
8. Inter Press Service News Agency, "More Soy, Less Forest – and No Water", by Marcela Valente
9. "Up in the Trees, the Boss hangs on for a Miracle", Mark Forbes Indonesia Correspondent Kalimantan. *Sydney Morning Herald*, 1 Dec 2007
10. United Nations Environment Programme (UNEP) in their report "Last Stand of the Orangutan"
11. The main reason for this is because Australian beeswax is free from the chemical residues found in beeswax from other countries because our hives do not have to be chemically treated for the varroa mite.
12. The main exception to this rule is if the candle is burning in a breeze, which makes the flamer larger and melts the wax quicker and may lead to some dripping.
13. The carbon neutrality of pure beeswax candles is stated by the organisers of Earth Hour globally, the World Wildlife Fund.
14. Wikipedia
15. Essential Oil Encyclopaedia
16. Wikipedia