ARIZONA HISTORICAL SOCIETY

CANDLE MAKING

Educational handout created by the Pioneer Museum of Flagstaff, Arizona

There is no record of the first candle or its user. Some authorities attributed the first candles to the Egyptians, as clay candleholders from the 14th century B.C. have been found in Egypt. King Tut's tomb contained a candleholder. It was a bronze socket on a wooden block. A very simple candle form attributed to the Romans by Pliny was a flax rope soaked in pitch and a wax called a "link." The name candle derives from the Latin word *candela* meaning a light or torch. The invention of the candle and wick rank high on the scale of inventions. The first candle remnant found in the Western world was found in a cave near a small French village dating from the first century A.D.

The main source of wax for making candles, until the development of the petroleum industry in the middle 1850s, was tallow. This was cheap and readily available and was obtained by rendering animal fat which separated the tallow from the rest of the glycerides. It burned with a somewhat smoky flame and unpleasant odor. To overcome this, it was found that adding beeswax to the tallow created a brighter flame and a more pleasant odor. Candles were part of early religions, some of whom thought that the bee was the only pure form of heaven. In many religions today, religious candles are still required to be 50% beeswax.

The first really successful substitute for tallow was discovered in the mid 1700s. This was spermaceti, a substance that was separated from the oil in the head of the sperm whale. Candles made from spermaceti proved to be superior to all others, but the hunting also resulted in the near decimation of the sperm whales within less than 100 years. The measure of one candlepower of light is based on the light of one pure spermaceti candle weighing 1/6th of a pound, burning at a rate of 120 grams per hour.

The next of these inventions was the braided wick developed in about 1825. Before the braided wick, and the pickling process that is used before the wick is burned, untreated wicks stood straight in the flame when they burned and did not combust completely. As a result, people called "candle snuffers" had to keep trimming the wicks because the longer the wicks became the smokier they became.

The third development was the beginning of the petroleum industry in the 1850s. People began the making waxes that were odorless and colorless. Crude oils contain wax to a certain extent and this can be separated and refined to different melting points, such as canning wax which melts at 115 degrees Fahrenheit and candle wax between 145 and 160 degrees.

Beeswax makes the finest candles known and properly made beeswax candles produce a bright flame that will not smoke, and gives off a pleasant aroma when being burned. The wax, which is made by the female workers bees from special glands, turns white and hardens as it comes in to contact with the air. It is used for making the honeycombs and the hexagonal cells used for food storage and chambers in which the young are reared. Beeswax melted from the combs is a widely traded product and is practically indestructible. The beeswax used for making candles is yellow because it has been in contact with pollen.

How does a candle wick work? A candle without a wick is just a hunk of wax. And a wick without wax around it is just a piece of string. The wick is what a candle is all about. The earliest known candle was basically a wick-like material coated with tallow or beeswax, not even resembling a modern candle at all. In taper candles the wick supports the first layers of wax that creates the candle. In all candles it acts as a fuel-pump, supplying liquefied wax to the top where all the action takes place. To regulate the flow of wax, different sized wicks allow different amounts of wax up into the combustion area, providing different size flames.

The wick works on a principle called capillary action. Cotton fibers are spun into threads which are then braided together. The spaces between the cotton fibers, treads, and braids act as capillaries, which cause liquids to be drawn into them. Capillary action is a force that is the result of adhesion, cohesion and surface tension in liquids which are in contact with solids. When the cohesion force is greater, the surface of the liquid tends to rise. In the candle the liquid is the wax and the solid is the wick. The cohesion force is greater, therefore the liquid tends to rise up the wick.

The most common types of wicking are the Flat and Square braided. Each thread is called a ply. At the Pioneer Museum, we use a 30 ply square braided wick. Because of the high melting points of the waxes, 160 degrees for candle wax and 145 degrees for beeswax, the 30 ply wick is used to draw all the melted wax up to the flame creating drip-less candles. Aa small amount of canning wax (which melts at 115 degrees) is added to the beeswax and paraffin wax to make the candles easier to light.

The candle flame is the whole reason for the existence of the candle. What we perceive as the flame of a candle is not truly fire at all. Rather, it is an effect of fire. The candle wax and the canning wax being burned are hydrocarbons, each carbon atom holding four hydrogen atoms. The hydrogen combines with oxygen in the air to create water and an almost invisible fire, while the carbon atoms, which do not burn, are released and driven upward on a column of hot air. They become incandescent as they pass through the flame. This is what we perceive as the flame—the glow of floating carbon atoms.

How does a candle burn? Wax, the fuel source of the candle, goes through all four states of matter as it burns: solid (wick/hardened wax), liquid (melted wax), gas (vaporized melted wax) and plasma (flame/energy). When we light a candle, we

touch a flame to the end of the wick. At first the wick starts to burn, and the flame creeps down the sides of the wick until it reaches the wax. This is when the mechanism starts to work. The heat from the flame melts the wax around the base of the wick directly beneath it. By the principle of capillary action, the melted wax is drawn into the wick providing fuel for the flame which burst into life. The liquid wax is drawn up to the tip of the wick where it is heated even more, vaporizes and enters a gaseous state. The gaseous wax enters the combustion area of the flame and becomes plasma as it is converted to energy. The energy conversion gives off heat, which melts more of the solid wax and the cycle repeats until the wick no longer functions due to consumption or lack of fuel for the flame.