

The Traveling Beekeeper



BEESWAX

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How do bees produce beeswax?

After foragers return to the hive loaded with nectar, enzymes are added and moisture is removed to generate honey. During the process, certain worker bees inside the hive take up the liquid from the nectar processors and work as wax producers or remove it from the honey comb and digest the sugar in their digestive tract to produce a complex set of compounds in the wax glands and mirror plates on the underside of the abdomen of the worker. There are eight of these plates, each generating one thin scale of wax. The wax is secreted as a liquid but hardens immediately. Under the microscope the scales appear in layers, reflecting this secretion process. Once the scale is large enough the workers remove it with a spine on their hind leg and transfer it to their mouthparts where saliva is added and the striated scale is masticated into a pliable form so that it may be applied to the places on the hive where comb construction is active. This may be where honeycomb is being constructed, added to brood comb to cap the cells of larvae ready to pupate, or to construct queen cells.

Properties of beeswax

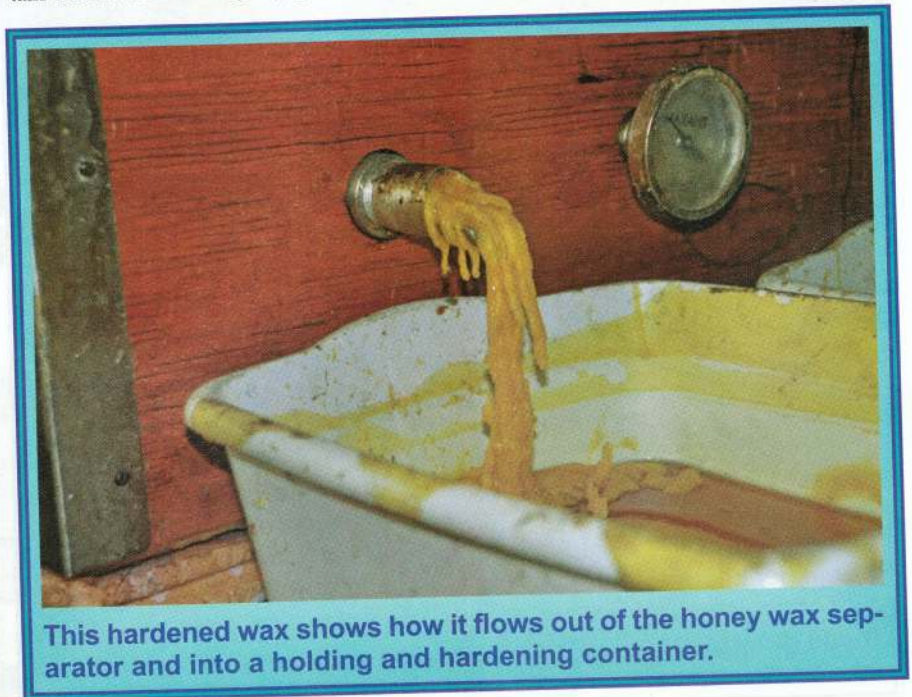
Beeswax is secreted by eight glands arranged in pairs on the ventral (under) side of the worker honey bee on abdominal segments four to seven. The glands are enlarged when the bee secretes wax, but shrink in size when the bee is not. Beeswax is a complex mixture. It is a tough wax, able to withstand great stress and pressure from the weight of honey, pollen, brood and the bees that hang on the honeycomb structure. Heavily loaded wax combs will stretch when exposed to high temperatures. The wax consists of monoesters, hydrocarbons, diesters, free acids,

hydroxy polyesters, hydroxy monoesters, trimesters, acid polyesters, acid esters and free alcohols.

Peak wax secretion in bees is at 12 days after emergence, but bees must feed on pollen for the first five to six days of their adult life to be able to produce the fat bodies that are essential to wax production. These bees congregate in areas where wax production is underway, and maintain a temperature of 95 to 97 degrees F. It takes 8.4 pounds of honey to produce one pound of beeswax from 450,000 wax scales. New wax is white, but it quickly takes on the pigments of pollen—the yellows, tans or browns according to pigment color.

Beeswax is valued for its very high melting point range of 144 to 147 degrees F., producing superior burning candles and an excellent resist in both electronics and art production. When exposed to increased heat beeswax bursts into flame at 250 degrees F. Considerable discoloration takes place whenever beeswax is heated over 185 degrees F, an excellent reason to carefully monitor processing equipment to prevent wax overheating and discoloration.

Wise beekeepers maintain a separate building for wax processing due to the increased fire risk. Many commercial beekeepers have lost their entire honey houses by locating wax



This hardened wax shows how it flows out of the honey wax separator and into a holding and hardening container.



After going through a chain uncapper the wax and honey are placed into buckets so the melting process can be carefully monitored.

processing within the rest of the building. Walter T. Kelley was a strong advocate of a separate building for each manufacturing and processing activity.

Forming wax comb

Each wax-producing bee generates these

scales as they hang together in clustering areas on, between and below comb where wax is generated, festooning in some cases, hanging leg to leg in a mass of bees to concentrate heat and increase wax secretion and keep the wax soft and workable. Saliva is added to the wax as it is chewed to form a



Damaged comb--Every experienced beekeeper has a pile of frames with damaged wax. This may be put through a wax melter to capture the wax. Old brood combs will produce darker wax. Some beekeepers simply burn old brood combs to eliminate the risk of processing residual disease and chemical deposits found in old combs.

workable material. Wax is applied to the edge of the comb, or the the beekeeper's wax/plastic foundation and shaped into the proper form—the hexagon for comb building. Other bees remove bits of the wax and relocate it to new locations, so that through this process the wax is formed into the perfect form with their mandibles. Worker cells measure about five to the inch, and drone cells measure about four to the inch; yet each hive has its own specific natural comb size determined by its genetic background. This is overwhelmed by the presence of a foundation template on which they build. Beekeepers must take caution to add the right sized foundation for the area where bees are building—for example, never add drone foundation to an area where the bees are constructing only worker cells, or they will try to use the drone template and produce worker sized cells. Instead, place the drone foundation on the edge of the brood area where drone brood is naturally produced. Only do this after the colony has produced a healthy brood area of worker-sized cells.

Collecting beeswax

New beekeepers marvel at the formation of new beeswax by swarms and other new colonies of bees, constructing 90 percent of the hive's eventual needs in the first six weeks after a swarm occupies an empty cavity. Pollen and nectar are often placed in the cells as it is being completed. When no nectar flow is underway beekeepers may use sugar syrup to stimulate wax production. This is important with new colonies and with queen rearing cell production.

While they are all started with the same construction, combs of wax for honey storage are usually longer (deeper) than combs used for brood rearing. Comb for honey storage and brood rearing have a 13 percent upward angle, but deep honey comb will have a greater upward angle if comb/frame spacing provides extra room (such as spacing 8 frames in the space of 10) to facilitate holding the thick liquid. This provides the beekeeper with an efficient opportunity to cut off the wax cover or capping of the cells with a knife, uncapping tool, or use a metal scratcher to break the surface of the cells so honey can be removed in a honey extractor. Some beekeepers use a series of rotating chains or brushes to flail the wax cappings off the honey comb and open the surfaces. This leaves a rough and ragged surface that the bees will repair when the empty combs are placed back on a hive.

The cappings and the bits of wax containing honey must be either allowed to drain off their honey or be spun out in a centrifugal device. This drives the honey through a grid and captures the beeswax that collects on a grid or perforated surface. This wax can be used in the beekeeping operation for the production of beeswax foundation. Many beekeeping supply firms will take the wax in trade for foundation. Only a few will give you back your own wax.

Processing

Many beekeepers use some sort of capping melter to separate the beeswax from the residual honey attached to it. This may be as simple as a large stainless steel container in a water bath, allowing the wax-honey mix to liquefy, cool and be mechanically separated.

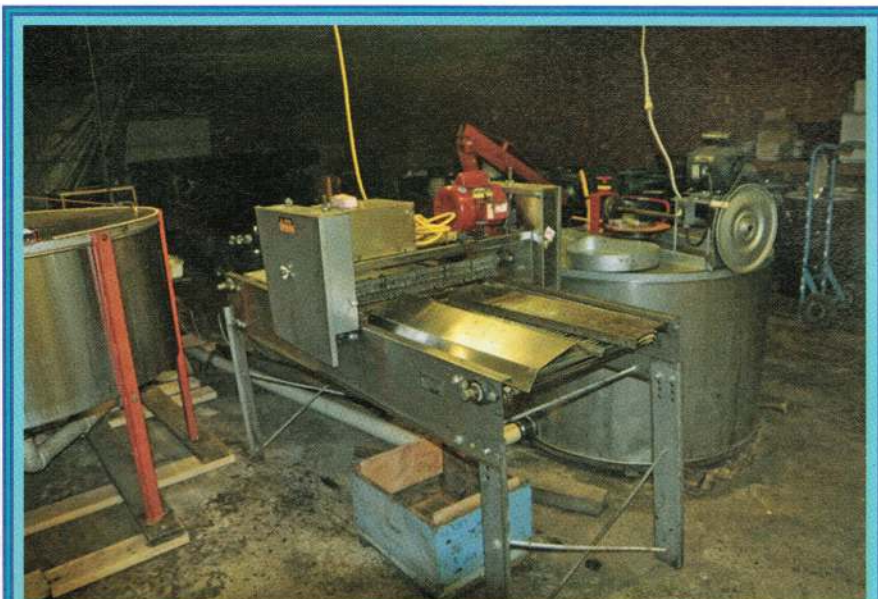
For others, some sort of heat source heats the entire slurry of wax/honey in a large melting tank, using a resistance heat source to avoid open flame. The wax floats on top the honey, and can be drained. The honey, called capping melter honey, is often heated so much that it has darkened and cannot be added to the extracted honey, but is kept separate and sold to the bakery trade where some heating and sugar caramelization is not detrimental to the final baked items. Because this honey usually sells for a significantly lower price, many beekeepers find ways to prevent overheating the honey by careful temperature management.

The liquid wax is then poured or drained into a metal or plastic pan where it is allowed to harden. This may be sold in the bulk wax market as is or further processed to remove bits of honey that may linger on the wax, or to filter the wax to remove dirt and other impurities picked up in the processing of wax. A series of cloth and metal screens can be used to remove these impurities. The final wax is just wax—no honey, bee parts, dirt, or any other impurities. Well prepared capping wax sells for a premium price to folks who make beeswax candles, do batik, encaustic painting, and use the wax to produce beeswax creams and related products.

One style capping melter has an electrical resistance wire heat above the floating beeswax to keep it liquid (and thus reduce the amount of heat exposed to the honey), so it flows out a drain hole into a container. The lack of open flame from resistance heat is safer than using open flame.

Cleaning

Capping wax is considered to be very pure and is the most valuable beeswax pro-



Palmer extracting and uncapping--Northern Vermont. Mike Palmer has a double extractor set up with a chain uncapper.

duced by the beekeeper. It is fresh and new, has the minimum of pigmentation from pollen, has not had cycles of brood produced in it, and has the lowest risk of any chemical contamination (unless the beekeeper treated with a chemical during honey gathering, which nobody advises).

Small amounts of nearly perfect beeswax may be finished in an electric oven, set at about 180-190 degrees F. A series of hooks will hold the wax to be melted in a metal filter above the collection pan. A final filter material is placed at the bottom of the container, such as a piece of sweat-shirt fabric. The oven can be turned on and the wax allowed to slowly melt into the final mold. This may be the mold used to prepare beeswax for show, or for fine work, such as making beeswax flowers. The oven may be turned off once the wax has all melted and the clean, molded wax left in the oven overnight to cool slowly, preventing cracks

experienced with rapid cooling.

References

There are two classic beekeeping books, both published by Wicwas Press (www.wicwas.com). Coggshall and Morse's *Beeswax* is the industry standard for beeswax, and shows useful ideas for wax handling. It also contains some of the early science dealing with beeswax, and is useful to many beekeepers.

Berthold's *Beeswax Crafting* makes more of an effort to explain the processing of beeswax for candle making, batik, encaustic painting, and related items.

Dr. Connor will offer his introductory queen rearing class at his farm in Galesburg, Michigan on June 17, 18, and 19, 2011. Email lconnor@aol.com for an application form and schedule. Enrollment is limited.

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