Processed Bee Comb Foundation

THE gradual development over the past 100 years of a process for the manufacture of a satisfactory form of comb foundation has made possible the present world-wide extension of commercial beekeeping. Though comb foundation is essential to modern beekeeping practice and is now in universal use, the principles of its manufacture remain unknown to many beekeepers. In this article a modern comb foundation manufacturing plant using the improved Weed process is described.

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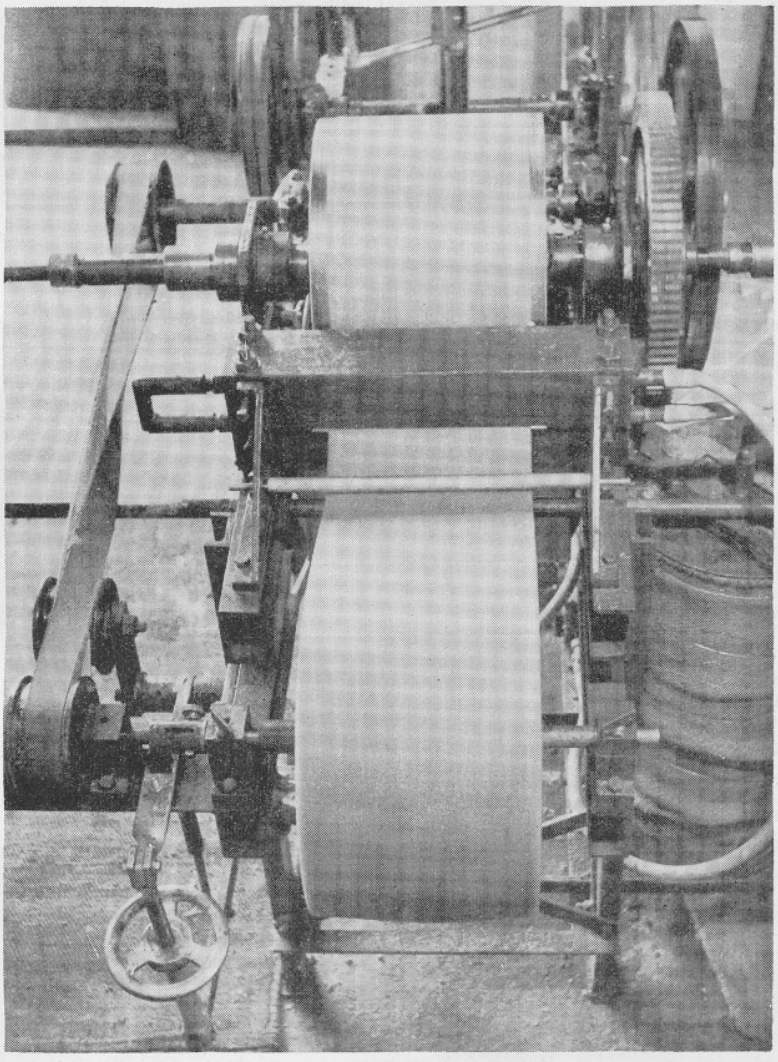


After the crude wax has been melted, thoroughly filtered, and solidified in moulds, it is processed in the Weed sheeting machine. Here it is melted again, picked up by a water-cooled rotating roller on which it solidifies into a sheet, and fed directly into a tapered die $\frac{1}{8}$ in. wide at the exit. The pressure which builds up in the die compresses the molecules in the wax, greatly increasing its tensile strength, and forces it through in a continuous sheet $\frac{1}{8}$ in. thick.

AS first made by Mehring of Germany in 1857, comb foundation was an extremely crude product. It was not until 1875 after further development of the original process by Wagner, the King brothers, Weiss, and finally A. I. Root and A. Washburn, that a satisfactory comb foundation became commercially available. Further improvement to the process followed through the development in 1895 by E. B. Weed of a wax sheeting machine which could produce wax sheets of any length and of absolutely uniform thickness. The Weed process, with improved filtering and refining of the crude wax, is still the basis of modern comb foundation manufacture.

Before the advent of comb foundation, beekeeping on anything other than a relatively small scale was most laborious and was greatly limited. The development of a comb foundation manufacturing process after the invention of the movable frame by Langstroth and the honey extractor by Hruschka made commercial beekeeping practicable on a scale hitherto impossible.

From what was largely a part-time occupation of farmers and small holders, commercial beekeeping has now developed to a stage where it provides a full-time living for many beekeepers in most Western countries. Apart from the many tens of thousands of tons of honey produced annually, the production of beeswax and other products is of considerable commercial importance. This universal expansion of an ancient craft has also provided countries dependent on pastoral and horticultural industries with a widespread insect pollination service.

Combs Naturally Haphazard

Before comb foundation was developed beekeepers had little or no control over the way in which bees built combs. They built them as and when needed and according to their own designs, so that the combs were of various shapes and sizes, were often joined together, and always contained a large proportion of drone comb. The presence of large amounts of drone comb meant that great numbers of

drones would be raised and there would be a consequent serious drain on the food and labour resources of the colonies.

Processed Comb Foundation

The use of comb foundation has brought many advantages to beekeepers, the most important being the production of straight combs which permit rapid manipulation of colonies, easy removal of honey from the supers, a great saving of honey and labour by the bees in the construction of combs, the control of a desirable population of worker bees, and much easier inspection for the presence of brood diseases.

Comb foundation is a sheet of pure beeswax embossed on both sides with the bases and beginnings of the cell walls of the comb of the honey bee. These cell bases are made to worker bee size, as a sufficient population of drones is always provided by small areas of drone cells which the bees will build in the bottoms and corners of the combs.

Two Grades of Foundation

In New Zealand comb foundation is usually made in two weights or grades, known in the trade as thin super and medium brood. Thin super is made from very thin sheets of wax embossed with an extra thin cell base and light side walls and is used exclusively for the production of comb honey as sold in sections, half frames, or in small pieces cut and wrapped. The use of thin super foundation encourages the bees to build combs containing much less wax in the midrib than normally. The delicate friable wax of such combs is much more attractive to the human palate than that of the coarser combs which would be built without its use.

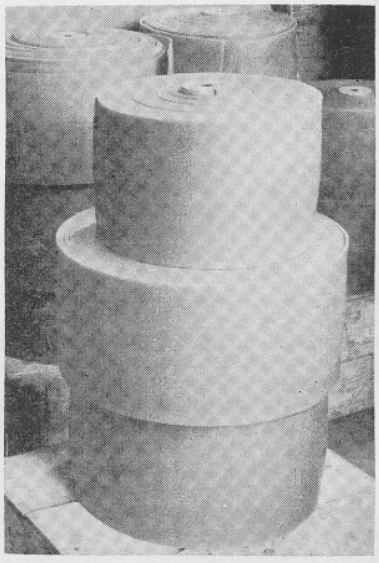
Medium brood is a much heavier grade of foundation which is given to the bees for the building of combs which are to be used for brood rearing and extracted honey production.

The manufacture of comb foundation of good and consistent quality is a highly technical process requiring precision machinery. Because of the high standard of workmanship, technical knowledge, and considerable financial outlay required, its manufacture is generally concentrated among the larger bee supply organisations and a few individuals specialising in the trade.

Manufacturing Process

Bee combs deteriorate in use and beekeepers, to maintain efficient production, must constantly cull combs which have become damaged or are otherwise unsuitable and eventually they are melted down and the wax content reclaimed. Because the combs of the honey bee are the sole source of pure beeswax, which is used for many commercial purposes apart from the manufacture of comb foundation, other waxes of vegetable or mineral origin should not be added to beeswax used in foundation manufacture.

At the first stage of manufacture into comb foundation the crude wax is melted down in a steam-heated tank (upper left corner) and then in liquid form passed through a pressure filter in which diatomaceous earth is used as a filtration agent. After it has solidified it is processed in the Weed sheeting machine shown on page 193.



The sheeted wax is rolled on to wooden cores and left for about a fortnight so that it can become thoroughly annealed before embossing.

Grading and Filtering

Before the crude wax is melted down preparatory to manufacture into foundation it is sorted into grades of colour, the darker yellow and brown shades being separated for use in making the heavier medium brood foundation and the lighter yellow being used for thin super for comb honey production. The wax is melted down in a steam-heated container and in liquid form it is passed through a pressure filter using diatomaceous earth as a filtration agent. This highly efficient filtration system removes all traces of propolis and pollen and other extraneous matter from the wax and helps to retain much of its natural odour, at the same time making the final product much more dense and pliant.

The initial melting of the crude wax is done with boiling water and steam. When the wax is thoroughly melted the steam is turned off and the wax allowed to settle for a few minutes, then skimmed to remove any coarse fragments of wood which may be present. Sufficient diatomaceous earth to ensure good filtration with proper colour retention is added and thoroughly incorporated in the liquid wax. Excess water is drawn off from the base of the melting tank and the wax pumped through the specially constructed filter at a pressure of up to 80 lb per sq. in. By this thorough filtration a dense, bright, clean wax is produced. From the filter the wax

flows continuously into moulds and it is left in the moulds for 48 hours or more until it is completely solidified. It is now ready for further processing in the Weed sheeting machine.

Sheeting

When ready to be converted into sheet form the blocks of wax are placed in a steam-heated melting tank at the head of the sheeting machine and then subjected to a controlled temperature of 180 degrees F until it is again thoroughly liquefied. The melted wax is fed into another heated reservoir in which is fixed a stainless steel revolving drum, with its lower part submerged in the wax and cooled by cold water flowing constantly through it. The drum rotates and as it does, it picks up a thin film of the molten wax about 1/32 in. thick. Carried round on the drum the wax is rapidly cooled and in one half turn of the drum it has solidified into a sheet. The sheet is peeled off the drum by a fixed heated knife and fed by the rotation of the drum directly into a heated die held by thermostatic control at a temperature of 110 degrees F.

The opening in the die is 8 in. wide and tapers from $\frac{1}{4}$ in. in depth at the mouth to $\frac{1}{8}$ in. at the exit. The soft wax sheet builds up in the mouth of the die until there is enough pressure to force the wax through the tapered opening and it emerges from the die in a continuous sheet $\frac{1}{8}$ in. thick. The high pressure in the die compresses the molecules of the wax and so greatly increases its tensile strength.

Annealing

As it leaves the die, the sheeted wax is rolled on to wooden cores. The rolls of wax sheeting are stored for 14 days or more so that the wax can become thoroughly annealed before embossing. Annealing helps to toughen the sheet wax preventing distortion of the cell base and side wall pattern as it passes through the embossing rollers.

Embossing

When the annealing is completed the wax sheets are passed through the embossing machine. The rolls of wax with their wooden cores are placed on an axle, and the free end of the wax sheet is led under a plain roller submerged in a tank of warm water held at a temperature of 105 to 110 degrees F. Passing under another roller, the slightly softened sheet of wax is fed between the embossing rollers where the pattern of the cell bases and the beginnings of the side wall are impressed into the wax.

The embossing rollers are made of a comparatively soft metal and must be very accurately engraved. The manufacture of these rollers is a highly technical process calling for the greatest possible skill and accuracy in engraving and is confined to only one or two firms in the world.

The rollers are set one above the other with the lower one constantly immersed in a cold solution of soap and water which prevents the wax sheeting from sticking to the rollers as it is embossed. The upper roller is hand fed with the soapy solution. The space between the embossing rollers can be adjusted so that the thickness and weight of the foundation can be controlled.

Because of the different requirement of thickness of cell base and side walls needed in thin super foundation as compared with the heavier medium brood, separate, differently engraved embossing rollers must be used for each type.

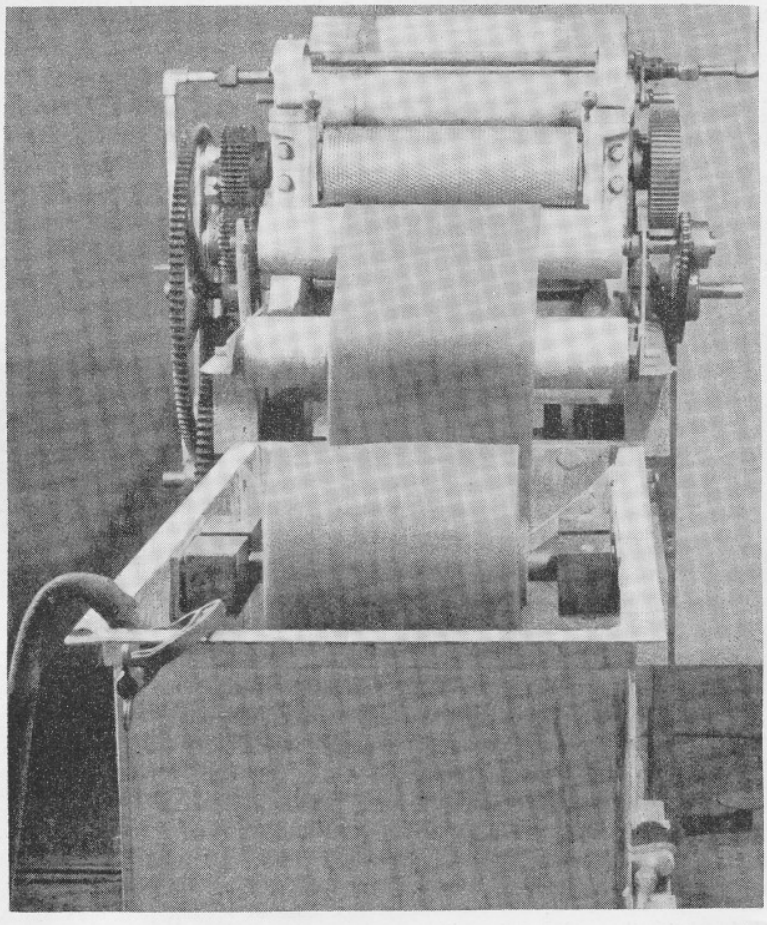
Cutting and Packing

After passing through the rollers the embossed sheet of wax is carried by an endless rubber belt to a mechanically operated guillotine where it is cut into the correct lengths for fitting into the frames. This is the final process and after leaving the guillotine the foundation is carried away by the belt to be packed into cases for delivery.

Though the manufacture of comb foundation is largely mechanical, the operator must have a sound technical knowledge of the chemistry of beeswax and the effects of heat, pressure, and tension during processing if a consistently high-quality foundation is to be produced.

Acknowledgment

The technical information and access to their plant given by Pullins Apiaries Limited are acknowledged.



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