National Bee Unit

The Food and Environment Research Agency

Hive Cleaning and Sterilisation

Introduction

Honey bee colonies are subject to infection or infestation by a range of pests and diseases. These include insects, mites, fungi, viruses, and bacteria, such as the microbes that cause American or European foul brood (AFB and EFB) (*Paenibacillus larvae* and *Melissococcus plutonius* respectively. Because they are social insects, honey bees are at risk of epidemics, so it is essential that beekeepers not only recognise the signs of such pests and diseases, but also know how to reduce their impact in colonies, apiaries and the locality. A key factor in the prevention of spread of infection is good hygiene (Figure 1). The following article provides some advice about when and how you should be cleaning your hives and your equipment.

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A few notes to the reader

Be aware that to clean and sterilise your hives and equipment properly can be hard physical work. You need to make sure that you have all the necessary tools and equipment ready for the task before you get started. You also need to have appropriate protective clothing, including eye protection, strong waterproof gloves, steel capped boots etc. If possible, arrange for someone to help you on the day. A good place to get support and practical help can be through your local beekeeping association. Note that not all treatments listed below are effective against foul brood spores, and please bear in mind that all are potentially hazardous to human health. When using chemicals, always read the precautions on the manufacturers' labels, and always and take suitable safety precautions. Take sensible precautions when working with fire.

When should you clean and sterilise your beekeeping equipment?

It is good practice to clean and sterilise beekeeping equipment:

- when you bring it in from the field for storage (e.g. at the end of the season) or reuse;
- when your colonies have experienced infection or infestation;
- before using/reusing spare or empty hives, **especially** any second hand items;
- when reusing any items which may have been associated with foul brood infection;
- whenever it is necessary to move items between colonies.
- Even apparently healthy colonies can harbour organisms that cause disease. The bacteria responsible for both EFB and AFB can exist in a colony's combs for long periods of time and remain capable of causing disease to develop. It is therefore important to maintain good standards of hygiene at all times, even when pests and pathogens are not obviously present in an apiary. Replace old brood combs with foundation for new drawn combs on a regular basis.
- Always clean hive tools between inspections.
- It is important to remember that it may not always be practical or safe to clean, disinfect and re-use beekeeping equipment once it has become contaminated, or is too old and/or damaged to withstand rigorous but necessary treatment.
- It is good practice to melt down or burn old combs and replace them with new frames of fresh foundation or new drawn combs, and to destroy other materials that cannot be properly cleaned.
- Methods for destruction are outlined in a separate section, below. Your local bee Inspector will help and advise you in respect of hives and colonies that have been infected with notifiable diseases AFB and EFB.

Cleaning and Disinfecting wooden hives

Dismantle the hive, and if possible, place all it's component parts into a large domestic chest freezer (-20^{o}C) for at least 48 hours before cleaning. This will kill insect pests, such as the wax moth. Then place parts onto sheets of cardboard, newspaper, or any other easily lifted substrate that will catch debris dislodged as you work. Begin by scraping the boxes as thoroughly as possible, using a paint scraper, hive tool or other suitable instrument, to remove any adhering wax comb or propolis lumps (Figure 2). Be especially careful when cleaning the internal corners of the boxes and the frame runners, as these provide ideal nooks and crannies that may

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harbour pests and pathogens. You may wish to consider removing "dirty" frame runners altogether and replacing them with new ones when you reassemble the disinfected hive. If you plan to sterilise your equipment by scorching (see below), remember to remove all plastic runners. During the process of scraping, bits or wax and propolis will fall onto your cardboard or newspaper sheets, and all this should subsequently be destroyed by burning when you have completed this part of the cleaning process. You will also need to clean your scraper before you put it away.

Figure 2. Removing brace comb from top bars (image courtesy of Claire Waring)

Once the wooden hive components are free of obvious dirt, they can be sterilised to kill germs. You can do this in several different ways:

a. *Scorching with a blowlamp or hand held electric paint stripper*.
(Figure 3). When doing this, make sure any remaining propolis boils, and that the timber darkens to a uniform coffee-brown colour, indicating that the wood has been heated to a sufficient temperature and for enough time to be properly sterilised. There is no need to burn the timber, but do be especially thorough in the corners.

Figure 3. Scorching a brood box with a blowlamp

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b. *Chemical sterilisation with disinfectants.*

Brood boxes, and supers (and other beekeeping equipment) can be effectively sterilised using disinfectants containing hypochlorite. Sodium hypochlorite is present at a concentration of about 3% in household bleach. Research has shown that immersion for twenty minutes in a solution of 0.5% Sodium Hypochlorite in water kills AFB spores and other bacteria. In this case you therefore need to make a solution of one part of household bleach to six parts of water. (Check the label). It is essential that the spores are in contact with the solution, so any items immersed really must be thoroughly clean. For disinfecting one or two boxes a suitable tray could be used and one box side at a time treated. For larger quantities of equipment a deeper trough will be needed. Laboratory studies conducted at the Food and Environment Research Agency suggest that other chemical disinfectants may be useful for general sterilisation, but further tests are required to ensure these are effective against foul brood infection, especially AFB spores. When using this system **you must wear suitable protective clothing, protect your eyes and use rubber gloves**.

c. *Chemical sterilisation with acetic acid.*

Combs can be sterilised to destroy the spores of chalkbrood, wax moth, and Nosema disease of adult bees using the evaporation fumes from acetic acid, but there is no evidence that this treatment is effective against AFB or EFB. Acetic acid is available from chemical suppliers and online. Begin treatment by stacking the brood and/or super boxes with combs to be sterilised on solid surface such as a board or hive floor. Note that acetic acid is corrosive and will attack metal and also concrete. It is also important to block off hive entrances, as acetic acid fumes are heavier than air and will travel from the top to the base of the stack, leaking out of any gaps or holes at the bottom. Place a non-metallic dish (saucer or similar container) on the top of the frames of the top box. Very carefully, put 80% acetic acid into the dish, allowing 120 ml acetic acid/box (e.g. 600 ml would therefore treat 5 boxes). Then, place an empty hive box on the top of the stack. Close off the empty box on the top of the stack with a hive cover. Seal any joints between the boxes with wide adhesive tape to stop fumes escaping. Leave the stack for about one week to ensure sufficient fumigation. When treatment is complete, dishes of acid must be removed with caution, and boxes should be thoroughly aired (at least two days) before use. When using this system **you must wear suitable protective clothing, protect your eyes and use rubber gloves**.

d. *Boiling in caustic soda (Sodium hydroxide).*

This treatment is not very practical for the average beekeeper due to the caustic nature of the bath and the problems of disposal of the used solution. It requires great care and caution. The method requires a bath of caustic soda solution, made up of 450 grams Sodium Hydroxide (available from chemical suppliers) in 38 litres of water, which must then be brought to the boil. Wooden hive parts are then immersed in the solution for between 5 and 15 minutes (Figure 4), before being dipped in clean boiling water. After drying, the parts will probably need re-nailing. When using this system **you must wear suitable protective clothing, protect your eyes and use rubber gloves**.

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e. *Immersion into molten paraffin wax*.

Paraffin wax has to heated to 160^{o}C for 10 minutes. This is a dangerous process; a fire must be allowed to burn for up to 2 hours before it reaches the required temperature; at the same time, the flash point for paraffin wax is 199^{o}C, so the temperature must be kept well below this level; **you will need specialist equipment and heavy duty protective clothing**, which the average beekeeper does not have. For further details see a suitable beekeeping textbook or research online.

Figure 4. Immersion of wooden frames in a washing soda bath

f. *Irradiation*.

Wooden hive components such as stored supers and empty combs can be sterilised by gamma rays from a radioisotope of cobalt. This will kill infective organisms without damaging the equipment. Firms specialising in irradiation (Isotron Limited **assistance@isotron.com**) use 25 kiloGrays (kGy) to kill foul brood spores. Note: it is especially important that any equipment subjected to this treatment is entirely free from any signs of disease, such as the scales associated with AFB, prior to irradiation; this is because such symptoms will remain indistinguishable visually from infectious untreated disease signs when the hive is put into use again, and can lead to failure to diagnose fresh infection. When using irradiation to sterilise hives after foul brood infection, you should only do this under the guidance of your local bee Inspector.

Recycling wooden frames

Hot Steam is very effective for melting wax from dirty wooden brood boxes and frames prior to their reuse. Apparatus consists of a source of steam, for example

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from a domestic wallpaper stripper, a plastic hose pipe, a collection tray, and a modified brood box lid (Figure 5). Equipment as described, is available online.

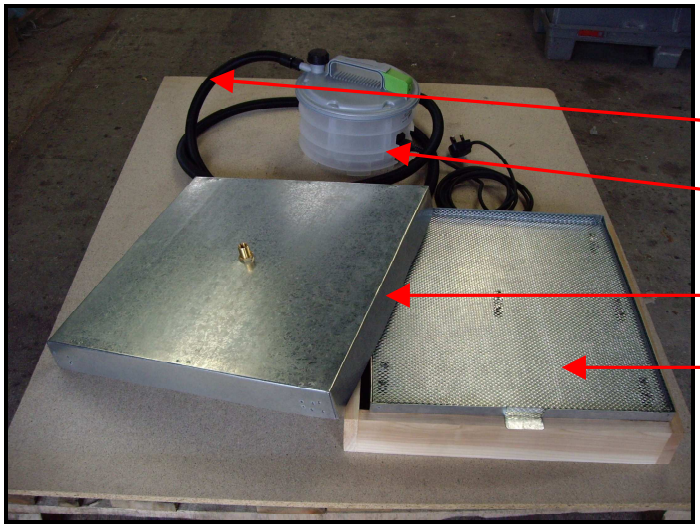

Figure 5. Steam cleaning apparatus

Begin by placing a box filled with dirty frames onto the purpose built collection tray, which needs to be similar in size and shape to a hive floor but with a small opening at one edge, and cover with the lid such that this closely fits the box; attach the end of the hose pipe from the steam chamber into the top of the sealed box (Figure 6).

Figure 6. Steam sterilisation apparatus *in situ*

As the wax softens and melts it runs down through the box and out of the opening in the tray, from where it can be collected for use in wax exchange (Figure 7). The

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stripped and cleaned wooden frames can be reused. Allow at least one hour of treatment for each box of frames.

Figure 7. Molten wax collecting from steam sterilisation apparatus

When the steam cleaning process is complete, you can sterilise frames using caustic soda treatment (see above), before refitting with fresh foundation.

Cleaning and Disinfecting plastic or polystyrene hives

Plastic beehives have been used in Europe for at least 30 years. Although still relatively uncommon in the UK, they are becoming more popular. Prior to sterilisation, plastic hives and components need to be carefully cleaned, just as you would a wooden hive. i.e. freeze components to kill insect pests, place onto a disposable work surface (newspaper or cardboard), scrape all parts as thoroughly as possible to remove adhering wax comb or propolis, and destroy all debris that you remove, by burning. Once your plastic hive is clean, it is ready to be sterilised. However, options available are limited compared to the range of treatments you can use on wooden hives. Use of a blowtorch, for example, is clearly out of the question as this would simply melt the equipment, and the temperatures involved in paraffin wax treatment would also be inappropriate. Manufacturers of popular plastic hive brands recommend that the best available options are chemical disinfectants that contain hypochlorite or caustic soda, as described above for wooden hive sterilisation. Only hypochlorite-based products are recommended for AFB (see Dealing with EFB and AFB, below). Gamma irradiation should also be effective, but no details are available at time of writing. Any cleaning and treatment agent or solution should be tried on a small component or area to check that no damage will be caused.

Queen excluders

Queen excluders need to be cleaned and sterilised in different ways, depending on the type used. Begin by removing debris by scraping with a suitable tool (Figure 8). It is easier to remove propolis when it is cold and wintery, as propolis will be brittle

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under these conditions. A wire brush is very useful to remove bits of wax and propolis. Wire excluders can then be scorched using a blowlamp, but if they are soldered be careful not to melt the solder joints as sometimes they are very 'soft'. If foul brood has been present, zinc slotted excluders must be destroyed by burning. Otherwise, it is possible to scrub these clean with a solution of washing soda. This needs to be fairly concentrated (1 kilogram soda to 5 litres of water), and a dash of washing up liquid in the mix also helps. **You will need to wear suitable protective clothing, protect your eyes and use rubber gloves**. Plastic excluders can be disinfected in the same way as plastic hives and components, as described above.

Figure 8. Removing debris from an excluder
(image courtesy of Claire Waring)

How should I treat other equipment?

First remove any adhering wax comb or propolis lumps by scraping using a paint scraper, hive tool or other suitable instrument, so that the bits of wax and propolis fall onto some cardboard or newspaper. This should subsequently be burnt. A washing soda and water solution effectively dissolves propolis (see above). Hive tools, smokers, scrapers and other potentially contaminated items should be soaked for an hour or two, and then lightly scrubbed off. As always, when working with washing soda, **you will need to wear suitable protective clothing, protect your eyes and use rubber gloves**. Hive tools should be scorched off using a blowlamp, but do not heat them to the extent that you damage their metal hardenings. Plastic equipment or components can also be scrubbed off in a washing soda solution. Open-ended correx plastic sheet is difficult to clean inside so it is a good idea to seal up open ends prior to use. This does not apply to harbourage traps, which can be destroyed if necessary.

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Cleaning beekeeping clothing

Leather gloves are difficult to clean and are best avoided. If you must use them, wear a pair of thin disposable gloves over them. Leather gloves can be washed in soapy water and proprietary glove soaps are available. However, leather gloves do tend to become hard. It is better to use washing up gloves or thin disposable gloves. These can be swilled between examining colonies, thus reducing the risk of spreading infection, and they can be renewed on a frequent basis. If using wellington boots, these can be scrubbed in a washing soda solution as described above. Other footwear should be cleaned of mud, propolis and honey splashes and wiped off in a suitable manner. Beekeeping overalls should be washed regularly in the normal way. A small quantity of washing soda crystals mixed with the detergent helps to remove propolis. Make sure all zips are done up to avoid damage.

Dealing with EFB and AFB

Both AFB and EFB are notifiable diseases. This means that if you suspect that your colonies are affected by either of these diseases you must report this to the National Bee Unit (NBU) who will provide confirmatory diagnosis. Details of how to do this are available on the NBU's BeeBase website (**www.nationalbeeunit.com**); otherwise, a contact telephone number is also provided at the end of this article. Even before diagnosis is confirmed, close the hive and reduce the size of the entrance, and take any other steps necessary to prevent the hive being robbed by other colonies in the area. Disinfect gloves and other beekeeping equipment with a strong solution of washing soda before examining other colonies. If AFB is subsequently confirmed, your local Bee Inspector will burn infected colonies, and hives must be sterilised before reuse. NB. Virkon S is very effective against non-spore forming microbes such as EFB bacteria and viruses. It is **not**, however, recommended for AFB – use a hypochlorite based cleaner i.e. bleach. If EFB is confirmed, lightly infected colonies may be treated, but as with AFB, colonies with severe EFB infections will be destroyed.

Figure 9. Burning diseased combs and frames

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Destruction of old, damaged and infected equipment

Wooden equipment can be burnt in pit about 45 cm deep (Figure 9), and the pit must be covered in afterwards. Plastic equipment should not be burnt. If uninfected and clean it may be suitable for recycling. You will need to check with your local authority's recycling centre. Infected material can be incinerated at a suitable plant, or buried deep so that it will not become exposed if the ground is subsequently used for cultivated crops, etc. The delay in covering landfill sites makes them unsuitable for equipment disposal, as they could act as a source of infection in the interim period. NB. Before burning any equipment, you must ensure that you are adhering to local byelaws.

Are you registered on the BeeBase database?

BeeBase database is the sophisticated IT system that supports the bee health programme. It includes custom designed databases comprising mapping, Geographical Information Systems (GIS) and spatial analysis capabilities. BeeBase contains all the apicultural information relating to the statutory bee health programme in England and Wales. It provides information on the activities of the NBU, legislation, honey bee pest and disease recognition and control, interactive maps, current research areas, and lots of helpful contacts. Many beekeepers find this an extremely useful resource, and recognise the role that BeeBase has to play in the beekeeping community. If you register as a beekeeper on the BeeBase database you can request a free apiary visit from your local bee inspector, who can provide you with detailed help and advice on all aspects of beekeeping, including hive cleaning and sterilisation.

Further information

BeeBase is regularly updated with the latest news and information, at: www.nationalbeeunit.com This website gives a great deal of information about the NBU and its work. There is also a general email address: nbu@fera.gsi.gov.uk to which you can send any enquiries about honey bees. For enquiries regarding Bee Health Policy and Regulatory issues, please contact Bee Health at: beehealthinfo@fera.gsi.gov.uk

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