Preservation of wooden hive equipment

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Department of Agriculture, Western Australia

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PRESERVATION OF WOODEN HIVE EQUIPMENT

Compiled by Lee Allan
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Department of Agriculture
Western Australia
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Introduction

The enclosed articles on Wood preservation of hive equipment have been published in the Australasian Beekeeper and Australian Bee Journal since 1984. The request for this information was made by the Western Australian Farmers Federation, Beekeeper's Section, Research Committee. The articles are the latest information on the subject and have been incorporated in this booklet to provide beekeeper's with a useful reference.
BEEKEEPING AND WOOD PRESERVATION IN AUSTRALIA

P.J. Robinson and J.R.J. French
CSIRO Division of Chemical and Wood Technology

Introduction

Over the past decade honey production in Australia has been, on the average, 19.5 thousand tonnes per year. Export earnings in the 1982-83 season were $12.7 million for 14.6 thousand tonnes of honey exported. Statistics for honey production in Australia are compiled by the Australian Bureau of Statistics and are based on apiarists owning more than 40 hives. The under 40 group may contribute as much as an additional 2.5 thousand tonnes of honey to the domestic market. Bees are an important vector in crop pollination. Their value to the farming community and consequently their input to the national economy, although difficult to measure in monetary terms must be substantial. Hive repair and maintenance costs were estimated in 1981 for a 900 hive apiary at $1500. Today this figure may well be greater than $2000.

Considerable variation in these costs are to be expected throughout the industry as the majority of Australian apiarists are either amateur, hobbyists or small commercial producers. About 80 per cent of apiarists operate less than 40 hives representing only 15 per cent, on the average, of the total number of hives in Australia. There is considerable scope for these and other producers to utilize 'do-it-yourself' hive maintenance procedures that include wood preservation. Construction of hive and hive components is mostly from softwood such as Pinus sp and Araucaria sp.

Untreated wood parts of beehives have been reported to last up to 10 years in America depending on the climate, but under Australian conditions 2-5 years may be a reasonable estimate. Termites can be a problem. Considering that the replacement value (retail) of a two super, eight frame hive is about $55 any wood preservative treatment that would extend the service-life of a hive before any remedial treatment, could have considerable economic impact on the bee industry. The authors have seen beebases claimed by their owners to be 40-50 years old, treated with various waxes and oils, that were in excellent conditions. Our experience with a number of commercial wood preservatives suggests that a 20 years of more minim-um maintenance period is not an unattainable goal.

Choice of wood preservative

Wood preservation systems can be classed as follows in order of effectiveness:

(i) paints or plastic film;

(ii) surface layer treatment with a water repellent;

(iii) surface layer treatment with an organic fungicide;

(iv) pressure impregnation using organic solvent soluble or water soluble preservatives. Some water soluble preservatives may be diffused into wood.

We consider water repellency, fungicidal effectiveness and the effect on bees and hive products to be the main considerations when choosing a wood preservative system for wooden hive components.

Dry wood, that is wood with less than 20 per cent moisture content will not support decay organisms and where the moisture content of wood remains relatively constant, swelling and shrinking, particularly in the joints, is minimized. For instance, window units dip-treated with a water repellent formulation containing paraffin wax, resin and mineral spirit were exposed to the weather and are still performing satisfactorily after 20 years exposure. There is a great likelihood of mechanical damage occurring to a hive when prising supers apart or during transportation to honey flows. Galvanized iron straps are often used to secure supers. The straps may cut into the wood, breaching any surface treatment and allow the entry of moisture.

Dip or brush-on treatments with water-repellent formulations may need retreatment every 2-3 years to maintain repellency. Painting the outside surfaces of the hive with a suitable oil-based or acrylic paint will reduce this requirement.

Some apiarists have been experimenting with various hot wax bath treatments of supers and frames. Successful treatments are claimed to last in excess of 15 years before retreatment is required. Usually, paraffin wax, microcrystalline wax or beeswax is used, sometimes in combinations with mineral turpentine and linseed oil. Hives are generally given an external coat of paint immediately after the hot wax-bath treatment.

Commercial wood preservatives incorporating a fungicide, and in some cases an insecticide, are available for treatment of beehives. Hive components may be brush-coated, dipped, soaked or subjected to a series of vacuum/pressure regimes. The most popular wood preservatives contain metallo-organic compounds dissolved in light organic solvents such as mineral turpentine. Generally, wood preservative treated hives are given at least one external coat of paint for additional protection. Painting alone will only give temporary protection.

Some wood preservatives recommended for beehive preservation may cause high bee mortality. The most
recent information we have suggests that Pentachlorophenol (PCP), Bis-Tri-N-Butyl-Tin Oxide (TBTO) and Copper-Chromium-Arsenic (CCA) treatments have adverse effects on bees, leave residues of the chemicals in bees, honey or wax depending on the individual treatment and in all three treatments were associated with poor survival of colonies during their first winter. Painting the inside of beehives treated with CCA will reduce the risk of bees ingesting arsenic. However, there are suitable alternatives to this treatment that contain no arsenic. Care should be taken in selecting a paint since some contain fungicidal components that may effect bees and/or their products.

Where protection from termite attack is desirable and the wood is not in contact with the bees, for instance in hive stands or cleats, a durable timber treated with a wood preservative containing an insecticide such as in CCA. Pressure impregnated wood will generally provide the best protection against termite attack and decay.

**Dip/soak treatments—some preliminary results**

1. **Microcrystalline wax**

Metal vial lids (25 mm dia.) with their base removed were glued onto the radial and tangential faces of *P. radiata* dressed wood blocks. A microcrystalline wax (m.p 74° C) coloured with a wax soluble dye was placed in the lids and each assembly placed in an oven at 135°C. After one hour the wood blocks were cooled at room temperature and then a one millimetre deep strip was shaved sequentially off each face. On average, the dye was just visible in the latewood at 2 mm on the radial face and up to 5 mm on the tangential face.

2. **Alkyl ammonium compound**

Radiata pine wood blocks (200 x 30 x 20 mm), ten per treatment, were dipped for 20 minutes in alcoholic solutions of benzalkonium chloride (Quartramine 80), 2.5% m/v, 5.0% m/v,

7.5% m/v and 10.0% m/v. Air-dried, treated blocks had 1 mm shaved from a tangential face and were placed vertically into moist soil at 26% C. Decay on each tangential face was assessed visually after 4 months exposure. The scores obtained were ranked - higher ranks indicating less decay, and the data analysed using the Kruskal-Wallis one-way analysis of variance. Briefly, there was no significant difference (P > 0.05) between the treatments of the shaved face indicating that preservative penetration was largely confined to a shallow surface layer. Dye diffusion tests in fact confirmed this conclusion. Treatment differences were significant (P < 0.05) on the unshaved tangential face. Thirty per cent of the woodblocks in the 2.5% m/v treatment group failed a stress test.

3. **Organic fungicide**

Wood blocks of *P. radiata*, six per treatment, were dipped for 10 minutes in white spirit solutions of copper naphthenate, 0.5% m/v, 1.0 m/v, 2.0% m/v and 4.0% m/v. Air dried blocks were placed vertically in soil and scored, after six months exposure, for decay as previously described (No. 2). Treatment differences were only significant (P < 0.05) on the unshaved tangential face. All the wood blocks are still under test.

**Some concluding remarks**

Throughout the bee-keeping industry there are many variations of surface treatments being used to protect hives from decay and insect attack. The most common brush-on or dip-soak treatment used is probably copper naphthenate. For instance, in Queensland 80-90% of apiarists use this wood preservative (T.F. Weatherhead pers. comm.). Hot wax dip/soak treatments are also popular using either paraffin or microcrystalline wax. How important the use of vacuum/pressure impregnated wood is in the bee industry is unknown. Revision of current practices may be necessary in light of recently received information citing the detrimental effects of CCA, PCP and TBTO. This study indicated that the wood preservatives tested, copper naphthenate, copper-8-quinolinolate, acid copper-chromate and a water repellent dip treatment could be used without adverse effects on bees, honey or wax. What we would like to quantify is the degree of maintenance associated with the various treatments, particularly surface treatments such as waxes and brush-on wood preservatives (see industry survey on page 8).

CSIRO has had over 40 years experience in the field of wood preservation. New preservatives are still being developed, the technology is available to substantially improve the service life of wooden hive components for the bee industry.
WOOD PRESERVATION IN VICTORIAN COMMERCIAL APIARIES

Peter J. Robinson and John R.J. French
CSIRO Division of Chemical and Wood Technology, Melbourne, Victoria

Summary

During the past few months we have surveyed commercial apiarists (200 or more registered hives) throughout Australia to obtain information about the success or otherwise of wood preservation methods being used to treat wooden hive parts. A considerable number of requests for information specifically about wood preservatives for beehives has prompted us to release some survey results, but only for the Victorian scene. We offer some suggestions, hopefully to encourage apiarists to use a wood preservative on their bee boxes and to apply the preservative in the most efficient manner.

The survey

Two hundred and eleven apiarists were requested to answer a series of questions pertinent to bee box wood preservation. Seventy four (35%) returned our survey forms.

Two categories of wood preservation are predominantly used by these apiarists. They were 'painting only' (45%) and 'wood preservative followed by painting' (31%). Copper naphthenate was the wood preservative favoured by apiarists (60%) in the latter category. Copper Chromium Arsenic (CCA) treated radiata pine was used to construct supers in one apiary. Apiarists (95%) who did their own wood preservative treatments used radiata pine.

Linseed oil either separately or in combination with various waxes, kerosene or mineral turpentine and sometimes copper naphthenate, is used by some apiarists (14%) to treat radiata pine hive parts prior to painting. A smaller number of apiarists (9%) used hot bath dip or soak treatments with waxes such as beeswax, paraffin wax and microcrystalline wax.

A more reliable interpretation of the effectiveness of the above treatments and others not mentioned may be obtained from the larger sample size in the Australia-wide survey. For this preliminary assessment of the Victorian scene we will examine data obtained from those apiarists (76%) that simply paint their boxes or use a wood preservative prior to painting. Wood preservative in this case is defined as 'chemical compounds or mixtures' (e.g. copper naphthenate, CCA) traditionally used as wood preservatives by the wood preservation industry.

Comparing beeboxes painted only with beeboxes treated with a wood preservative and then painted

Note: A percentage refers to the number of apiarists responding to a survey question. (P = paint, Wp = wood preservative)

<table>
<thead>
<tr>
<th></th>
<th>P</th>
<th>Wp</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+P</td>
<td></td>
</tr>
<tr>
<td>1. Painting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Only outside of beehive</td>
<td>66%</td>
<td>57%</td>
</tr>
<tr>
<td>Three coats of paint</td>
<td>59%</td>
<td>64%</td>
</tr>
<tr>
<td>Three coats of oil paint</td>
<td>65%</td>
<td>43%</td>
</tr>
<tr>
<td>Two coats of oil paint</td>
<td>30%</td>
<td>10%</td>
</tr>
<tr>
<td>Brand preference</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>Apiarists estimates of:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum years between repaints...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>2-10</td>
<td>2-12</td>
</tr>
<tr>
<td>Average</td>
<td>4.3</td>
<td>7.3</td>
</tr>
<tr>
<td>Average years between repaints...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>2-10</td>
<td>3-18</td>
</tr>
<tr>
<td>Average</td>
<td>5.74</td>
<td>7.9</td>
</tr>
<tr>
<td>Maximum year between repaints...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>5-25</td>
<td>7-25</td>
</tr>
<tr>
<td>Average</td>
<td>8.4</td>
<td>13.9</td>
</tr>
<tr>
<td>Reasons given for painting:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appearance</td>
<td>35%</td>
<td>19%</td>
</tr>
<tr>
<td>Coolness</td>
<td>35%</td>
<td>52%</td>
</tr>
<tr>
<td>Extra Protection</td>
<td>-</td>
<td>24%</td>
</tr>
<tr>
<td>Bees locate hive easier</td>
<td>21%</td>
<td>5%</td>
</tr>
<tr>
<td>Apiarists that would always paint after using a wood preservative</td>
<td>-</td>
<td>95%</td>
</tr>
</tbody>
</table>

2. Wood Decay

Noticed sometimes prior to repaint (overwhelmingly found in joints) 79% 80%

Apiarist's estimates of percentage decay:

| Supers Range | 1-30 | 0-20 |
| Average      | 8.4% | 4.8% |
| Bottom boards|      |      |
| Range        | 1-40 | 0-40 |
| Average      | 10.5%| 8.5% |
| Lids Range   | 1-10 | 0-20 |
| Average      | 4.6% | 5.2% |

(continued overleaf)
<table>
<thead>
<tr>
<th></th>
<th>P</th>
<th>Wp</th>
<th>+P</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Termite Damage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rarely</td>
<td>48%</td>
<td>45%</td>
<td></td>
</tr>
<tr>
<td>occasionally</td>
<td>52%</td>
<td>45%</td>
<td></td>
</tr>
<tr>
<td>Where found</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottom boards</td>
<td>84%</td>
<td>80%</td>
<td></td>
</tr>
<tr>
<td>Cleats/Risers</td>
<td>29%</td>
<td>93%</td>
<td></td>
</tr>
</tbody>
</table>

4(a). Wood Preservative Treatments

- Apiarists always does own treatments 80%
- Apiarists never treats before cutting 100%
- Apiarists always precuts then assembles 86%
- Apiarists never assembles, then treats 76%
- Apiarists always treats in batches 89%
- All supers treated with a wood preservative 58%
- All bottom boards 72%
- All lids 63%

4(b). Commercially Treated Wood

Used for construction of beeboxes
Annual cost (1984-5) of treated wood (5 apiaries) range $50-300

5. Replacement Of Preservative Treated Wood, resulting from decay or termite attack

- Sometimes 44% 25%
- Never 56% 75%

6. Maintenance Of Beeboxes

- Days per year painting...
  - Range 3-75 4-60
  - Average 22.0 22.1
- Days preservative treating...
  - Range - 1-30
  - Average - 6.8
- Days repairing beeboxes...
  - Range 1-60 10-60
  - Average 20.0 20.4

Employment of labour (additional assistance)

- 36% 22%

Employed one person preservative treating...

- 5%

Employed two persons preservative treating...

- -

Employed two persons painting...

- 15% 11%

Employed two persons repairing beeboxes...

- 12% 11%

7. Apiarists Estimates Of Super Life Time (Redwood/Red pine excluded)

Minimum years life of supers...

- Range 1-20 3-20
- Average 7.7 11.0

8. Apiarists Choice Of Research Needs Improvements in...

- wood preservation 70% 79%
- paint systems 52% 59%
- construction of beeboxes 52% 53%
- handling techniques - reducing mechanical damage 45% 41%

9. Number Of Registered Hives

- closest to...200 52% 27%
- closest to...400 33% 41%
- closest to...600 9% 32%
PRESERVATION OF HIVE EQUIPMENT

BY T.F. WEATHERHEAD

PAPER PRESENTED TO THE QUEENSLAND BEEKEEPERS ASSOCIATION
CONFERENCE AT ROCKHAMPTON 28 AND 29 JUNE 1985

Why do we want to preserve the equipment
and what are we preserving it against?

Decay or rot as it is commonly called costs the bee-
keeper a lot of money: Supers can start to decay in 12
months in the tropical areas and to a lesser extent in
the sub tropical areas. What is decay and how does it
work?

Decay is caused by a fungus that feeds on the wood.
Before it can affect the wood there must be two factors
present, warm temperatures and moisture. The higher
the temperature the faster the decay can work. This
means that decay is bigger problem in the tropics than
say Tasmania. The other factor is moisture. You
often hear the term “dry rot”. There are no dry rots in
Queensland, so any decay that has formed must have
been the result of moisture.

The wood needs to be above 20 per cent moisture con-
tent before decay can start or continue to work. Areas
of low humidity e.g. The Darling Downs or the Far
West are not high decay hazard areas even though the
temperatures can be high. The tropics with high tem-
peratures and high humidities provide ideal conditions
for decay to work.

Paint can help prevent decay because it keeps out the
moisture. When you consider your normal procedures
when inspecting a hive, it is obvious paint is not the
complete answer. When you use the hive tool to sepa-
rate the supers, you break the paint seal thus allow-
ing moisture to enter at these points.

To help preserve the hive components, you have to
look to something to preserve the wood. There are
many chemicals on the market that prevent decay.
Work on the most popular of these and their affect on
honeybees has been published in an article “Effect of
Wood preservative Treatment on Honeybees and Hive
Products” by Martin A. Kalnins and Benjamin F.
Detroy. Michael Kennedy of the Queensland Forestry
Department and myself have also spoken at two
previous QBA Conferences in 1980 and 1981 on
preservation of hive components.

Of the chemicals tested, copper naphenate seems to
be the best to use. In the trial by Kalnins and Detroy,
the concentration of copper naphenate in the wood
was 30 times higher than the level recommended by
the Queensland Forestry Department. The level of
copper in the honey, remembering it was 30 times
higher than recommended in Queensland, was 0.43
ppm. This is 20 times lower than the permissible
level allowed by the Health Department in Queensland
which is 10 ppm. So if you use copper naphenate
at the recommended levels, the honey should not con-
tain any more copper than the natural occurrence of
copper.

The other chemicals tested and commonly available
were tributyl tin oxide (THTO) pentachlorophenol
(PCP) and copper chromated arsenate (CCA). These
three were considered responsible for winter loss of
colonies in Kalnins and Detroy’s work. I probably
should say a little on copper chromated arsenate
(CCA) as I know some beekeepers have supers treated
with this. In work by Kalnins and Detroy, they did
not paint the inside of the supers. Most beekeepers I
know that have used CCA have painted the inside of
the supers. This would most likely not cause bee
deaths the same way as the experiments in America.

Copper chromated arsenate is a water based preserva-
tive and is not a “do it yourself” treatment as is the
case with copper naphenate. Being water based you
will have to wait months for it to dry. Warping of the
wood could occur during drying.

Copper chromated arsenate is good for use in bee-
keeping for the cleats on the hive and for toad stands
as it gives termite (white ant) resistance.

These parts are not in regular contact with the bees.
For these components it is important to make sure
you use durable or treated timber but even treated hoop
pine is not suitable for the toad stands because it does
not have sufficient strength.

When considering treatment of any timber,
you must remember that only sapwood is
 treatable. The heartwood is not. In
hardwood, the sapwood is easily picked by its
different colour. In pine it is not so
readily distinguishable.

The two most common timbers used for hive
components are hoop pine (Araucaria cunninghamii)
and radiata pine (Pinus radiata). The sapwood of these
is quite easily treated with copper naphenate
remembering the heartwood does not treat. The
heartwood in radiata pine is distinguished by its pink
colour. In hoop pine it is browner than the sapwood
but is not easy to see. Radiata pine heartwood has
low durability and hoop pine has been put in the same
category but there are enough instances of excellent
service by the old hoop pine heartwood to indicate it is
much more durable. There are instances of untreated
supers lasting 40 to 60 years without signs of decay.
These would have been predominantly heartwood.
Hoop pine available today contains a lot of sapwood and this should be treated.

To treat with copper naphthenate, there are two common ways. Firstly, you can completely soak the wood in a 1 per cent solution for eight hours. It must then be aired for a minimum of 14 days before painting. The other method is to completely soak it for one hour in a 1.25 per cent solution, wrap in plastic for three days and then air for 10 days. It must be aired to allow the solvent to evaporate. If airing for longer than the recommended is possible, this will ensure evaporation of the solvent.

When soaking the hive components in the copper naphthenate, the pieces should not be block stacked. There must be a space between each of the individual pieces. Pieces of fencing wire would be sufficient but this is an absolute minimum. The wood components will float in copper naphthenate so they must be weighted down. This weight should be in place before the liquid is poured in.

Some timber often has a blue discolouration where it has been affected by a fungus called a blue stain. The strength of the timber will not be affected, only the looks. The area affected with blue stain will absorb a lot more of the treatment solution compared to the normal timber. It will often be greener looking and heavier after it is taken out of the treatment solution. It may also take longer to dry than the normal timber.

Copper naphthenate comes in a variety of different strengths. The figures mentioned above are expressed as percentages of copper. When buying the concentrate, the strongest you can buy is about five per cent copper. If this was expressed as per cent copper naphthenate then it would be 50 per cent. The conversation factor is 10. There are concentrations of 40 and 20 per cent on the market. To convert these to per cent copper divide by 10 and they become four per cent and two per cent respectively.

In the drier areas of the State, some beekeepers use linseed oil in the treatment solution. This is to help prevent cracking of the supers. It is best to use pale boiled linseed oil and not raw linseed oil. Raw linseed oil encourages the growth of mould and also takes a long time to dry. If not dried for a long period, it will interfere with the painting. The maximum amount of pale boiled linseed oil should be about 15 per cent of the treatment solution. If it has more, it will interfere with the uptake of the copper naphthenate and also affect the painting quality.

An accurate table allowing for the density differences of the concentrate and the solvent is given at the end of this paper.

When airing the wood after treatment, make sure it is stacked so the air can get all parts. It should be stripped in the same manner as timber. Some beekeepers nail the boxes together after treatment and let it air that way. This is all right but if you want to paint the joints you will have to completely air it before putting it together. It is important to use galvanised nails as the copper will corrode the normal steel nails.

Colour on the outside is not a good indication of effective treatment. A bright green colour only indicates you have a high concentration of copper on the outside. After you take the wood out of the solution, the solvent starts to evaporate. It carries the copper naphthenate to the outside, the solvent evaporates leaving behind the copper. This will be evident if you soak for eight hours then dry. If you soak for one hour and the wrap in plastic for three days, the green colouration will not be as bright. As the air inside the plastic is saturated with the solvent, the solvent in the wood does not evaporate straight away. It continues to penetrate the wood taking the copper naphthenate to the centre of the wood.

Some beekeepers only soak for 10 minutes and then take the wood out. It has a nice bright green colour so they think it is fully treated. It is only partially treated and has a skin of penetration all round. When a nail is driven in past this skin treatment, this allows a passage for moisture to enter and decay can start on this untreated part.

If you use glue in putting together your supers, copper naphthenate will interfere with the gluing properties of the wood. The super must be put together first before treatment. This method is not recommended as the glue will stop the uptake of the copper naphthenate in the end grain.

Wax dipping of supers has been tried by beekeepers as a means of preservation. The work by Kalnin and Detroy indicates this is not effective as a preservative. Norw Rice who is one beekeeper who uses wax treatment has said it works well on hoop pine but not on radiata pine. This would again point to the hoop pine heartwood being naturally more durable than the radiata pine.

In summary, it would seem that copper naphthenate is the most suitable preservative for hive equipment. It is important to use it at the right concentration and air for the required period to allow for painting. CCA is suitable for the cleats and hive stands.

**WARNING**

Some commercial formulations of copper naphthenate sold in shops have aldrin added. Aldrin is highly toxic to bees and will leak out through paint. Avoid these formulations and read the label carefully before buying.

**Acknowledgements**

I would like to thank Michael Kennedy who made comments for me on this paper and helped with the tables.
Table 1. Recommended treatment schedules - pine hive parts

<table>
<thead>
<tr>
<th>Schedule type</th>
<th>Soaking time (hours)</th>
<th>Wrap time (days)</th>
<th>Airing time (days)</th>
<th>Conc., (% Cu)</th>
<th>Preservative solution concentrate + mineral turpentine</th>
<th>Concentrate</th>
<th>Solvent</th>
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Soak: Fully immersed (weighted down and spaced) in preservative solution.
Wrap: Block stacked while still wet and tightly wrapped in plastic.
Airing: Strip stacked with good cross-ventilation to speed solvent evaporation before assembly and painting.
Copper naphthenate concentrate: These figures based on a 5% and 2% copper concentrate (5% maximum strength available)
Solvent: Mineral turpentine. If available power kerosene gives good results.

References
PRESERVATION OF BEE HIVE COMPONENTS

T. WEATHERHEAD, QUEENSLAND D.P.I.

Following on the work done by Mr Mike Kennedy of the Queensland Forestry Department and myself comes some important work by Martin Kalnins and Benjamin Detroy.

Martin Kalnins is from the United States Department of Agriculture, Forest Service, Forest Products Laboratory, Wisconsin. Benjamin Detroy is from the Science and Education Administration, Agricultural Research Service, Bee Research Unit at the University of Wisconsin. These gentlemen have written a paper entitled "The effect of Wood Preservative Treatment of Beehives on Honeybees and Hive Products".

Seven different treatments plus a control (no treatment) were used. The treatments were - copper naphthenate, copper 8-quinolinate, pentachlorophenol (PCP), chromated copper arsenate (CCA), acid copper chromate (ACC), tributyl tin oxide (TBTO) and water repellant. Honey, wax and bees were sampled periodically during two successive summers. Elevated levels of PCP and tine were found in bees and wax from hives treated with those preservatives. A detectable rise in copper content of honey was found in samples from hives treated with copper naphthenate. However, the level was more than 20 times lower than the permissible level. CCA treatment resulted in an increased arsenic content of bees from those hives. In all cases described the insides of supers were not painted. This is discussed later. CCA, TBTO and PCP treatments of beehives were associated with winter losses of colonies.

The following comments endeavour to put the results in perspective for Australia. Of the preservatives used, acid copper chromate (AAC) is not available in Australia. Copper 8-quinolinate is not readily available in Australia. Tributyl tin oxide (TBTO) is not presently recommended for tropical or sub-tropical areas by the Queensland Forestry Department who have trials presently underway with TBTO. The adverse report on TBTO would tend to rule out any intended use by beekeepers.

The adverse comments on pentachlorophenol (PCP) would tend to rule out its use. My own experience with PCP was that even with one to two months airing before painting the paint lifted within a year. This may have been due to the oily carrier more than the PCP.

This leaves the two most common preservatives used by beekeepers, chromated copper arsenate (CCA) and copper naphthenate. CCA has been used by Queensland beekeepers with no apparent side effects. The report found increased levels of arsenic for the experiment and losses of bees. This is in line with work done in New Zealand in 1959 by Harrison.

Palmer-Jones and Nairn. I wrote to Mr Kalnins to find out if the hives have CCA treated supers. In the American experiment, only the outside had been painted. Mr Kalnins' comment was "Painting the inside of hive bodies would undoubtedly reduce residue levels in the hives. Pentachlorophenol vaporization is measurably reduced by paint films."

This probably explains why Queensland beekeepers have not observed adverse effects with CCA. As CCA is a water based preservative it does not lend itself to treatment of pre-cut hive components as the wood takes time to dry. During drying the components may warp. The best use for commercially treated CCA timber would be as cleats and hive stands where bees do not have regular contact with the wood. CCA treatment gives termite (white-ant) resistance so is excellent for the above uses. CCA treatment is not a "do it yourself" treatment which the bekeeper can carry out but requires treatment by a suitable commercial plant.

Copper naphthenate is the most widely used of the preservatives tested. The treatment level used in the trial, 3% copper in wood is 30 times higher than the level recommended by the Queensland Department of Forestry. I raised this point with Mr Kalnins who replied "Higher levels were considered by us to be preferable to lower ones because we wanted to magnify any adverse results so as not to miss them."

The copper content in the honey in untreated hives was less than 0.3 ppm. In honey from hives treated with copper naphthenate the copper content averaged 0.43 ppm. The maximum level of copper in honey allowed by the Health Department in Queensland is 10 ppm. It can be seen that the level is way below the allowed limit. This, coupled with the high treatment level indicates that beekeepers should not have any problems with copper naphthenate treated hive components treated at the lower concentration. Copper naphthenate is only a fungicide and does not offer protection against termites.

The paintable water repellant used was paraffin wax and varnish in mineral spirits. The report commented on the preservation ability of this mixture: "It is not yet clear whether the preservative-free water-repellant solution appreciably extends the life of beehives; early indications are not very encouraging." The wood used in the American experiment was clear sapwood of ponderosa pine (Pinus ponderosa). Radiata pine (P. radiata) would have a similar durability rating to ponderosa pine. Mr Norm Rice, of Beaudesert, has used wax treatment of hive materials for many years. His experience with radiata pine is that the treatment does not appreciably extend the life of the radiata pine; this is in line with the American result. Norm has been successful with hoop pine (Araucaria cunninghamii) but I think this is due to the hoop pine being more durable than the radiata pine.

In summary it would seem that copper naphthenate is suitable as a preservative for bee hive components. It is important to use it at the right concentration and
aim for the required retention levels. Some beekeepers are shortening the schedule of treatment because of problems with dovetail supers. It is hoped to have a look at this problem. CCA would not seem suitable for supers but would be suitable for cleats and hive strands.

WARNING

Some commercial formulations of copper naphthenate sold in shops have aldrin added. Aldrin is highly toxic to bees and will reach out through a paint film. Avoid these formulation and read the contents label carefully before buying.

REFERENCES

Kalinins, M.A. and Detroy, B.F. “The effect of Wood preservative treatment on beehives on honey bees and hive products” (Personal communication - in press).


12
CHOOSING PAINT FOR BEEHIVE TIMBERS

M.J. KENNEDY - QUEENSLAND DEPARTMENT OF FORESTRY

Timber Note No. 19

Introduction

Apriasts have a difficult decision to make when it comes to painting hive timbers. Alternative paint systems must be evaluated for their suitability in a number of different ways.

Compatibility with timber preservatives

Many apriasts have recognised the benefits provided by preservative treatment of their hive timbers. The preservatives commonly used on hive timbers contain copper naphenate and linseed oil, insecticidal additives being avoided because of the danger of bee mortalities. These components protect against decay, and make the timber slightly water repellent.

Less water is taken up by the timber, and hence it expands and contracts less. As a result, the paint is less likely to flake away, and most types of paint last longer. However, some of the water-based acrylic paints do not adhere well to the water repellent treated timber.

You should avoid acrylics (especially primers) when using these types of preservatives on hive timber, unless you have tested to check that a particular paint adheres well to the treated timber being used.

Ease of application

The primer coat should be brushed into the timber, to make a better key between the paint and the wood. The later coats can be brushed, rolled, dipped, or sprayed, provided you obtain an adequate paint film thickness.

Inexperienced painters often prefer acrylics, because they dry faster and clean out in water, while linseed oil-based paints dry very slowly.

Reaction curing paints such as epoxy resins are difficult to use. They are supplied as two-part packs, which must be accurately mixed before use. After mixing, they have a fairly short pot-life, and must be used within a couple of hours.

Durability of the paint film

Weather and scuffing damage

Both weathering and scuffing due to hives rubbing together in transit cause erosion of the paint film.

The two-pot reaction-curing epoxy and polyurethane paint systems are very hard and resistant to weather erosion and scuffing. The premium quality alkyd (house paint) enamels and acrylics have very good weathering and wear resistance. The older linseed oil-based systems tend to weather a little more quickly, by heavy chalking, while aluminium paints also weather fairly rapidly. Linseed oil, aluminium and acrylic paint films are prone to scuffing, owing to their softness.

Hive tool damage

When used to lever boxes apart, hive tools place considerable pressure on a small area of the box face. Hard, brittle paint films such as epoxies and, to a lesser extent, alkyd house paints, tend to crack at this point. Softer films from acrylic, aluminimum and linseed oil-based paints are more flexible, and resist this cracking.

Sticking boxes

Paint films which soften with heat, such as acrylics, tend to cement the hive boxes firmly together. When they are forced apart, the paint film often separates from one timber surface. Unless this is repaired quickly, it is fatal to the rest of the paintwork, because water will enter the bare surface and wet the entire piece of timber, causing rapid “blowing” of the film.

General

The durability of the paint on the hive timber is related to its hardness. If too hard and brittle, it will easily crack, and if too soft and plastic, it will adhere to other surface, sticking boxes together. A compromise must be reached. The intermediate hardness of linseed oil-based formulations makes them perform well in this regard, even if they require re-coating a little earlier than some other types.

Fire resistance

Some apriasts require the paint on their bottom boards and boxes to exhibit some fire resistance. Aluminium paint is often used, as it takes longer to ignite than many other paint systems. However, white intumescent paints are now available from the major manufacturers. These intumescent paints, applied at the recommended rates, expand and bubble into a thick insulating layer when in contact with fire, and are able to protect the underlying timber. Tests conducted in accordance with the Australian Standard AS 1530 pt. 3 have given an ignitability index of zero for timber painted with these products.

Colour availability

The colour of the paint finish markedly affects the hive temperature. Gloss white paint, which reflects the most light and heat, will give a cooler hive than other colours. Aluminium paint, even though a light, reflective silver-gray, can cause internal hive temperatures about 4°C higher than white. This is detrimental to honey production in the winter months of the year, especially in western areas.
Costs

Usually, when buying paint, you get what you pay for. Many lines of paint are manufactured at a price. Manufacturers have a tremendous range of raw material type and quality from which to formulate their product.

Long service life should not be expected from cheap paint. You should aim to buy premium quality paint at the best possible price.

Linseed oil-based paint is quite expensive, but the two-pot epoxy and polyurethane systems are even dearer.

The decision

You must consider the alternatives and decide on the most suitable finish system for your own particular circumstances. The style, size, and location of your beekeeping activities may make one system stand out as being superior to the rest. As a broad summary of the difference between the paint types available Table 1 may be useful.

A few painting tips

1. Mix the paint thoroughly before use. Spend a few more minutes after it "looks right".

2. After sanding the timber, remove all traces of dust from crevices on the timber surface. Blowing the dust out is good, but wiping with a cloth soaked in turpentine is usually sufficient.

3. Round any sharp edges on the timber before painting. Paint always runs away from sharp edges, resulting in a thin film at these critical areas. Thin films crack easily.

4. Allow ample drying time between coats. If a hard-drying top coat is painted over a soft, incompletely dried lower coat, the top coat will crack rapidly. On the other hand, do not allow more than a couple of weeks between coats, or the second coat may not adhere well.

5. Sand very lightly between coats to remove nibs, dust specks and other imperfections. Remove all dust before applying the next coat.

6. Allow the paint to harden before stacking boxes on one another. Some beekeepers smear the mating faces with beeswax to prevent the paint films sticking together.

7. When the hive components are in service, cracks and splits should be touched up immediately (while still in use as hives) to prevent the entry of water and further paint failure.

8. When repainting hives, allow exposed damp timber to dry thoroughly before new primer is applied. When using enamelized house paints, the use of undercoat before the gloss coat will give better adhesion than applying gloss over gloss.

Further information may be obtained from the Timber Utilization Branch of this Department which has offices in:

Atherton - Phone (070) 91 1844.
Rockhampton - Phone (079) 27 6877.
Brisbane - Phone (07) 377 6454.

References


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<tr>
<th>Availability</th>
<th>Aluminium paint</th>
<th>Acrylic paint</th>
<th>Alkyd house enamel</th>
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E = excellent, G = good, F = fair, P = poor, V = very poor.
The following guidelines have been prepared to assist beekeepers who have diagnosed American Brood Disease (ABD) in a apiary, and intend to use wax dipping as a means of disinfecting equipment and controlling the disease. It is necessary to deal safely with infected bee equipment so the it does not constitute a risk of the apiary, or to other apiaries.

1. Identify the infected hives

All infected hives should be identified with a lumber crayon, felt pen or some other semi-permanent marking pen as soon as they are detected. Thereafter, all healthy or uninfected hives should be handled first during honey extraction or other hive management before attempting to work with any infected colonies.

2. Honey extraction

If a significant amount of honey is present in the infected hives than it can be salvaged. However, it is recommended to burn the honey along with the frames and the infected brood where small numbers of hives are infected.

If honey is extracted on-site, then the honey should be extracted from all of the healthy hives first. The frames of honey from infected hives should be extracted last, and the extraction van and equipment should then be immediately washed down. Particular attention should be paid to the extractor baskets as they are a major source of contamination. These should be soaked overnight prior to final cleaning, or cleaned with high pressure equipment. Wash-down water should be led to a drainage hole near the van to trap the waste water. The hole should be covered over after cleaning has been completed.

3. Destroy bees from the infected hive

At night the entrances to infected hives should be sealed with wads of newspaper or masking tape, and 500 mL of petrol should be poured under the lid of the super to kill the bees. It should be noted that the petrol fumes are toxic to bees, and that special care needs to be exercised when handling petrol because of its highly flammable nature. If the honey has already been extracted from the infected hives, bees may congregate around the sticky boxes and fail to return to the hive on the first night following extraction. In this case, it is best to wait for 48 hours before killing the bees in the hive.

4. Infected brood and honey frames

All honey, dead bees, scrapings and brood frames should be destroyed by burning in a hole of sufficient size so that the remains can be covered by at least 60 cm of soil. Burning should be done at night and hives should never be placed on top of the ground to be burnt as any remaining honey would then be subject to robbing. Beekeepers have a responsibility to themselves and to the industry to prevent robbing wherever possible.

5. Transport of infected equipment

All boxes, frames and gear (including lids and bottoms) from infected hives that are to be salvaged should be placed in plastic bags before they are removed from the site. Any debris on the bottom boards and any excess burr-comb should be scraped off the boxes where practical before the equipment is stored. It is recommended that 200 L drum liners (75 micron thick) be used for this purpose. These plastic bags are manufactured by Gromark Packaging Pty Ltd, Kewdale, and also available from beekeeping equipment suppliers.

6. Storage after transport

The equipment must be stored in sealed plastic bags and should be stored in bee-proof sheds. If a bee-proof shed is not available, then an under-cover storage area could be used. In these circumstances, the equipment, stored in plastic bags, should be covered by a tarpaulin and secured at the edges so that it provides a bee-proof barrier thus preventing robbing.

7. Contaminated lids

It is suggested that lids should be burnt; however, they may be salvaged.

If the lids are to be salvaged by wax dipping, then the tin must be removed from the top of the lid if any insulation has been placed between the lid and the masonite. This is necessary because the paraffin wax used in the dipping process will become trapped under the lid during the course of dipping. The problem is further compounded because the masonite component of the lids absorb the paraffin wax. When the wax-dipped lid is re-used, the trapped wax may melt and run down outside of the hive in hot weather. Alternatively, where lids contain insulation material, the lids may be decontaminated by using a blow lamp.

8. Contaminated bottom

Metal bottom boards can be removed and decontaminated by wax dipping.

Where bee boxes are mounted on high-rise bottoms and wooden grates have been used, the wooden grate should be removed from the bottom and burnt. Where bottoms are made of masonite or wood, rather than metal, these should be burnt.

9. Contaminated pallets

Where pallets are used to form the entrance of a hive, as is the case in some commercial apiaries, the pallet should be decontaminated using a blow lamp.

10. Contaminated queen excluders

Metal queen excluders can be cleaned and decontaminated by using either a blow lamp, or by steam
cleaning, or they can be dipped in boiling water. Plastic queen excluders cannot be effectively cleaned and these should be burnt.

11. Wax dipping boxes and other equipment

- **Cleaning prior to dipping**

  It is essential that all boxes be free of propolis and wax before they are subjected to wax dipping. Otherwise, the wax used for wax dipping becomes quickly soiled and contaminated with paint and debris, and its useful life shortened. This initial cleaning process DOES NOT DISINFECT the equipment.

  Equipment can be cleaned by:

  - hand scraping;
  - charring the inside of the boxes, by building a small fire inside the boxes;
  - using a hot air brush or blow lamp, as is used for commercial paint stripping in order to melt the wax build-up;
  - using caustic soda in boiling water;
  - using boiling water. When boiling water is used, the boxes are placed in the container of boiling water and the wax and residue floats to the surface and is skimmed off. The residue that is created must be disposed of safely, and it is recommended that the residue is either buried or disposed of at shire dumps. Prior contact with the shire should be made to ensure that if material is to disposed of at a dump, then it will be covered within a short period of its arrival at the dump-site.

  Where any heat treatment is used for cleaning, the boxes should be turned upside-down to assist in the removal of the debris. A Yankee type of hive tool is particularly useful for scraping out the rebated edges.

  Once boxes have been cleaned using one of the above methods, they are then ready to be sterilized by wax dipping.

- **Wax dipping**

  The boxes should be dipped in a mixture of 50 per cent micro-crystalline wax and 50 per cent paraffin wax. The equipment must be submerged in the molten wax for a minimum of five minutes at 140°C to 150°C (284-300°F). It should be noted that when the wax is heated above 150°C it can cause severe burns to exposed skin. The wax should not be overheated as it will give a highly-flammable vapour above 175°C (350°F) and the wax reaches flashpoint at approximately 230°C. Boxes to be dipped must be dry, since moisture will cause the molten wax to froth and boil.

  It should be noted that as the temperature for wax falls below 130°C, the amount of surface wax retained by the timber as it cools, increases, and this decreases the subsequent holding power of any paint that is applied to the timber surface.

  When wax dipping units are not in use, the paraffin and crystalline wax should be stored and identified, so that it will not be mistaken for beeswax. Under no circumstances should paraffin wax be mixed with beeswax as the resulting contaminated beeswax is unsaleable.

- **Draining boxes**

  The boxes should be removed from the molten paraffin and allowed 1 - 2 minutes to cool. As soon as the excess paraffin on the surface of the box has been absorbed by the timber and the box is "dry", but still hot, it can be painted inside and out with an acrylic sealer. Painting the inside of the box is not necessary, but if this is to be done it will help keep the boxes free from burr-comb in later use. Boxes should be stacked in a manner not to allow contact with each other while drying.

- **Storage of clean boxes**

  All boxes that have been wax-dipped should be identified with the date of wax dipping to help assist in the future management of the apiary. This will prove helpful in the future should any outbreaks of disease be found elsewhere in the apiary.
WAX DIPPING VAT

Instructions
These instructions are to be read in conjunction with the industry approved protocol for wax dipping.

Power supply
A 15 amp power outlet is required for operation of the vat. Should a suitable power outlet not be available, arrange for a qualified electrician to install a 15 amp power outlet. Warning: Do not operate the vat using a 10 amp power supply as electrical wiring may be damaged resulting in an electrical fire.

Operating Instructions
Install the vat near the power outlet in a well ventilated and covered area away from naked flames, rain and moisture.

Place the wax in the vat and replace the lid. Turn on the power supply and adjust the thermostat to the 90°C setting. The red neon light on the control box near the thermostat will indicate that the heating elements are operating. When the wax has melted add extra wax to bring the level of wax to 20 cm below the top of the vat. Do not fill above this level as frothing can occur when dipping hive equipment, which may cause the wax to overflow.

When the wax is liquid, increase the temperature setting on the thermostat to 155°C which will raise the temperature of the wax to 140°C. This is the correct operating temperature for wax dipping. It usually takes between 30 minutes to one hour to increase the temperature of the wax from 90°C to the operating temperature.

As the wax reaches operating temperature highly flammable vapour can be seen rising from the wax.

Install the lid in the draining tray position securely and commence wax dipping.

On completion, turn off the power supply and allow the wax to cool to just above setting point of the wax. Drain the wax off into wax moulds and allow to set.

Debris in the bottom of the vat is to be removed and disposed of.

Note
1. The wax dipping vat is fitted with two thermostats:
   (i) The operating thermostat to adjust the temperature of the wax by the operator as described.
   (ii) A limiting thermostat which is set to turn off the elements should the wax overheat. The limiting thermostat can be reactivated by pushing the reset button, using a pencil, through the hole in the control box at the end of the vat. For safety reasons this thermostat should not be tampered with.
2. If the wax dipping vat fails to operate correctly return it to the hirer for service.
3. Wax dipping vats are available for hire from John L Guilfoyle (WA), 1 Wildon Street, Bellevue.

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