THE THERMO-LIGNUM PROCESS

I would like to present you firstly with a small introduction to the one problem that unites all restorers and conservators, woodworm damage!

And secondly an outline of what I believe to be the solution to this problem, THE THERMO-LIGNUM PROCESS.

In doing this I will share my findings on the dangerous drawbacks of nearly all of the traditional methods of woodworm treatment.

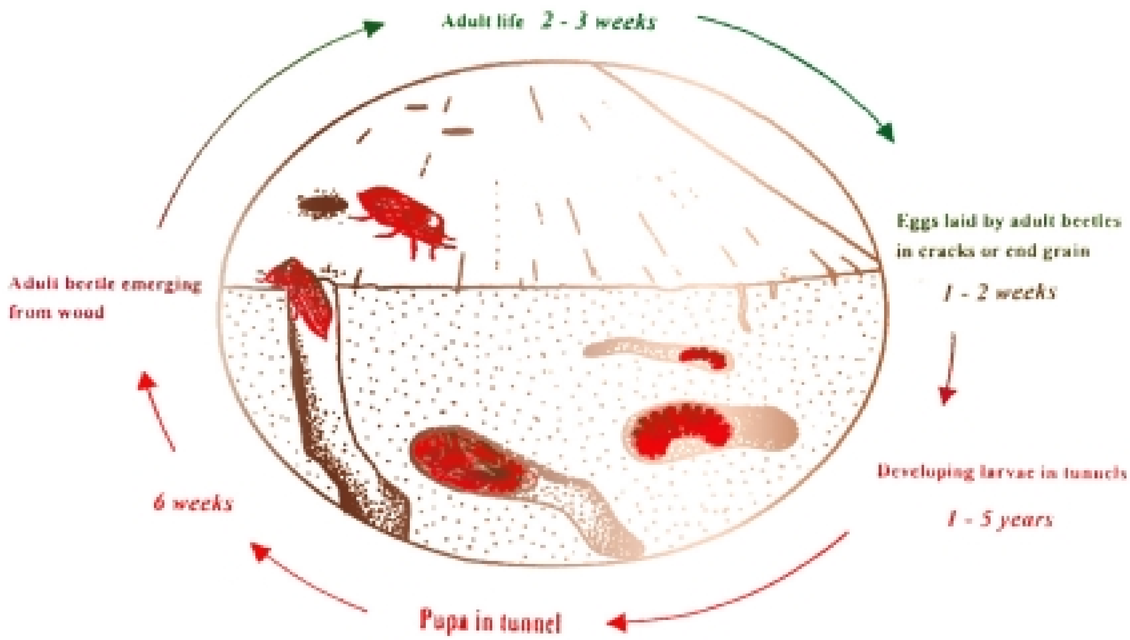
The Thermo-Lignum process is a forward thinking solution that gels with the professional and ethical philosophy of the British Antique Furniture Restorers Association. It also reflects the well respected code of ethics of the United Kingdom Institute for Conservation.

To begin with then I would like to open with a quote taken from David Piniger's paper to the 1996 UKIC conference;

"The Greeks and Romans complained of "worms" which devoured their wall hangings and furniture and sometimes caused their houses to collapse.

Archaeological remains on some Roman sites show structural timber with serious damage by woodworm".

"Through the 15 centuries since then, a succession of pests has continued to compete with man in his domestic environment".



As you can see from the above picture taken from David Pinnigers book “Insect Pests in Museums” The grub matures to a stage where it is ready to lay eggs outside of the timber in the 2-3 weeks of adult life spent in the open air. Some restorers could wait for years to ever see a beetle, and if you see one then it is already probably too late.

The damage is caused in the period shown in my illustration in red. This is the period of 3-5 years the grub spends eating its way along the fibres of the timber below the surface.

One thing that is very distinct about the damage caused by this insect is that it is totally irreversible and more often than not quite invisible. All we see are the flight holes left by the emerging beetles when they have feasted on the treasured heirloom and the damage is already done.

As the picture of this drawer bottom clearly shows the destruction this grub can reek under the surface before even being detected is horrendous.

FUMIGATION;

Fumigation has been extensively used to control insect parasites.

Three types of gas are principally used to fumigate artifacts that are infested, Methyl Bromide, Phosphine and Carbon Dioxide. The techniques used by Rentokil, Fumabug and some other companies are all basically the same.

The infested artifacts are placed within a plastic “Bubble” which is in effect a Microenvironment. These bubbles range in size from a few feet across to large enough to contain 12 pallets of furniture. The objects are sealed within this bubble and as much as possible of the air is excavated using a vacuum pump.

Once this partial vacuum has been achieved the chosen gas is introduced until the atmosphere within the bubble is as near saturated as possible. Methyl Bromide and Phosphine are highly poisonous to the insect population they come into contact with whereas Carbon Dioxide kills by asphyxiation.

Methyl Bromide is described as a colourless gas (or volatile liquid) with an odour resembling that of Chloroform. It is highly poisonous and used in some industries as a solvent.

As recently as 1994 it was accepted that Methyl Bromide could interact with some materials;

“Polished metalwork was prone to tarnishing, rubber and some types of plastics have been known to show signs of degradation,”

“ There can be an odour akin to that of rotting cabbage given off when some organic materials such as wool leather and horse-hair are treated, which in itself shows some evidence of degradation of the material”

(Rob Paynton and Kate Starling Cons/news#53mar1994) Phosphine is a highly flammable gas with a distinct fishy odour, and whilst it is lethal to the insects that come into contact with it, it is also soluble in water!

Timber used in the construction of antique furniture can contain 5-15% water within its structure.

With Phosphine being water soluble it is reasonable to assume that after treatment we would be left with an object that contained 5-15% Phosphine solution.

This is of course also a definite “poke in the eye” for the reversibility argument.

Finally comes Carbon Dioxide , not actually anywhere near as dangerous to objects as the two gases listed above.

It therefore needs a much longer fumigation period, up to 21 days in fact, and during this three weeks a concentration of 60% CO_2 and a temperature of 15-20oC has to be maintained.

Then of course the Methyl Bromide, Phosphine and Carbon Dioxide have to be released into the atmosphere contributing to the “Greenhouse Effect” and poisoning the air we all breathe.

Not really a very responsible approach from a group of professionals charged with the responsibility of maintaining a responsible ethical public image.

Health risks associated with the above gases are profound. These include Digestive disorders, headaches, sore eyes, sore throats, nausea, dizziness, allergies, asthma etc.

LIQUID INSECTICIDE;

In the last 6 or 7 years I have personally used about 5 or 6 gallons of commercially prepared woodworm fluid and treated virtually every piece that passed through my workshop.

The evaporation of this type of solvent-based insecticide vehicle is rapid, as I’m sure you all know. I now find myself in the position of horrified amazement at the health risks I have imposed on myself.

A B MACLEISH in his 1972 publication “The Care of Antiques and Historical Collections” starts his section on insect treatment with the stern warning

“*All Insecticides, fungicides and fumigation materials are TOXIC some are extremely so”*

And he goes on to say

“*Very few Insecticides are considered safe to use any more and the list is shrinking”*

Chemicals contained in these preparations can include Pyrethrum, Dichlorvos, Permethrin and Bendiocarb.

Side effects from inhalation and skin contact range from "*Mild acute symptoms, to chronic illness and even death"* according to SIMON KNELL in his 1994 publication Care of Collections.

By this we mean skin irritation, contact Dermatitis, asthma, conjunctivitis, and with prolonged exposure Liver damage!

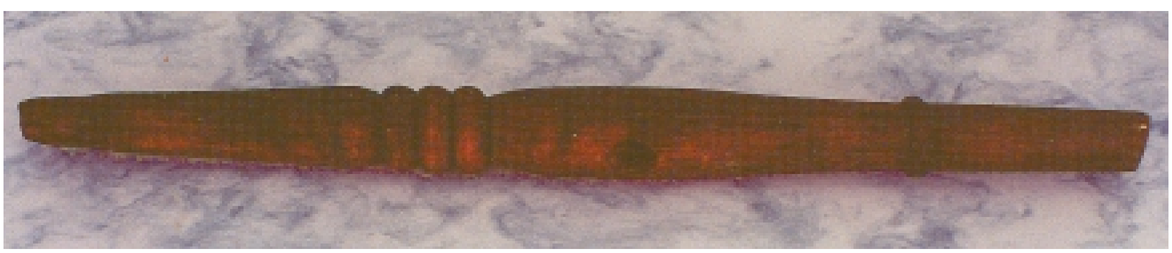
Having found the evidence condemning pesticides as extremely harmful to use I then began to wonder if the risks could be justified.

Further reading of ROBERT F McGIFFIN's "Furniture Care and Conservation" soon lead to the statement

"*Unfortunately this method may produce few or no results because the liquid insecticide should come into ACTUAL CONTACT with the woodborers to its work"*.

He was of course referring to the Method, which I am sure most of us, use on a regular basis. The injection of Insecticide into the flight holes left by the emerging beetle.

Prompted by this I decided to attempt to measure how far this Insecticide would travel into an infested piece of timber. For this experiment I chose a beech Three-ring leg removed some years ago from a late 19th Century Slat backed kitchen chair.



A coloured dye was needed to track the progress of the fluid and spirit soluble blue stain was chosen for this purpose. The relative viscosity was matched using the eyedropper and inclined glass plate method. The dyed solution was then injected into the flight holes in exactly the same way one would treat woodworm. Three applications were applied taking a total of 45 minutes. This roughly translates to 6 or 7 hours treating a single slat back chair. A thorough regime and one to which I'm sure we all aspire. But I did not want to influence the results by not applying enough fluid.

The leg was then left 24 hours to allow any internal capillary action time to complete its work. The leg was then band-sawn into 4 pieces along its length and it was possible to see where the injected fluid had reached.

I have to admit I went into this experiment as a pessimist but I was still amazed by the results.

As you can easily see from the pictures the preparation has made very little progress through the possibly tens of yards of tunnels.

Not only are there metres of seemingly endless tunnels, but also huge amounts of frass left by the burrowing grubs. This frass is extremely dry and highly absorbent soaking up much of the fluid just below the surface.

We also could be treating the infestation at any or various stages in the beetles' development. For the fluid to come into contact with the developing grub it needs to be near the surface, a mere 2% of the total lifecycle! .

In truth we cannot even rely on the pesticides remaining active as they are intrinsically Volatile and therefore may not remain potent for the necessary 3-5 years.

Not only is this method retrospective it is also ineffective.

THERMO-LIGNUM PROCESS

The use of high temperatures to de infest objects is by no means a new concept. Howard and Marlett published papers in 1902 on the subject and the technique of placing insect, plant and other objects into an oven overnight. Articles were heated to 60 degrees C for 12 to 24 hours. This practice was relatively widespread within the museum sector by the late 1950's.

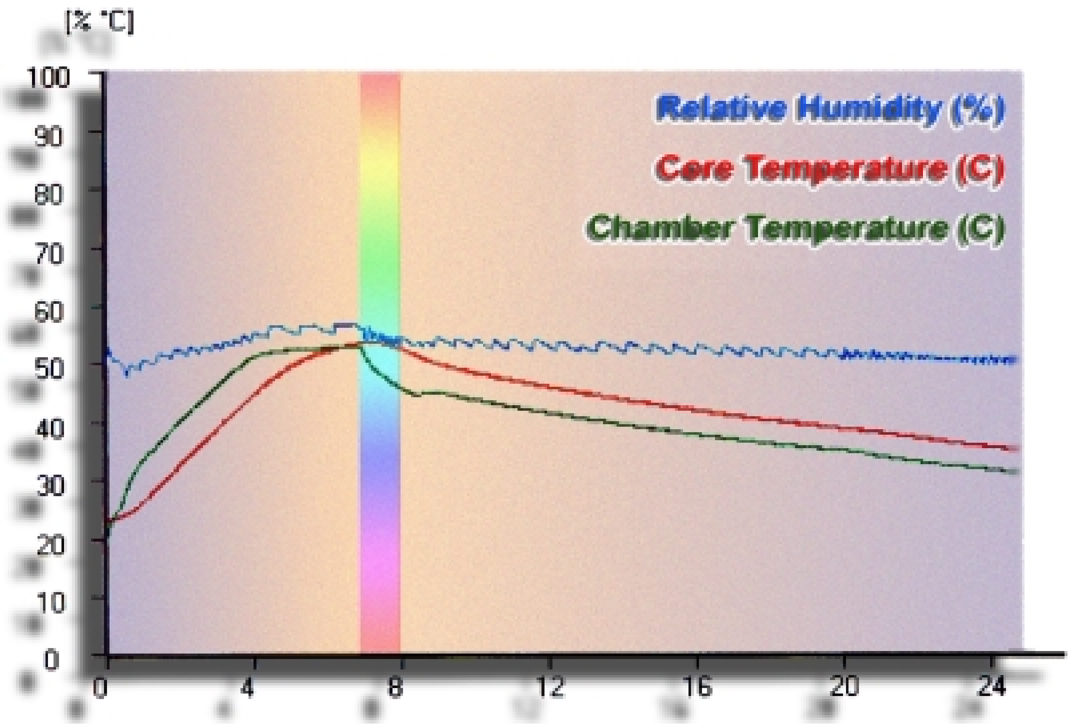
The early pioneers of high temperature insect treatment however were working with temperature and temperature alone. No control over Relative Humidity was built in to the procedure and consequently wooden objects were losing moisture from the timber. Warping and shrinkage problems were inevitable and ultimately irreversible rendering the process of no use to the Furniture Restorer.

The process relied on knowledge more recently tested by Strang and Fields in 1992,

Death occurs at anywhere between 42 and 55 degrees Celsius. This is due to certain chemicals present in the insects nerve membrane breaking down, eventually causing its metabolism to fail. As you can see death occurs in the common furniture beetle at 50 oC.

Thermo-Lignum's treatment chamber controls its environment using very sensitive and responsive temperature and Humidity sensors.

These are linked to a computer, which constantly monitors and adjusts the atmosphere. This ensures the stable Humidity necessary to stop the timber from importing and exporting moisture during the process.



As you can see from the Graph the chamber temperature increases from the ambient starting point of 22 degrees steadily up to the target temperature of 52 degrees. It reaches this temperature after 4 hours. The core temperature rises at the same rate until a temperature of 52 degrees is reached 7 hours into the run. You can also see from this graph that as soon as the core temperature reaches the target temperature the chamber begins to cool. The core temperature obviously lags a little behind that of the chamber but the difference between these two temperatures is always kept to a minimum, this means that expansion and contraction stresses are not created within the structure of the timber being treated. The area highlighted here is the period that the core temperature is up to 52oC and death occurs to the infestation of Common Furniture Beetle.

The most important feature of this graph is the blue line showing the Relative Humidity within the chamber, which as you can see remains within the 48-55% range, the crucial factor as far as moisture migration is concerned.

The Thermo-Lignum technique was developed in Germany and perfected between 1984 and1989.

A patent was granted in 1994 and a UK company formed.

In September 1994 Thermo Lignum UK limited opened its doors with a launch seminar in co-operation with BAFRA.

In 1995 the 100% kill rate was verified in controlled tests by the Central Science laboratory.

Also in that year, R.E. Child was happy to commit arguably the most delicate of finishes, Lacquer-work, to the chamber.

By now the National Museums and Galleries commission, an organization very much on the leading edge of conservation research in Great Britain, were happy to endorse the process.

In 1996 the Victoria and Albert museum used Thermo-Lignum process for the treatment of its photographic collections.

1996 also saw the first whole-building treatment.

De-infesting structural timbers and furniture in situ at Weald & Download Open Air Museum.

The company was responsible for treating the tributes to Diana Princess of Wales that were to be saved for the nation in 1997.

1998 saw the Victoria and Albert museum use Thermo-Lignum to treat their highly important and extremely delicate collection of Grindling Gibbons' carvings.

To summarize we seem to have a 100% effective method of killing all insects living in any form of organic material,

WITHOUT; Using any toxic chemicals,

WITHOUT; Imposing any health risks on yourself,

WITHOUT; Contributing to an environmental problem or creating a new one.

WITHOUT; Undermining the structural integrity of the object being treated

Also WITHOUT affecting the surface whether inlaid polished or gilded.

The existence of this treatment is not just another alternative available to us.

It is the only ethical safe and sensible choice for the next generation of furniture Conservator/restorers.

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