



Preserving Bamboo with Borates

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Editor: Based in Chiang Mai Thailand, Thomas Singer serves as technician with Meribah Ram Pump, <http://meribah-ram-pump.com/index.aspx?mn=0>, the appropriate technology component of the Rain Tree Foundation (<http://raintree-foundation.org/RainTreeFoundation/Welcome.html>).

Working together with Thai Care, the children's ministry of the Rain Tree Foundation, Meribah Ram Pump is engaged in various community development projects in northern Thailand. A major focus is to make simple, sustainable technology, such as ram pumps and bio sand water filters, available to those who have limited access to water and electricity.



Bamboo plays a key role in our work as well. Meribah enhances local livelihood opportunities by promoting the production and sale of bamboo products such as handicrafts, and has also constructed a coffee shop almost entirely out of bamboo.

Bamboo is widely available in the area and local people understand its use, including for the construction of traditional homes. But because of damage from bamboo pests, such as borer beetles and fungi, such homes must be rebuilt nearly every two

years.

A related problem includes the scarcity of bamboo due to overharvesting. Unfortunately, as those who can afford it rebuild their homes with concrete, skills for constructing traditional bamboo houses are likely to be lost.

In response, we have determined that bamboo treatment and preservation offers an opportunity to help:

- prevent over harvesting of bamboo and create sustainable bamboo utilization;
- preserve traditional building techniques;
- offer durable bamboo housing and products; and
- encourage the production of bamboo handicrafts and other marketable products.

Our web research about bamboo preservation options led us to the Environmental Bamboo Foundation (EBF), <http://www.bamboocentral.org/index1.htm>, based in Bali. The foundation's website offers the downloadable *Vertical Soak Diffusion Treatment Manual*

(<http://www.bamboocentral.org/index1.htm>), an excellent source of information that explains practical bamboo preservation procedures.



With information from the EBF manual, we were able to utilize the boric acid/borax formula and replicate other key steps. We have also improvised certain variations of our own, including the use of a solution bath in which culms (bamboo poles) are soaked

horizontally as opposed to having the solution injected into them vertically.

Having successfully adapted EBF's bamboo preservation technique to our work in Thailand, the following is an overview of key materials and steps, including our own observations and adaptations.

Required facilities and tools for bamboo preservation with borates

- A watertight vat, trough or pool (protected from the sun and rain) for soaking the bamboo in borate solutions. The size of treatment containers may vary according to the demands. Our vat, measuring 6 m (19.7 ft.) long x 1.5 m (4.9 ft.) wide x 1 m (3.3 ft.) high, is designed to handle large amounts of bamboo to be used for construction purposes.
- Metal grate that can be placed atop the soaking vat.
- Eye protection.
- Rubber gloves and boots.
- Water.
- 200 liter (52.8 gallon) plastic container for mixing and storing the solution.
- Dye.
- Plastic containers for mixing and measuring materials.
- Handsaw.
- Iron T-bar with a spearhead welded to the end (length depending on the bamboo to be treated).
- Wooden stick for mixing solution.
- Hydrometer (an instrument used to measure the specific gravity or relative density of liquids).
- Brushes (or coconut husks) for cleaning.
- A piece of cloth stretched over a frame, used for skimming debris off the surface of the solution.
- **Tim-Bor** [*Editor: Tim-Bor is a commercial wood preservative that works as an insecticide and fungicide, utilizing disodium octaborate tetrahydrate, a natural borate compound, as the active ingredient*] or **boric acid and borax** (used in combination as a substitute for Tim-Bor).
- Well-ventilated space unexposed to sun or rain, for drying the bamboo poles.

Harvest of Culms

The EBF manual stresses that the best season to harvest culms is the period immediately **after the rainy season** when starch content in the bamboo sap is low (starch is a favorite food for bamboo pests). This season occurs in November and December in northern Thailand. Conversely, it is not a good idea to harvest poles during the period that shoots are being produced, when starch content is at its peak.

The EBF manual also recommends using **3- to 5-year-old** bamboo. Younger culms are too weak, while poles older than five years tend to be too hard, having inner culm walls that may be impermeable to the treatment solution.

Instead of using a machete to cut the culms, we have discovered that cutting bamboo cleanly **with a saw** will keep capillaries in the wood open, allowing the solution to penetrate better.

Preparing the solution

- If **Tim-Bor is available**, mix 25 kg (one bag) with 225 liters of water to produce a "10% weight for weight solution."
- Instead of purchasing Tim-Bor, our large batches of **borate solution** are made by slowly adding 50 kg of **boric acid** and 75 kg of **borax** to 700 liters of **water** while stirring the solution. Based

on this ratio of boric acid, borax and water, depending upon the amount of solution needed per situation, the amount of borates mixed proportionately with water can be adjusted. When all crystals are dissolved, you will have a 17% boric acid/borax weight (or mass) solution that is equivalent, in borate concentration, to a 10% Tim-Bor weight solution.

Editor: EBF's bamboo treatment manual offers limited information about the availability of Tim-Bor in Indonesia and Thailand. Related to the comparative expense of using either Tim-Bor or the boric acid/borax mixture to treat bamboo, depending upon the location in Thailand, Tim-Bor costs approximately 85 baht (\$2.58 US) per kg or 2,125 baht (\$64.39 US) for a 25 kg bag. A 25 kg bag of boric acid costs approximately 1,500 baht (\$45.45 US) and a bag of borax of equal weight costs approximately 950 baht (\$28.78 US).

To better manage the composition of the solution, it is easier to mix smaller volumes of higher concentrated solution in a container (e.g. 200 l) and then pour the solution into the pool, adding the volume of water needed to attain the correct concentration of the Tim-Bor or borax/boric acid solution.

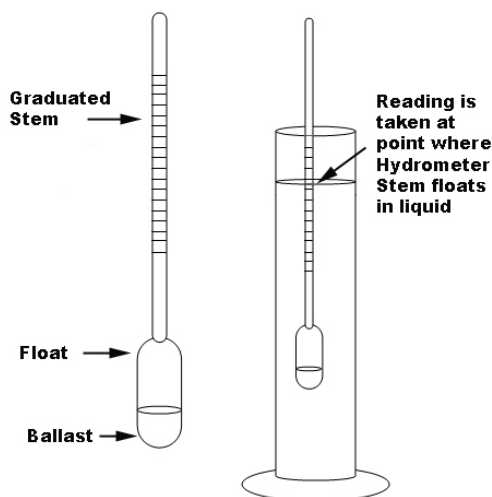
Editor: The EBF describes Tim-Bor as "more environmentally friendly than other wood preservatives currently used" and superior to boric acid "because it diffuses and penetrates bamboo or wood better and faster." However, the Tim-Bor label prescribes caution in the use of the product, specifically warning against ingesting or inhaling the material and cautioning users to avoid contact with eyes or clothing. The same precautions should be applied to all borate solutions.

In our experience, adding warm water to the container aids in dissolving Tim-Bor or boric acid/borax powder. However, before checking the composition of the solution in the pool with a hydrometer (see below), the liquid must have cooled down completely.

Tinting the solution

While mixing the solution in the container or vat, add adequate amounts of dye, such as red or green, for easier identification of treated poles.

Measuring the solution



To monitor the level of borates in the treatment solution, the EBF manual recommends using a **salt measuring hydrometer** "under normal temperatures of your region" as opposed to measuring during either extreme hot or cold weather conditions. We have found that the optimum air temperature range to measure the solution is 20-25 degrees C (68-77 degrees Fahrenheit).

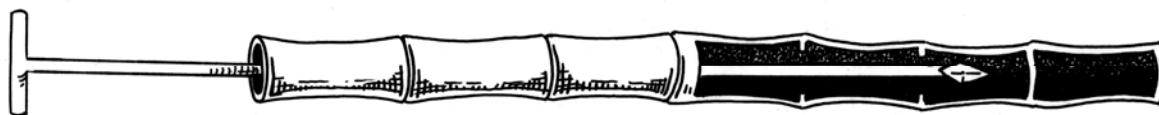
To test with a hydrometer, slowly add the borate solution to a test container (bucket, etc.), so that you avoid air bubbles in the solution prior to lowering the hydrometer into the solution. Before releasing the instrument, allowing it to partially float, give the hydrometer a quick twirl by spinning its top shaft. This action will help deflect air bubbles which can accumulate around the hydrometer, affecting its buoyancy and resulting in a false reading.

A hydrometer is read similar to a thermometer. Note number where the solution crosses the scale. A well-calibrated hydrometer should have a reading of **1.045** (plus or minus 0.005).

Preparing the bamboo poles for the treatment

The EBF manual recommends the following:

- Thoroughly clean the outside of the bamboo culms with either water and brushes, coconut husks and sand, or a product similar to Scotch Brite.
- Prepare a long rod with a spear head welded to one end. The spear head should be approximately 10 cm long with a diameter of 2-3 cm at the base (depending on the width of the bamboo poles). This modified iron rod can be used to punch holes easily through the node diaphragms separating the internodes. *[Editor: see adjoining illustration of a cut-away view demonstrating technique for hollowing bamboo culms]*. Piercing the diaphragms will prevent clogging from inside of the culm and allow the solution to move freely throughout the interior. Larger diameter holes are recommended to prevent air bubbles from forming during the filling procedure. Fortunately, larger holes will not diminish the strength of the culm.
- To facilitate the hollowing process, place one end of the bamboo against a study wall and force the iron rod into the other end, punching holes through all of the nodes.



Treatment

The EBF injects borate solution into culms arranged in a vertical position. However, for convenience, we prefer to use the following soaking method:

- Add borate solution to the soaking vat. We have found it best to add enough solution to fill the vat approximately 1/3 full. Then arrange the bamboo poles into the container until the displaced solution rises almost to the top of the vat.
- While placing poles into the vat, be careful to displace as many air bubbles as possible. Also, keep the culms submerged by placing **weights on top of the poles**. Several 50-liter containers full of water work well as weights.
- Allow the bamboo to soak for at least **two weeks**.

Removing the poles and reusing the solution

- To save the borate solution for reuse, remove the bamboo poles before placing a metal grate on top of the vat. Immediately stand the freshly treated bamboo on top of the grate for at least one hour, to allow as much solution as possible to drain out of the poles back into the vat.
- Use a simple screen to remove debris and other materials suspended in the solution. A screen can be made from cloth, such as an old tee-shirt, stretched across a small frame.
- The borate solution can be used over and over. *[Editor: according to the Tim-Bor label, wastes resulting from the use of the product may be disposed of on site or at an approved waste disposal facility. However, the pesticide is toxic to fish and wildlife. Tim-Bor or Tim-Bor solutions that are spilled or applied to plants or cropland may kill or seriously retard*

plant growth. The label also warns against applying the product or solutions directly to surface water and discharging the effluent into streams, ponds or other bodies of water or into sewer systems].

- Before reusing a batch of solution, check the borate level with a hydrometer. If the reading is **less than 1.040, add more solution**. Should the scale show a reading **more than 1.050, add more water**, checking and adding water until the optimum concentration is reached.

Drying and storing

In a well ventilated, covered area, allow the bamboo to dry in a **prone position for 4-6 weeks** (length of time depending on the humidity). This must be done in the shade, as direct exposure to hot sun while drying can split the culms.

Testing

A simple way to test the success of the treatment is to capture some bamboo borers and place them into a closed (but not airtight) container along with two pieces of bamboo; one treated and the other untreated. After a few days any untreated bamboo will show obvious signs of infestation. This is the simplest, most effective means of monitoring the efficacy of the treatments and should be repeated with each finished batch.

Occasionally we find a few holes made by borers in treated wood. However, we have learned that this results from a few remaining bugs which are actually dying from the borax treatment. Fortunately, there will be no additional infestation as the treated bamboo remains unpalatable to the pests.

Summary

Our method is only one of many techniques that can be used to preserve bamboo. Other approaches include the vertical injection method recommended by EBF; pressure treatment; and smoking.

With borate treatments, bamboo can reportedly last 15 to 20 years or longer. Over the past two years we have implemented the borate soaking method to treat bamboo used to build two houses as well as to produce furniture and handicrafts. As the work remains pest free, we invite others to see for themselves how such treated bamboo lasts longer.

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References

Alibaba.com. Tim-Bor Wood Preservatives (product photo). http://www.alibaba.com/product-free/247564597/Tim_bor_Wood_preservatives.html.

Chomwarangkhan Veerachot (Chemical Fareast, Chiang Mai), telephone conversation. December 11, 2009.

Environmental Bamboo Foundation. Vertical Soak Diffusion for Bamboo Preservation, Third Edition. <http://www.bamboocentral.org/>.

Meribah Ram Pump. About Us, Our Mission. <http://meribah-ram-pump.com/mission.aspx?mn=1&sm=1-0>.

Nisus Corporation. Tim-Bor Professional Insecticide and Fungicide Label. <http://www.nisuscop.com/portal/page/portal/Nisus/categories/pmp/products/timbor>.

Numchai Loyritthiwuthikri (Chieng Thai Trading, Bangkok), telephone conversation, December 15, 2009.

Oberg, Ralf (Rain Tree Foundation), e-mail communication. December 16, 2009.

Rain Tree Foundation. Community Development. <http://www.raintree-foundation.org/CommunityDevelopment/CommunityDevelopment/Welcome.html>.

Sobel, Christi. Bamboo cut-away illustration. Submitted January 21, 2010.