International Plant Protection Convention
Protecting the world's plant resources from pests
www.ippc.int

No. 04 / 2014 ENG

Dielectric heating as a treatment for wood packaging material

Dielectric heating is a newly approved treatment for wood packaging material that uses heat from electromagnetic energy to disinfest the wood. The International Plant Protection Convention's Commission on Phytosanitary Measures (CPM) approved dielectric heating as a phytosanitary treatment for wood packaging material as part of the International Standards for Phytosanitary Measures (ISPM) No. 15, *Regulation of wood packaging material in international trade*.

This quick guide provides additional information on dielectric heating as a phytosanitary treatment for wood packaging material. It is for information only.

What is dielectric heating?

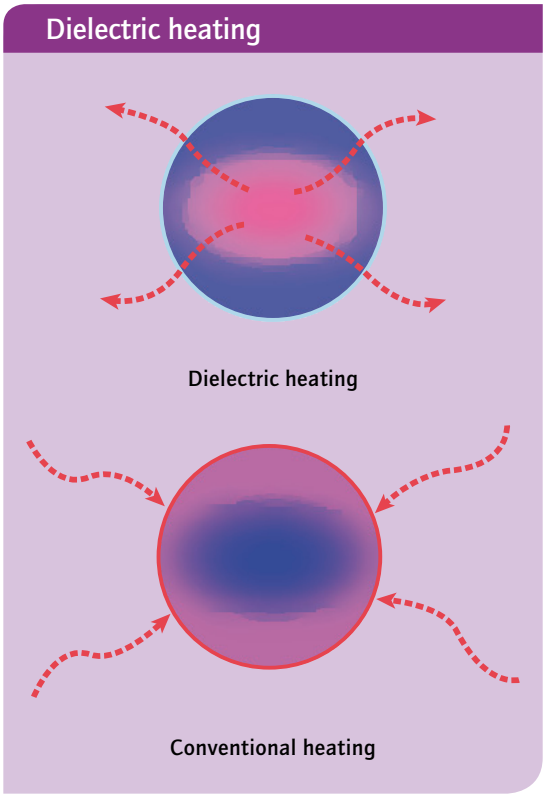
Dielectric heating uses electromagnetic waves – such as microwaves (MW) or radio-frequency (RF) waves – to create heat. Some of the electromagnetic energy converts into heat when it interacts with moisture, just like in the ordinary kitchen microwave oven.

How does dielectric heat treat wood packaging material?

When wood is heated to the temperature, and within the time period, specified in ISPM 15 Annex 1, the heat kills the pests in the wood that need to be eliminated.

Because wood contains moisture throughout its structure, dielectric heating simultaneously heats wood across the whole profile of the wood. As a result, dielectric heating differs from conventional heat treatment methods like air or kiln heating because those methods raise surface temperatures more quickly than the core. It takes time for heat to be conducted from the surface of the wood to the core and so with conventional heat treatment it is necessary to monitor the temperature of the core of the wood to ensure that sufficient heating has occurred to eliminate the pests.

In contrast, when using dielectric heating, the temperature of the wood can be measured at its surface or by monitoring infrared images that show heat levels of the wood's surface. With dielectric heating, the surface of the wood is often cooler than the core because the outer surface cools first as heat radiates into the surrounding environment. Because of this, if you record the target temperature of 60°C at the wood's surface you can be assured that the temperature is equal or higher inside.



Dielectric heating works across the entire profile of the wood, while conventional heat has to be conducted into the wood from the surface.

Is the treatment approved?

Yes. The Commission on Phytosanitary Measures[1] approved dielectric heating in 2013 as an effective treatment for wood packaging material (ISPM 15). The CPM adopted the treatment schedule based on the conclusions of the Technical Panel on Phytosanitary Treatments and recommendation by the Standards Committee that dielectric heating is an effective phytosanitary treatment of wood packaging material.

Dielectric heating is one of several treatment options for wood packaging materials approved in ISPM 15. If an NPPO chooses to use this treatment, it should approve the treatment providers and specify or approve the treatment schedules to ensure that they are in line with ISPM 15. The specific method for achieving the required temperature (including length of exposure to the electromagnetic energy) will vary for each facility and would be designed and tested by an appropriate treatment facility engineer.

Is this an alternative to methyl bromide?

In 2008, the CPM adopted a Recommendation on replacement or reduction of the use of methyl bromide as a phytosanitary measure. Dielectric heating is an alternative treatment to methyl bromide (MeBr) for phytosanitary treatment of wood packaging materials.

What other applications does dielectric heating have?

CPM-8 (2013) approved dielectric heating for use as a phytosanitary treatment for wood packaging material.
In addition to this CPM-approved use, dielectric heating has been used to disinfest other materials of plant origin. A specific treatment schedule is required for each material. Some materials that may be disinfested with dielectric heating include: raw wood (packaging materials, trunks, etc.), processed wood (furniture pieces, artistic objects, icons, etc.), paper (books, archives, etc.) cloth (carpets, tapestries, paintings, etc.) and food (such as cereal grains, legumes, dry fruits, etc.). Only wood packaging material has a globally approved phytosanitary treatment schedule at this time (February 2014). The other uses are mentioned here, for information only, because some national regulatory agencies may wish to coordinate use of a dielectric heat treatment facility for various purposes.

What type of facility is needed?

This depends on the needs of the treatment provider, including the volume of material and whether the facility would be used only for wood packaging material or for a variety of applications. There are two methods of exposing material to electromagnetic wave irradiation:

- Batch (chamber) facilities:
  The material to be treated is placed in a compartment and exposed to electromagnetic waves. Batch systems can be either permanent or portable. This approach allows a large quantity of solid wood packaging material can be treated at a time.

- Continuous (conveyor) process facilities:
  A conveyor belt moves the product through a treatment irradiation chamber. The speed of the conveyor belt adjusts the product's exposure time to the electromagnetic waves. This system may be optimal for treating smaller wood components and can be designed to treat constructed pallets.

Both systems (batch and conveyor) can be installed either:

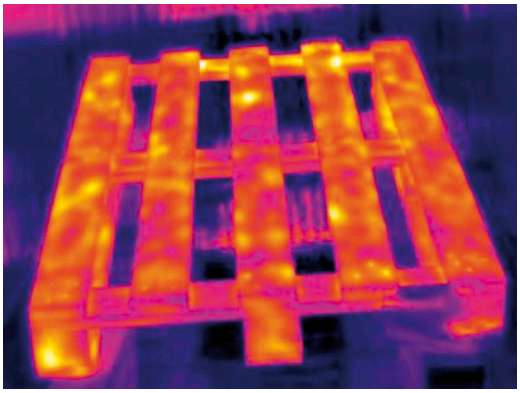
- at the end of a production line (for example, the last step in production of wood packaging material), or
- as a stand-alone operation where wood packaging material (and other materials) can be sent for treatment.

Is dielectric heating cost-effective?

The cost of treating wood packaging material with this method will vary depending on the design and approach of each facility. It would be advisable to complete a cost-benefit analysis to consider the advantages and disadvantages over other treatment options.

---

1 CPM-8 (2013) report is available at www.ippc.int/cpm8report



A continuous process (left) allows a constant throughput of material such as pallets. Infrared imaging can be used to monitor surface temperature and ensure temperature requirements have been met. (Photos: EMitech srl)

Initial start-up costs for a facility depend on the desired production volume and rate of treatment. These factors determine the number and size of electromagnetic wave generators. Costs will vary depending on whether the facility is designed to treat only wood packaging or a variety of materials.

Local electricity prices and total energy consumption, based on the initial condition of the wood, can also affect cost. Wood with higher moisture content requires greater energy input because it takes more time to heat up larger amounts of water.

Speaking generally, dielectric heating may be a cost-effective way to sanitize materials using heat in some cases because:

- **Treatment times are shorter:** Target temperatures are achieved rapidly because electromagnetic waves heat the full profile of the material.
- **Handling is reduced:** Fewer human resources are needed, especially in an automated in-line facility.
- **Energy consumption is lower:** Short treatment times reduce energy consumption. In addition, dielectric heating is a just-in-time process: facilities can be turned on and off according to production needs. No preheating time is needed, and this further reduces energy waste between treatment cycles.

What is the role of the NPPO in this treatment?

It is the responsibility of the NPPO to ensure that implementation of the treatment is in line with ISPM 15 and other ISPMs. The NPPO must ensure that the facility complies with a treatment schedule that meets the requirements of ISPM 15 Annex 1, including some form of temperature monitoring to verify that the wood packaging material reaches 60°C through its entire profile for one minute, within 30 minutes of the start of the treatment. ISPM 15 specifies maximum dimensions for the wood used in wood packaging material treated in this way, based on the efficacy data available at the time of treatment adoption.

As with other phytosanitary treatments, options for making sure that treatment is applied appropriately may include: directly managing the treatment application; supervising external providers (options may include authorization, auditing, registration, etc.); providing training, providing guidance or standards for the application and monitoring of dielectric heating; registration of treatment providers; etc.

How to start using dielectric heating

To start using this treatment, service providers should contact their local NPPO, or NPPOs should contact possible service providers to explore options for designing a facility that would meet the need to treat wood packaging material in line with ISPM 15. NPPOs should ensure they have systems in place to authorize and supervise the application of the treatment.

Treatment options for wood packaging material

Treatment options

- These options apply to units of wood packaging material or to pieces of wood that are to be made into wood packaging material.
- Regardless of the type of treatment, wood packaging material must be made of debarked wood.
- See ISPM 15 for all specific treatment details; this graphic is for information only.

Heat treatments

- Bark can be removed before or after treatment
- Temperature should be monitored at the location of the wood likely to be the coldest.
- Treatment schedules should be specified or approved by the NPPO.

Methyl bromide (MB)

- Bark must be removed before the treatment.
- Wood pieces must be smaller than 20 cm cross-section at smallest dimension.
- Note that CPM adopted a *Recommendation on replacement or reduction of the use of methyl bromide as a phytosanitary measure*.
- Contracting parties are encouraged to use other treatment options.

Conventional heat (HT)

- Conventional steam or dry kiln heat chamber.
- Core temperature is likely to be the coldest.

Dielectric heat (DH)

- Surface temperature is likely to be the coldest.
- Wood must not exceed 20 cm across the smallest dimension (including bark).

Microwaves

- In 2013, when DH treatment was adopted, only microwaves had been shown to be able to achieve the prescribed temperature within the required time.

Radio-frequency waves

- RF waves penetrate wood more deeply than microwaves but also more slowly. As of 2013 RF waves had not been demonstrated to achieve the prescribed temperature within the time prescribed by ISPM 15 Annex 1.
- If RF waves can operationally achieve the ISPM 15 requirements, they can be used as an approved treatment.

About this document:

This quick guide presents information on dielectric heating as a phytosanitary treatment for wood packaging material. It was developed as a component of the IPPC National Phytosanitary Capacity Building Strategy, which was adopted by the fifth session of the Commission on Phytosanitary Measures (2010) of the International Plant Protection Convention. The IPPC Capacity Development Committee (including members from all seven FAO regions) developed this quick guide as part of the Standards and Trade Development Facility Project 350 (Global Phytosanitary Manuals, Standard Operating Procedures and Training Kits Project). Input and peer review were provided by technical specialists in dielectric heating, individuals involved in the development of the treatment and individuals with experience on relevant IPPC technical panels, and the Capacity Development Committee. It is consistent with the agreed definition of National Phytosanitary Capacity and the CPM-adopted strategy and is provided for information only.

Feedback, please:

Did you read this quick guide? Share how you used it or give comments and suggestions to improve it through a fast and easy two-question survey here: http://surveymonkey.com/s/dielectric

Your feedback will help the IPPC Secretariat and Capacity Development Committee strengthen this and other training resources.

References and Additional resources:

- International Plant Protection Convention website: www.ippc.int
  - ISPM 15: www.ippc.int/ispm15text
  - Adopted ISPMs: www.ippc.int/ispms
  - IPPC Convention text: www.ippc.int/text
  - IPPC national contact points [new link]: https://www.ippc.int/nppos
- IPPC helpdesk: irss.ippc.int/helpdesk
  - Includes a question and answer forum, frequently asked questions and links to additional resources
- Phytosanitary Resources page: www.phytosanitary.info
  - Manuals, training materials, and other resources
  - Materials posted to the page have been reviewed and noted by the IPPC Capacity Development Committee for relevance and consistency with the IPPC framework.
  - Additional materials can be contributed (in any language) through a form on the page, for review by the IPPC Capacity Development Committee.

Version 1.0
Publication date: February 2014

Contact us:
International Plant Protection Convention (IPPC)
Viale delle Terme di Caracalla, 00153 Rome, Italy
Tel: +39 06 5705 4812 | Fax: +39 06 5705 4819
Email: ippc@fao.org | Web: www.ippc.int

Editing, design and layout: Green Ink (www.greenink.co.uk)