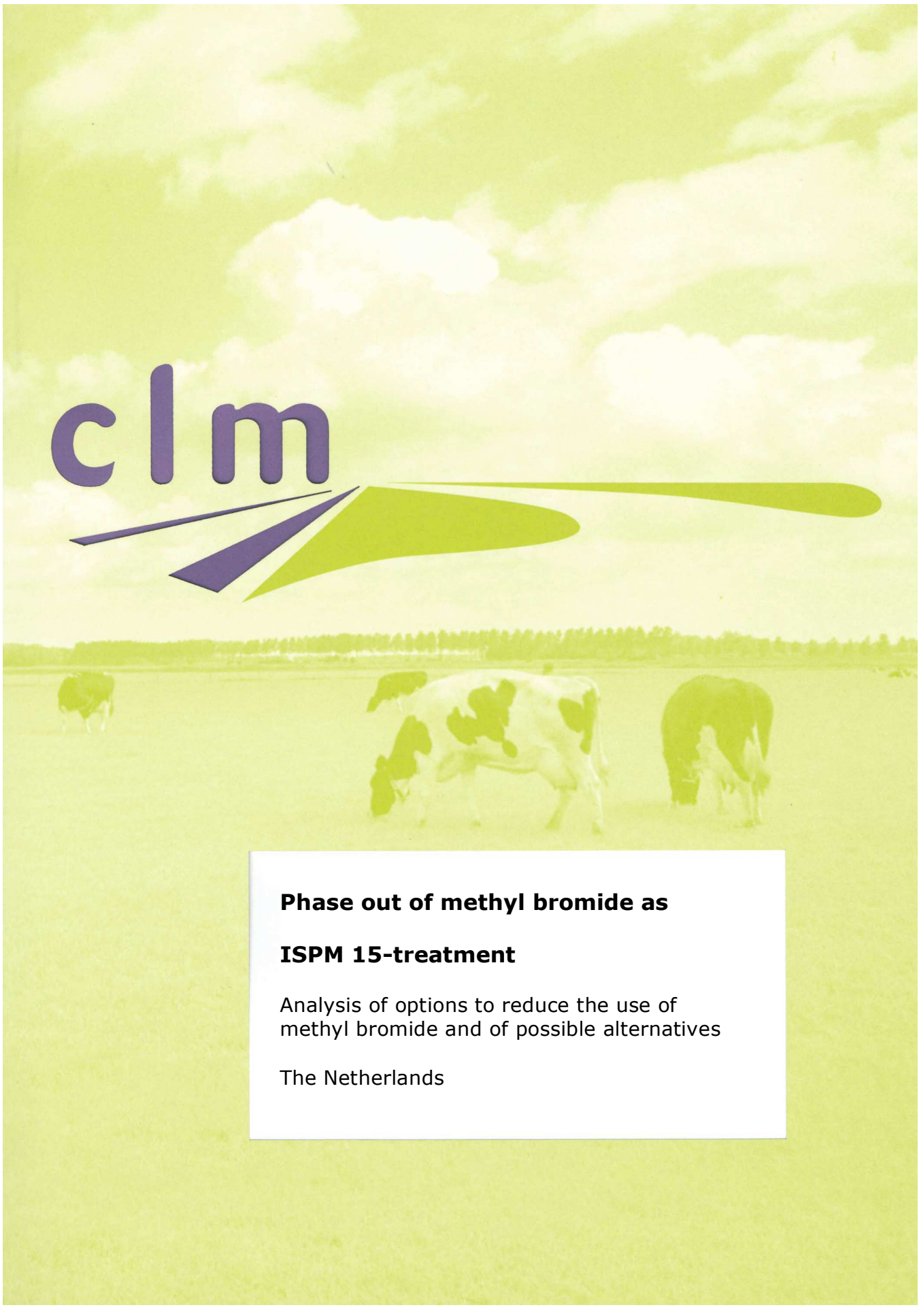

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# Phase out of methyl bromide as

# ISPM 15-treatment

Analysis of options to reduce the use of methyl bromide and of possible alternatives

The Netherlands

# Phase out of methyl bromide as ISPM 15-treatment

Analysis of options to reduce the use of methyl bromide and of possible alternatives


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# Content

# Summary

This report is intended for policy makers active in the field of methyl bromide, the Montreal Protocol on phasing out of ozone depleting substances and international phytosanitary requirements (IPPC). The report describes experiences with phasing out methyl bromide in the Netherlands.

The use of methyl bromide for Quarantine Pre-Shipment treatments (QPS) is increasing worldwide, despite the international desire to 'phase out' ozone depleting substances. Since the approval of the ISMP-15 guideline[1] by the contracting parties of the International Plant Protection Convention (IPPC) in 2002, a growing number of countries has put in place import requirements for treatment of wood packaging material (WPM) by exporting countries. Therefore, the European Union, including The Netherlands, has experienced an increase in demand for methyl bromide for export purposes. This increase in demand seems related to the growing number of countries that require WPM treatment and marking, in line with the ISPM-15 guideline. Last minute pre-shipment treatment of loaded containers with methyl bromide is a direct result of the use of untreated wood material. Containers could also require treatment according to the ISPM-15 guideline when there is doubt that treated wood has been used.

The number of imported containers with residues of methyl bromide is growing, some of these contain too high levels of the fumigant. This has resulted in food and non-food products containing residues of methyl bromide being placed on the market, sometimes exceeding residue limits.

In seeking ways to reduce the QPS use of methyl bromide for ISPM 15 in The Netherlands[2] (and worldwide), the Dutch Ministry of Housing, Spatial Planning and the Environment and the Ministry of Agriculture, Nature and Food Quality organised a stakeholder analysis to discuss the feasibility of possible alternatives. The alternatives were then analysed for their value in ISPM-15 and in logistics.

Use of methyl bromide can be limited by good housekeeping measures since WPM normally needs a one-time treatment (unless it is damaged). In Europe, there is an abundance of heat-treatment facilities and treated and labelled packaging material and pallets. Also in countries with warmer climates heat treatment can be relatively simple and cheap. Proper use and labelling of treated wood could make container treatment redundant. Heat treatment is an accepted and often used treatment for QPS and is accepted for all types of WPM. Using heat-treated wood material is also a cheaper method than fumigation of a loaded container in terms of costs per unit of WPM.

For increased prevention of methyl bromide treatment by using treated wood, international communication about ISPM-15 needs more attention. Communication should be directed to exporters shipping to countries that require treatment and

[1] The ISPM-15 guideline focuses on wood packaging material, WPM (pallets, packaging wood and wood used to stabilize cargo: dunnage).

[2] This is currently by far the largest use in NL, besides fumigation of cut flowers for export to Japan.

labelling in accordance with the ISPM-15 guideline and should be focussed on using heat-treated and labelled wood to fulfil the requirements.

In addition to preventative measures, alternatives for (container treatment of) methyl bromide are needed. Together with all stakeholders in the logistical chain two possible alternatives to methyl bromide were found favourable and were further studied: Controlled Atmosphere and the fumigant sulfuryl fluoride. Both alternatives were found to be valuable for logistics, both in terms of treatment time, costs and investments needed for new facilities. However, for placement on the ISPM annex-I both alternatives lack sufficient (public) data on effectiveness for the wood products that ISPM-15 focuses on, and a standardised treatment protocol for international use. The risks of residues from the fumigant sulfuryl fluoride on food and non-food products also needs to be analyzed further.

Further harmonization of dunnage requirements can prevent treatments with methyl bromide. According to ISPM-15 cargo needs to be treated when unlabelled dunnage wood is used. Not all countries follow up on this requirement because this would cause an increase in the number of treatments. Dunnage is often made by cutting up larger beams into smaller pieces. The original mark may be lost by the cutting up. Two possible ways of addressing the problem are to use multiple labels on the treated beams or to certify companies that apply dunnage so they can apply labels to treated wood cut-offs.

Since trade crosses borders easily, decreasing the use of methyl bromide needs to be harmonized at European level. Currently the use of methyl bromide differs widely between European member states, ranging from methyl bromide not being permitted to several thousands of container fumigations annually.

Finally, for imported cargo that doesn't comply with the ISPM 15 requirements, European member states could choose to treat the containers using the alternative treatments of Controlled Atmosphere or sulfuryl fluoride. At this moment the national phytosanitary authorities can require (methyl bromide) treatment, total destruction of the cargo or destruction of the packaging material, or they can require the packaging material or the total shipment to be sent back.

# 1 Introduction

Methyl bromide is a natural substance that causes ozone depletion in the atmosphere. The use of methyl bromide as biocide and pesticide therefore contributes to the depletion of the ozone layer. Besides ozone depletion, methyl bromide can cause safety risks for its users, workers unloading treated containers, harbour officials and consumers (gas releases slower from fabric than from wood). Due to the efficacy of methyl bromide, the reliability, price and ease of use, the substance is widely used in international trade. Fumigation is a guarantee against undesired invasions of harmful organisms.

The Montreal Protocol, originally negotiated in 1987 is an international treaty with the goal of protecting the earth's ozone layer, a thin band of ozone that protects the earth from otherwise hazardous exposure to certain ultra violet radiation. To date 189 countries have ratified the treaty and become subject to its provisions, which, with certain exceptions require a total elimination of ozone depleting substances. In 1992 a 'phase out' of methyl bromide was internationally agreed upon in the *Montreal Protocol* (*on Substances that Deplete the Ozone Layer*). This phase out was completed in developed countries in 2005, however there are some exemptions. An international committee (MBTOC: *Methyl Bromide Technical Options Committee*) guides the process and recommends certain CUE's (*critical use exemptions*) which have to be approved by the Parties. Finally, MBTOC advises the Parties on the development of alternative treatments to methyl bromide.
In addition to the CUE's, methyl bromide can be used as *quarantine* and *preshipment* (QPS) treatment. These phytosanitary treatments are not yet controlled under the Montreal Protocol. Within the European Union however, there is already a maximum amount of methyl bromide that may be used for QPS (this can be reduced by the European Commission).

Phytosanitary awareness rose after WWII upon introduction of the Colorado beetle (*Leptinotarsa decemlineata*) to Europe, most likely transported with potato related products from the USA. This awareness led to the establishment of the International Plant Protection Convention (IPPC) in 1951. The urgency for protection of wild plants and trees was best illustrated by the re-introduction of aggressive forms of the Dutch elm disease (*Ophiostome ulmi*) to Europe in 1970 and 1990 from America. This disease was first transported from France to Northern America in the 1930's and spread throughout the eastern half of the North American continent in less than 40 years. Some other major pests are the pinewood nematode (*Bursaphelenchus xylophilus*) and its vector, the insect *Monochamus alternatus* and the Asian longhorned beetle (*anaplophora glabripennis*). These global phytosanitary concerns lead to international standards for phytosanitary measures (ISPMs), of which 24 have currently been developed since 1995[3]. ISPM-15[4] describes fumigation with methyl bromide and heat treatment as accepted treatments of wood packaging material, WPM (such as pallets, packaging wood and wood blocks to stabilize cargo).

[3] Besides ISPMs, countries can base measures on a Pest Risk Analysis (PRA).

[4] International Standard for Phytosanitary Measures No. 15.

Many countries have import requirements for WPM in place, in line with ISPM-15 (see www.smhv.nl, www.aphis.usda.gov), including the European Community in directive 2000/29/EC. Requiring ISPM-15 resulted in an increasing use of methyl bromide worldwide. Experts estimate that in 2002 the quantities in such use were around 11,000 tons growing to 18,000 tons in 2004 (TEAP Progress Report, May 2004 and May 2005. P.42; information note by the Ozone Secretariat for the ICPM. 4-8 April 2005), but it is thought the levels are an underestimate since not all countries are supplying full and accurate figures. Over time, many Protocol Parties have become concerned about the apparent growth in methyl bromide use for QPS purposes. That concern was recently heightened when the International Plant Protection Convention (IPPC) agreed reference standard 15 as an International Standard for Phytosanitary Measures. While the exact impact of the adoption of this standard on global methyl bromide use is uncertain, many believe that it will be significant and could nullify a significant portion of the phase-out of this chemical that has already been achieved in non-QPS uses. Recent talks on this topic within the United Nations resulted in a request for more insight in the use of methyl bromide for QPS, an urge for countries to consider using alternatives to methyl bromide and an encouragement for importing countries to consider alternative methods for QPS as sufficient treatment.

In The Netherlands the use of methyl bromide for QPS in wooden packaging materials has risen from 1,200 kg in 2001 to 2,678 kg in 2004. These trends conflict with the international desire to 'phase out' ozone depleting substances. The increase in use of QPS-treatments is also reflected in an increased number of containers found with too high (up to dangerous) concentrations of toxic gasses upon arrival. Currently 4 to 5% of the imported containers in Rotterdam exceed the safety criteria of pesticides, mostly methyl bromide but also PH3, dichloride ethane, formaldehyde, ammonia, and sulfuryl fluoride[5]. Fumigants cause a safety risk for workers opening the containers, but also for consumers that can be exposed to residues of chemicals in fabrics, food products, medicines and artefacts[6]. The Dutch government therefore hopes to align the objectives of the IPPC and the objectives of the Montreal Protocol. CLM was asked to analyze the consequences of ISPM-15 in The Netherlands and evaluate the alternatives to methyl bromide on a scientific level and with stakeholders.

In this study we therefore:

- Analyze how ISPM-15 is implemented in Dutch trade logistics and the obstacles the sector faces with reducing the use of methyl bromide (chapter 2). We discuss:
    - Communication about ISPM-15
    - Availability of alternatives
    - Harmonization of wooden dunnage
    - Harmonization within Europe
- Evaluate the alternatives for quarantine treatment given in Annex III of ISPM-15 (list of alternatives that are under consideration) both in terms of efficacy and desirability in logistics (chapter 3). The selection of alternatives of high priority was done together with all stakeholders in the shipping industry in The Netherlands (see list in the sources). Alternatives that are considered to have low priority in The Netherlands are described in appendix 1.

The recommendations are listed in chapter 4.

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[5] Dhr. Pronk, Rotterdam City Counsil, pers. comm.; Knol-de Vos, 2002.

[6] Knol *et al*., 2005.

# 2 ISPM-15 in logistics

This chapter describes how ISPM 15 is implemented in The Netherlands and how the Dutch government seeks to, together with the main parties active in logistics, phase-out methyl bromide.

## 2.1 Situation

A certification scheme for wood treatment and logistics according to ISPM-15 makes sure there is no shortage of (heat) treated packaging wood in The Netherlands[7]. The certification scheme covers the logistics of importing and manufacturing treated wood and the ISPM-15 treatments and labelling. The scheme is maintained by the SMHV (foundation for the labelling of wooden packaging material, www.smhv.nl) together with the Plant Protection service. More than 125 companies have joined this scheme, of which 25 perform heat treatments, 1 performs methyl bromide treatments, and 99 only process treated wood into pallets and packaging material. The companies make good use of wood that needed to be dried for use for electric equipment, paper, agricultural produce, etc. This drying process can be altered to also suffice as a treatment according to the ISPM-15 standard. On estimate 25 % of the pallets and packaging material produced in The Netherlands is heat treated and labelled according to ISPM-15 standard. The other 75% is used for transport within The Netherlands or the EU, and therefore doesn't need treatment. This 25 % amounts to more than 4 million pallets a year. The added cost of HT is 30-80 Eurocent per pallet.

Since most of the packaging material and pallets used for export is (heat) treated, the demand for methyl bromide is low in The Netherlands compared to some other Member States in the EU, but the demand is persistent. This demand can be explained by the growing number of countries that require WPM treatment and marking in line with the ISPM-15 standard. Treating loaded containers is a direct result of using non-treated and labelled wood. In 2005 422 containers still needed to be treated with methyl bromide as a result of the use of non-treated pallets or wood (quotes for methyl bromide treatment range from € 125,= to € 395,= per container[8]). Besides that, shippers estimate that roughly 18,000 containers are yearly rerouted by Antwerp for a fumigation treatment. (pers. comm. Bergwerff, EcO2, and Veldman, VROM inspection service, attendants at workshop)

Using heat treatment, most methyl bromide fumigations of containers are prevented, but not all. This has to do with communication, availability of alternatives, harmonization of dunnage requirements and harmonization within Europe.

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[7] The Netherlands are not the only country with a certification scheme for ISPM-15 treatments and use of labeled material.

[8] A 40 ft container contains 60 $m^3$ and would hold on average 60 pallets, depending on the type of cargo.

## 2.2 Communication

By using heat treated and labelled WPM all methyl bromide treatments of containers and of separate wood could in theory be prevented. Stakeholders claim this indeed is possible in Europe. It is up to the exporters to use this treated wood in their logistics. But these exporters range from large companies to one-time shipments and can be Dutch or from other European member states, using Rotterdam as Europe's export border. Most exporting organisations will receive help from their shipping agent. These shipping agents are therefore a main source of information about ISPM-15. Exporters have, of course, their own responsibility to ensure compliance with requirements of relevant importing countries.
Many treatments can be prevented when dispatching agents have (and share) correct information and when exporting companies tap into this information at the right time (in some cases dispatching agents are contacted only when the containers are already fully loaded).

In The Netherlands most dispatching agents, shipping agents[9], pallet manufacturers, and companies that secure cargo are aware of the ISPM-15 regulations. The site of SMHV (www.SMHV.nl) provides up to date information on import requirements both in Dutch and in English. Similar initiatives in other countries were not analysed in this study.

## 2.3 Availability of alternatives

QPS treatments are performed on WPM during manufacturing and on loaded containers before or after shipping. For both types of treatment some alternatives are listed in Annex-III. To focus the effort for accepting alternatives the gains of the different alternatives, in terms of reduction of methyl bromide, are compared:

- The cheapest way to comply with import requirements is to treat the wood during manufacturing; such as pallets, packaging wood, wood to stabilize cargo, wood that will be fixed inside the container, etc. The heat treatment accepted in ISPM-15 could suffice for this QPS use and does so for most cases in The Netherlands. Alternatives besides heat treatment would only be helpful to reduce the costs by raising competition. A likely, and in some countries accepted, alternative is Chemical Pressure Impregnation (see appendix 1). This treatment may guarantee longer protection of the wood against pests.
- Alternatives for treatments of loaded containers will have a major impact on reducing methyl bromide use and emission. Chapter 3 describes two possible alternatives for container treatment that were identified by both companies and government in The Netherlands: Controlled Atmosphere and sulfuryl fluoride. Both alternatives were selected based on cost, compatibility with current logistical requirements (mostly the treatment time), efficacy and side effects (environment and human toxicology).
- Since the EU implemented the ISPM-standard in its import requirements EU member states have increased inspection frequencies of consigned import. As a result more imported containers are found untreated. In addition some exporting countries specifically ask for possibilities of treatment within the European

[9] Shipping agents: companies hired by the shipping company, responsible for loading and securing the ship. Dispatching agent: hired by manufacturer or trader to arrange the transport. Larger companies have own or affiliated companies for this, called "packers".

importing nation. In general, the importing member state can treat the cargo/container, unpack the container and treat (or destroy) the wood, or destroy the cargo. Instead of treating the container with methyl bromide, the EU could accept alternative treatments at its own borders. The Dutch government decided not to fumigate imported cargo that does not comply with ISPM 15, but requires heat treatment on site or destruction. This policy could be accepted elsewhere as well.

## 2.4 Harmonization of dunnage requirements

Wooden dunnage is of growing concern since some countries are placing more emphasis on treatment and labelling of this wood. Wood to stabilize cargo indeed poses a quarantine risk. Wood used for stabilization is often made from low quality wood, and could therefore be a more important source for spread of organisms.
The following requirements are in effect:

- Australia: Only use bark-free wood;
- China: only use bark-free wood;
- South Korea: countries where pine wood nematode is found will need to use heat treatment as QPS-treatment (such as Portugal). The use of methyl bromide does not suffice;
- Europe: Only use bark-free wood as of 1 Jan. 2009. As of 1 January 2008 wood used to stabilize cargo needs to be treated and labelled according to ISPM-15;
- USA and Canada: wood used to stabilize cargo needs to be treated and labelled according to ISPM-15.

In theory all dunnage wood can be heat-treated. In practice it is difficult to track whether the wood used is treated. Treated beams are brought onto a ship or to the package site of the containers and cut to the right size. This service is often performed by contractors. The initial IPPC-label on the beams (proof of treatment) may not reappear on all the cut-offs, so that the cargo will require methyl bromide treatment for lack of correct labelling.
As a solution, treated beams could receive a strip of labels, or contractors could enrol in a (certification) scheme that gives them the possibility to label the wood cut-offs. This could be incorporated in certification schemes already in place in many countries.

## 2.5 Harmonization within Europe

Phasing out methyl bromide in Europe can be done to a great extend with only heat treatment as an alternative. This can only be done when all member states strongly direct exporters to use heat-treated wood for packaging material and pallets and so prevent methyl bromide treatments of containers and separate wood. Exporters can be steered using clear communication and making the alternative more accessible than methyl bromide. Both need to be done as a harmonized effort in Europe.

Within the European Union containers can easily be transported across the borders of different member states. More inland situated member states may use member states with a harbour for their international export, and exporters in countries with a harbour may decide to use the harbour in a neighbouring country. Because of the logistics of trade, most fumigations will take place at the harbour. Currently the use

of methyl bromide differs widely between European member states, ranging from methyl bromide not being permitted to several
thousands of container fumigations annually. Since trade crosses borders easily, decreasing the use of methyl bromide needs to be harmonized at European level.

# 3 Alternatives

For a complete phase out of methyl bromide as ISPM 15 treatment, more alternatives are needed. According to stakeholders in the shipping industry and government, these alternatives have to prove satisfactory at the following parameters: efficacy, acceptability in the IPPC framework, logistics and technical implication, costs, side effects such as environmental impact and consumers and workers safety.

Of the Annex-III alternatives (see box), the alternatives Controlled Atmosphere and sulfuryl fluoride were selected for further study.

Alternatives in Annex III:
- Fumigants: Carbonyl Sulfide (CS), phosphine, and sulfuryl fluoride (SF)
- Controlled Atmosphere (CA)
- Controlled Pressure Impregnation (CPI)
- Radiation (i.e. gamma irradiation, microwave energy)

The reasons for not including the other alternatives in this study were:
- Radiation and CPI can only be used for treatment of separate packing materials, for instance in production line. Because these techniques can not be used for whole container treatments they are not sufficient as alternative for methyl bromide-treatments of containers.
- Carbonyl sulfide and phosphine are chemical fumigants, like methyl bromide, with toxic effects and risks for workers safety and residues. Besides that, CS can not be used for food products and phosphine is corrosive. Because of lack of data concerning environmental risks, efficacy and price, CS and phosphine were not seen as successful alternatives for methyl bromide at this moment.

(see appendix 1 for further analysis of these alternatives)

## 3.1 Sulfuryl fluoride

Sulfuryl fluoride (SO2F2) is a fumigant commonly used to control wood-destroying pests and household insect pests and can be used as a direct substitute for methyl bromide in most QPS-treatments. The fumigant sulfuryl fluoride is being marketed by two identical products Vikane and Profume. Vikane is used for the disinfestation of timber and non-food structures and is licensed or registered for use in the USA and a few European countries. Vikane is not registered in The Netherlands.

**Characteristics**
Sulfuryl fluoride is a colorless, odorless, nonflammable, compressed gas fumigant and does not contribute to stratospheric ozone depletion. It is less reactive than methyl bromide (does not react with painting or gilding), has good penetration in wood, is non-carcinogenic and is 2-3 times less toxic to mammals. The costs per

container treatment are comparable to methyl bromide. However, residues of sulfuryl fluoride were found in fabrics and food products and the fumigant had side effects on medicines (Knol et al., 2005). Therefore the risks of sulfuryl fluoride residues upon container treatment in on food and non-food items will have to be analyzed before it can be accepted for the use on cargo conaining these products.

**Efficacy**
Sulfuryl fluoride is highly toxic to all post-embryonic life stages of insects; eggs of most species are less susceptible (USEPA 1996). The efficacy of sulfuryl fluoride depends on the concentration reaching the target pest and the duration of exposure. As a result the dosage required is calculated in g/hours, grams of Vikane multiplied by hours of exposure. The dosage required also depends on life stage.
In general, insect eggs require a higher g/hours dosage of sulfuryl fluoride compared to later life stages (i.e. a 10-fold increase in dosage for some insect species) (USEPA 1996). As an average, a dosage of 40g/m3 (varies between 30-60g/m3) is used for contained areas. In a 40ft container that dosage requires 3kg Vikane However, USDA states that eggs of many insects are tolerant to even high concentrations of sulfuryl fluoride and still hatch after fumigation (USDA 2002). APHIS (Animal and Plant Health Inspection Service, dep. of USDA) therefore no longer approves sulfuryl fluoride as a treatment for wood boring beetles. According to Dow Agrosciences, the producer of Vikane, lethal dosages indeed vary according to insect species and life stage (eggs need a high dosage compared with other life stages), but at the correct dosage all life stages of insects can be killed with Profume/Vikane. Dow Agrosciences developed a program to calculate the needed concentration and treatment time: Fumiguide®.

Efficacy data on ProFume/Vikane and the treatment schedule has been submitted by Dow Agrosciences to the Technical Panel of the IPPC for placement on Annex-I (Drinkall, 2005).

| | **Sulforyl fluoride** | **Methyl bromide** |
|---|---|---|
| Efficacy | • Not effective at temperatures <10 °C, optimum temperature between 25-30°C<br>• At wood structures a dosage of 40 (average, between 30-60) g/m3 is required (3 kg for a 40 ft container)<br>• Required dosages can vary between treatments<br>• No public data on QPS-treatments | Not effective at temperatures <10 °C |
| Logistics & technical implication costs | Exposure time depends on concentration, but varies between 18-48 hours without ventilation 20-22 €/kg. With a use of 3 kg's per 40 ft container this would be € 63,= per container. Exclusive handling (84ct per m3) | 24 hour treatment + 24-56 hour ventilation 125 / container excl. permit |
| Side effects | • Low environmental impact: no ozone formation or ozone depletion. Quick brake down by water, light or particles in the atmosphere. No significant contribution to acid rain<br>• Risk of residues in products<br>• Countries have to adapt to new gas with training for users, filters for gasmasks and sensors<br>• Lethal doses for insect eggs were not given by producer | • High environmental impact<br>• Workers safety issue<br>• Many imported containers found with methyl bromide levels higher than safety norm<br>• Risk of residues in products |

**Registration in Europe**
In Europe the use of sulfuryl fluoride for QPS-purposes will have to be registered in the relevant member states as a plant protection product. Member states can approve applications of pesticides when the active ingredient is placed on the Annex-I list of the EU directive (91/414/EEC). The annex-I inclusion of sulfuryl fluoride is anticipated for the end of 2006. Based on the anticipated inclusion of sulfuryl fluoride, a number of provisional approvals have been given by Italy, Sweden, United Kingdom, Germany and France. Only in Sweden does this approval include QPS-treatments of wood. If the annex-I inclusion is successful, the applicant (Dow Agrosciences, or another company under licence) will still have to register the use of Vikane/ProFume for QPS-treatments in The Netherlands and in other exporting EU-member states.

## 3.2 Controlled Atmosphere

Controlled Atmosphere is a commonly used technique for treatment of food products (especially fruits, vegetables and grains) and could be used as an alternative for (container) treatments of methyl bromide. Controlled Atmosphere is a technique that involves changing the relative concentrations of gases (oxygen, nitrogen and carbon dioxide) in the atmosphere of enclosures, in order to kill pests. Treatment can be done on site using mobile devices or in fixed chambers.

Advantages of this technique include a low environmental impact since it emits only small quantities of the greenhouse gas CO2. The technique does not involve hazardous contaminants for the environment, risks for residues and is relatively safe for workers. A disadvantage is the relative long treatment period required (about 9 days). A Dutch firm (EcO2) is investigating the possibilities to shorten this period to 24-36 hours using temperatures up to 48°C.

Parameters for a worldwide protocol for Quarantine Pre-shipment treatment of wood (minimal temperature, concentration CO2, exposure time, etc.) have not been developed. ISPM-15 inclusion is therefore not yet possible. The technique is currently used for the export of food products.

| | **Controlled Athmosphere** | **Heat treatment** | **Methyl bromide** |
|---|---|---|---|
| Efficacy | Stated as sufficient, no data for use as quarantine measure<br>Not effective at temperatures <20 °C | Accepted for Annex-I<br>Can not be used for heat sensitive commodity | Accepted for Annex-I<br>Not effective at temperatures <10 °C |
| Logistics & technical implication | Max. 9 days, research to shorten this to 24-36 hours by rising temperature | 24 hour treatment.<br>often standard step in wood drying-process | 24 hour treatment +<br>24-56 hour ventilation |
| Costs | 1 /pallet.<br>300-350 Euro/container | 1-1.50 /pallet<br>200-250 / container | No data on price/pallet<br>125 / container excl. permit |
| Side effects | Emission of CO2 (greenhouse gas)<br>Low handling risks | 0,1 m3 natural gas per pellet | • High environmental impact<br>• Workers safety issue<br>• Many imported containers found with methyl bromide levels higher than safety norm<br>• Risk of residues in products |

## 3.3 Heat

Heat treatment can be used for many types of cargo. The Annex-I alternative to methyl bromide is heat treatment. Many types of cargo can stand heat treatment (56 ºC for 30 minutes). Even in normal transport conditions temperatures in a container may rise to these temperatures. However, heat can damage certain types of cargo. In summary heat could replace many methyl bromide-QPS-treatments.

## 3.4 Prevention

Consequent use of treated wood for packaging and stabilizing of cargo before loading of containers could prevent all methyl bromide treatments in Europe. ISPM-15 focuses on WPM like pallets, packaging material and dunnage. For all these applications, heat-treated wood is available in sufficient quantities in Europe. As argued before, the use of methyl bromide for QPS-treatments could be prevented when shipping agents consistently use treated and labelled wood. Consistent use of treated and labelled wood can be facilitated by communication (as argued in par. 2.2), labelling of wood used to stabilize cargo (as argued in par. 2.4) and standard heat treatment and labelling of all manufactured pallets.

## 3.5 Conclusion

Better use of heat treatment and consistent use of heat-treated and labelled wood could prevent the use of methyl bromide in Europe. Other possible alternatives to methyl bromide are Controlled Atmosphere and sulfuryl fluoride (Vikane). These alternatives however, have still to be proven effective enough for the ISPM-15 standard and worldwide users guides need to be formulated. Both alternatives are widely used in other commodities (food and non-food products) and can be used as treatment for whole containers.

**Table 4.1: Summary of advantages and concerns of Controlled Atmosphere and sulfuryl fluoride**

| | **Controlled atmosphere** | **Sulfuryl fluoride** |
|---|---|---|
| Main advantages | • Low environmental impact<br>• Technique is used and commercialized | • Treatment similar to methyl bromide<br>• No ozone depletion<br>• Fumigant is commercialized |
| Main concerns | • Lack of a standardized, internationally accepted protocol<br>• Relative low availability of treatment facilities worldwide | • Required dosage varies (program Fumiguide calculates right dosage)<br>• Lethal dose for insect eggs are not known. High dosage can cause environmental risks and consumers- and workers safety issues<br>• Registration required in EU member states<br>• Risk of residues in consumer products (containing fabrics, food products and medicines) |

# 4 Conclusions and recommendations

## 4.1 Prevention

Most, if not all ISPM 15 treatments with methyl bromide in Europe can be prevented by using heat-treated material. The use of heat-treated and labelled wood can be facilitated by:

- Intensify international communication about the ISPM-15 guideline and (harmonized) requirements in Europe.
- Harmonization of regulation and law enforcement for methyl bromide use in loaded containers in order to stimulate exporters to use (heat) treated wood instead of treating containers with methyl bromide.
- Develop a national (internationally accepted) system to label wooden dunnage. Two options are: involving contractors in a (certification) scheme that warrants correct use, or a technique of multiple IPPC-labeling on the wood. The stakeholders in The Netherlands to develop this would be the KVNR (Royal Dutch association of ship owners), the Plant Protection Service and the ministry of Housing, Spatial Planning and the Environment.

## 4.2 Alternatives

Alternatives to methyl bromide and heat treatment are needed to reduce the use of methyl bromide for QPS-treatments in The Netherlands and worldwide. Heat treatment can be used for all packaging material and for many loaded containers. However a demand for treatment of loaded containers will remain if only for heat sensitive cargo that is not packed using (heat)treated and labelled WPM. Alternative quarantine treatments for loaded containers are therefore needed for a complete phasing out of methyl bromide. Stakeholders in the Netherlands (including government, industry, trade and parties in the logistical chain) concluded that Controlled Atmosphere and sulfuryl fluoride could be the most promising alternatives in terms of cost, compatibility with current logistical requirements (treatment time), efficacy and side effects (environment and human toxicology).

- Controlled Atmosphere causes only low risks for the environment ($CO_2$ emission) and for workers. The treatment is used in export of flowers and food products. The protocol for QPS-treatment of wood has yet to be developed and verified by the relevant IPPC Technical Panel.
- Sulfuryl fluoride seems the easiest alternative to implement in logistics. The fumigant is under consideration at the IPPC Technical Panel.

Controlled Atmosphere needs further research focussed on developing a protocol that is widely applicable and effective for QPS-treatment. Sulfuryl fluoride is under consideration of the IPPC. Besides approval for ISPM-15, sulfuryl fluoride will require approval as a pesticide in the relevant European member states.

## 4.3 Import

For imported cargo that doesn't comply with the requirements, European member states could choose to accept the alternatives of Controlled Atmosphere or sulfuryl fluoride. At this moment the national phytosanitary authorities can require (methyl bromide) treatment of cargo/containers that does not comply with ISPM-15, total destruction of the cargo or destruction of the packaging material, or they can require the packaging material or the total shipment to be sent back. Destruction of the wooden packaging material can be performed upon arrival in the harbor or airport, or upon arrival at the final site of destination. Besides these alternatives, European member states could also adopt other techniques like Controlled Atmosphere or sulfuryl fluoride. Adopting these alternatives would reduce the use of methyl bromide in Europe, and could have a worldwide effect if cargo would not be treated with methyl bromide upon export but, for example, with Controlled Atmosphere upon import.

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Mr. Hans Schut, Arch Timber Protection
Mr. Kees Pronk, City of Rotterdam, dept. REST

**Workshop/stakeholders**

Mr. Marty van Pelt, FENEX, association of dispatching agents
Mr. Visser, SGS-Holland
Ms. Erica Kostense-Smits SGS-Holland
Mr. Marco Leembarg, manufacturer of pallets
Mr. Rob van Hoesel, PKF, manufacturer of wood packaging material
Mr. Bart Kooijman, SMHV, foundation for the labelling of wooden packaging material
Mr. Evert Wijdeveld, deltalinqs
Mr. Pijls, kvnr, Royal Dutch association of ship owners
Mr. Alan Dirks, Port of Rotterdam
Mr. Willem Veldman, VROM inspection service
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Mr. Bram de Hoop, Plant protection service
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# Appendix 1 Alternatives annex III

According to the stakeholders, the following alternatives did not have enough added value to the two suggested alternatives in this report: Controlled Atmosphere and Vikane.

## 1.1 Phosphine (PH3)

| | **Phosphine** |
|---|---|
| Efficacy | Known treatment<br>No sufficient data on efficacy for ISPM-15<br>Not effective at temperatures <15 °C |
| Logistics & technical implication | Max. 14 days |
| costs | No data |
| Side effects | • Low environmental impact: half life of 1 day in air. Reacts with water. Quickly broken down in soil. Phosphine does not accumulate in the food chain<br>• Carrier tablets contain alumnium ($AlP_3$) or magnesium ($MgP_3$), which are released into the environment upon use<br>• Many imported containers found with phosphine levels higher than safety norm<br>• Risk of residues in products<br>• Corrosive and reactive on pigments (A combination of phosphine, co2 en warmth could reduce the risk of corrosion)<br>• Risk of build up of resistance in target organisms |

**Conclusion**
The risk profile of phosphine (residues, corrosion and reactive with pigments) makes sulphuryl fluoride a more attractive chemical alternative.

## 1.2 Carbonyl sulfide

Carbonyl sulfide is a naturally occuring gas that is emitted in to the atmosphere by volcanic activity, some combustion processes and various natural decomposition processes (in marshes, soil and forest). CS can be used as a fumigant like methyl bromide from gas canisters. Tests have shown that it will control a wide range of pests, such as beetles, frit flies, moths mites termites, moulds and nematodes. It has shown good efficacy in tests of grains, legumes, dried fruit, cut flowers and both hard and soft timber (USDA 2002). Despite these promising figures its efficacy on wood products has not been conclusively demonstrated, particularly for insect pests and fungi of quarantine significance.

CS is a toxic, flammable gas that presents acute inhalation danger to humans. There is no complete overview of environmental and workers safety risks.

| | Carbinyl Sulfide |
|---|---|
| Efficacy | No sufficient data on efficacy for ISPM-15 |
| Logistics & technical implication | Comparable with methyl bromide |
| costs | No data |
| Side effects | Risk of residues in products<br>Toxic, flammable gas |

**Conclusion**
The lack of sufficient data on efficacy and side effects makes sulphuryl fluoride a more attractive chemical alternative.

## 1.3 Chemical Pressure Impregnation, CPI

Key results of the pressure-treating process are the chemical **product** used, **amount** of preservative impregnated into the wood (called **retention**), and the **depth** of penetration. The development of chemicals for CPI is an ongoing activity. It is therefore difficult to state that CPI as a defined procedure will suffice for ISPM-15. Qualification for Annex I on ISPM-15 needs to be done per product and method.

**Chemicals**
The list of products used for CPI include: Creosote-based products, penta or pentachlorphenol-based products and water-borne preservatives. Creosote is unique in acting as both preservative and carrier. Creosote and penta or pentachlorphenol (PCP) are used in industrial applications to treat ties, utility poles, posts, pilings, etc. Most construction (incl. packaging wood) and home-use products are pressure-treated with water-borne preservatives (CCA, ACZA, ACQ, ACA, ACC, CCB, CA, SB)[10], of which CCA is used most common. CCA is not used in The Netherlands.
Some of the components are undesirable to some countries. For example, the EU does not support the use of any copper-containing substance, where Australia is against the use of chromated copper. However, some products could still be acceptable to all. A substance still used in The Netherlands, and accepted by Australia for quarantine treatment is Tanalith E 34-85 (copper, carbonate, tebuconazole or propiconazool, often in combination with boric acid). The chemicals used are selected on binding to the wood. Once treated, the wood is therefore perserved for a long period of time.

[10] CCA: Chromated Copper Arsenates: water based mixtur of dicromic acid ($H_2Cr_2O_7$), arsenic acid ($H_3AsO_4$) and $Cu^{2+}$
ACZA: Ammoniacal Copper Zinc Arsenates
ACQ: Ammoniacal Copper Quaternary (also used in Holland)
ACA: Ammoniacal Copper Arsenates
ACC: Ammoniacal Copper Citrates
CCB: Chromated copper boron
CA: Copper azole
SB: Sodium Borate

**Table: Minimal chemical preservation to full sapwood penetration accepted as sufficient quarantine measure in New Zealand.**

| Chemical | Minimum Retention |
|---|---|
| Boron compounds | 0.1% Boric Acid equivalent minimum loading in the sapwood core |
| Copper + didecyldimethyl ammonium chloride (Ddac) | 0.35% mass/mass OR<br>2.8 kg/m3 in softwood timbers,<br>5.60 kg/m3 in hardwood timbers. |
| Copper azole | 0.27% mass/mass OR<br>1.35 kg/m3 in softwood timbers,<br>2.7 kg/m3 in hardwood timbers. |
| Copper Chrome Arsenic (CCA) | 0.27% mass/mass OR<br>3kg/m3 minimum preservative retention |
| Arsenic | 0.04% minimum preservation loading in sapwood core |
| Permethrin | Minimum retention of not less than 0.06% mass/mass |

**Pressure impregnation**

Two different types of chemical pressure impregnation by vacuum-process are: full-cell treatment (double vacuum) and empty-cell treatment (single vacuum).

Full-cell treatment: To treat wood, a series of pressure and vacuum cycles force the waterborne preservative deep into the wood cell structure. The treatment process is carefully monitored and controlled within an enclosed cylinder. An initial vacuum removes air from the cylinder and wood, then the preservative is introduced into the cylinder without breaking the vacuum. Next, pressure is applied until the required preservative retention is obtained, as expressed in pounds of preservative per cubic foot of wood. A final vacuum is pulled to remove excess preservative.

Empty-cell treatment: The first step in the empty-cell treatment is applying pressure of 35-40 psi. This compresses the air into the cell lumen. The tank is filled with the chemical while the initial pressure is held on charge. Later the pressure is increased to 140-150 psi and held for several hours. Next the pressure is released before applying a final vacuum to remove excess preservative, as in the full-cell treatment.

The treatment is often followed by a steam treatment to wash off non-bound product. The run-off of this steam treatment is re-used.

The different chemical impregnation methods include washing and coating; brushing, spraying and dipping; soaking; Boucherie process; hot and cold bath process; diffusion process; and the described pressure process. The full cell pressure process is the best for the highest penetration and retention of preservative. This technique is commercially in use in most countries, including third world countries.

**Environment**

CPI treatments have been a cause of serious environmental concerns and local disasters. Nowadays treatments can be done without direct emission to the environment. The access chemicals of the treatment are re-used and the wood undergoes steam treatment to wash off all unbound chemicals. The wash off is also re-used. Some of the compounds used can become toxic and pollute the environment. If these measures are in place, as is the case for all sites in The Netherlands, the only concern is the active ingredient that bound to the wood.

Active ingredient bound to the wood will over time slowly "bleach off" and before or after this process is completed, the wood will be discarded. Both streams end up in the environment. The concentrations of active ingredient however are low (see table below). Experts will have to reach the conclusion whether these quantities are significantly higher than background level of heavy metals in the environment. Components other than heavy metals need to be assessed for their environmental impact and half-life of the chemical.

| | **CPI** |
|---|---|
| Efficacy | Some product-method combinations are currently accepted for quarantine treatment to a number of ISPM-countries.<br>Treated wood remains free from invaders for lifetime |
| Logistics & technical implication | 3 hours |
| costs | Higher costs than heat treatment (more expensive incubators with smaller capacity) |
| Side effects | • Clear safety and environmental measures are needed on the treatment sites<br>• Actual environmental risk is still debated<br>• Certain methods can be less energy consuming than heat treatment |

**Conclusion**
CPI may be interesting for wood that is re-used more often, like crates or wood fixed in containers. Of the known chemicals, Tanalith E 34-85 in a double vacuum treatment seems to be an interesting test-case for acceptance of CPI on Annex I. Tanalith is currently used in the EU and is accepted by a number of ISPM-countries. The environmental impact seems low when used in leakage-free treatment sites and with sufficient wash off of excess chemical before use. Tanalith contains copper, carbonate and tebuconazole or propiconazool. Both azole fungicides have relatively low environmental impact but can be persistant: tebuconazole has a half life of 753 days and propiconazool of 96 days (in soil).

CPI treatment seemed of not enough benefit in terms of reduction in methyl bromide-use in The Netherlands to support the treatment actively for Annex-I placement.

## 1.4 Radiation

Radiation includes different techniques: microwave energy, gamma-irradiation, infra red and electron beam radiation.

*Microwave energy*
The use of microwaves as a treatment method involves exposing wood to ultra high frequency magnetic fields, which elevate the temperature of any material containing moisture. This technique is only very limited used for treatment of wood. in Belgium a company treats parts of wooden floors with this technique (Groffils 2005). Disadvantages are the limited capacity (2,5 m3 /hr) and this technique can not be used for whole containers. Microwave energy can be considered as an alternative for heat treatment of wood at manufacturing, but the limited capacity and higher costs (+20%) are major disadvantages.

*Gamma-radiation, infra red and electron beam radiation* are techniques that could be used for treatment of foodstuffs or wood packing material. There not much experience with these techniques. Data of efficacy, costs and side effects are lacking.

**Conclusion**
The lack of sufficient data and relative low added value above heat treatment makes radiation an alternative with low priority.

## 1.5 Plastic pallet

Plastic pallets are an accepted alternative for wooden pallets. The life time of a plastic pallet can compete with that of a wooden pallet. Plastic pallets however, are more expensive than wooden ones. Besides that, developing countries often lack the facilities to recycle the plastic, which may cause a lot of waste locally.

**Conclusion**
The use of plastic pallets is allowed in ISPM-15.