



# Chapter 15 – Forestry Products

## 15.1 Softwood and Hardwood Timber, Plywood and Paper Products

It is important to be aware that all forms of forestry products are at risk of causing oxygen depletion in the cargo hold. Safe entry procedures should be followed by all personnel entering the cargo space, including testing of the atmosphere.

### **Softwood timber**

The main areas from which softwood timber is shipped are the Baltic and North America. Very few claims arise from the Baltic or the east coast of North America trades, but large claims have arisen on shipments of timber from the north west coast of North America, mainly due to the wet climate in this area. Softwood timber is commonly shipped in bundles or packages of planks of various lengths and sizes and secured with flat metal strapping bands. The timber is usually unprotected unless it has been kiln-dried, when it is normally protected by a loose plastic wrapper or shroud.

Softwoods, and pinewoods in particular, carry a great deal of sap and are susceptible to fungal growth, known as sap staining, which is relevant only where strength or appearance is of prime importance as clean timber is always a more attractive product. Blue staining occurs mainly in hardwoods and may be prevented by chemical treatment. This must be done within one day of sawing the timber into planks or it

may not be effective and may not prevent blue staining. This timber is often stored in the open, exposed to inclement weather, and the water may destroy the effect of the chemicals. Fungal development is associated with the moisture content of the timber and, therefore, kiln-dried timber that has been properly dried is normally not affected by fungal growth.

Due to the extent of rainfall in the British Columbia area of the north west coast of North America, timber is often loaded during pouring rain and may be wet before shipment. The problem is further exacerbated because the rain enters the ship's hatchways and the tank tops can become partially flooded. Apart from the bottom packages of timber becoming thoroughly soaked, the water may stain the timber with rust marks picked up from the ship's structure. It is, therefore, recommended that provision is made to keep the bilges pumped dry at all times when loading during rain. A further problem occurs when the metal strapping bands securing the bundles of timber become rusty and the rust runs into the timber, with resulting stain.

It is important to emphasise that many thousands of tonnes of softwood timber have been shipped over the years in a thoroughly wet condition on long voyages, with no ventilation between the planks or packages in the stow and with the timber remaining saturated for the entire voyage, without developing any defects as a result.

Invariably, B/Ls are signed 'clean', as it is well known that timber shipped from the British Columbia area is likely to be shipped in a wet condition. However, claims may arise as a result of blue staining, rust staining or, in some rare instances, rotting. Claims may also arise after discharge for drying the timber. It is, therefore, recommended that B/Ls are clause with appropriate remarks to reflect the condition of the timber as shipped, such as 'timber rust stained' or 'wet before shipment'.

### **Hardwood timber**

Hardwood and semi-hardwoods are shipped from many tropical and semi-tropical countries. Much of this timber, particularly from West Africa, is shipped as logs. Shipments of logs do not usually generate any cargo claims. However, logs are likely to cause condensation and may also contain insects. It is therefore important to keep logs segregated from cargoes that may be damaged by condensation or insects.

Hardwoods and semi-hardwoods shipped from South East Asia, particularly to Europe, are commonly shipped as boards in bundles or packages secured by metal bands. Most are unprotected. The following types of timber are often shipped from South East Asia:

- Meranti. This is a relatively light semi-hardwood suitable for general construction, interior fittings and furniture. The subgroups include meranti bakau, dark red meranti, light red meranti, white meranti and yellow meranti. This timber is not durable under tropical conditions and is difficult to treat with preservatives. However, it is easy to work and seasons without trouble. It is shipped into Europe in large quantities and used extensively for doors, window frames and other outdoor fittings
- merbau. This is a heavy, relatively strong and durable wood used mainly for heavy construction. It is bronze or red/brown in colour, weathering to dark red brown

- ramin. This is a moderately hard, moderately heavy utility wood, easily treated with preservatives. It seasons quickly but is very liable to blue stain and is usually dipped in anti-stain chemicals after sawing. The timber is white in colour and usually free from quality defects. It is used extensively in the furniture trade and is highly susceptible to claims.

## 15.2 Loading and Care of Timber Cargo

It is important that cargo holds are thoroughly cleaned before any timber cargo is loaded. Any grease and oil should be removed from the vessel's structure, as contact can stain the timber. All remnants of previous cargoes should be removed from the overhead beams and the underside beams of the hatch panels, as claims have arisen as a result of remnants of previous cargoes contaminating the timber. For example, iron ore dust, when made wet by condensation, can turn into a red liquid that may stain the timber. Ores or sand of an abrasive nature, such as ilmenite ore, can damage sawmill machinery if the timber has been contaminated.

If the steelwork in the hold is rusty, the timber should be protected from rust staining by the use of dunnage. Ship's sweat developing during the voyage and dripping on the timber may also result in rust stains, so correct ventilation and dunnaging is of great importance.

Bad stowage often results in breakage of the bands securing the bundles. This is usually as a result of not keeping the stow level or crossing the bundles in stow, or a combination of the two. It is the practice for stevedores to work forklift trucks on top of the timber, in the square of the hatches in bulk carriers, when the stow has reached about half the height of the hold. The surface of the timber in contact with the trucks usually becomes damaged by scuffing and through oil dripping from the trucks. If this method of loading is to be used, protective steel plates should be carefully laid over the exposed timber.

Care should always be taken to use the correct equipment during loading and discharge. Wire slings tend to score the lower corner planks in the bundles, particularly when the slings are overloaded and so rope or webbing slings are preferable. Forklift truck damage, caused by the forks of the truck being driven into the planks, is common. This results in deep score marks in the timber and, in many instances, splitting of the timber.

Careful supervision by the ship's officers can prevent much of this type of damage.

## 15.3 Seasoning of Timber

Reduction of the moisture content of timber is achieved by either air or kiln drying. Timber is fully seasoned when the moisture content has been reduced to between 15 and 18%. The moisture content may also be reduced further depending on the purpose of the timber.

### **Air-dried timber**

Air-dried timber is timber that has been allowed to dry naturally, usually by stick piling in covered storage. This involves piling wood in stacks with 'sticks' between them to allow natural air circulation between the planks. The time required for this process will

depend on the type of timber and the climate. Once seasoned, the planks are secured in bundles with a number of flat metal strapping bands and are ready for shipment.

Often, these bundles are stored in the open and exposed to the elements, resulting in moisture infiltrating the individual planks. Although this may result in the planks on the outside of the bundles having a higher moisture level than expected, these planks will quickly dry naturally. The condition of the internal parts of the bundles will depend on how long free moisture has been trapped within the bundles and also the nature of the timber, ie its resilience to the effects of wetness. In the worst situation, the planks will be mouldy, still wet and severely black stained.

In general, high moisture contents for air-dried timber, without staining, do not provoke claims. However, if the moisture content is excessive, it is not unknown for receivers to claim the costs of stick piling to re-dry the timber. If such timber is not dried and remains in store, mould may develop and could lead to staining of the timber.

Air-dried timber is often carried on deck, with shipper's approval, without protection.

### **Kiln-dried timber**

Bundles of kiln-dried timber are generally protected by plastic wrappers and typically have a stencil on the outside of the bundle denoting the fact that the timber is kiln-dried.

Kiln-drying certificates usually specify to what degree the timber has been dried. The usual parameters are 8 to 12%, 14 to 16% or 16 to 18%. Provided the timber has spent sufficient time in the kiln and has been properly treated, the moisture content at the heart of each plank should show the correct degree of drying to within 1 to 2%, even though the surface of the plank may show a higher level of moisture through natural absorption after the kiln-drying process. Sometimes, the moisture content reading from the heart of the plank shows a higher reading than the outside of the plank and much higher than the drying certificate. This is a clear indication that the timber has not been properly dried.

Claims for re-drying of kiln-dried timber represent a large proportion of claims on timber cargoes.

It is often alleged by cargo interests that, to stow kiln-dried timber in the same cargo hold as air-dried timber, is not caring properly for the cargo. However, provided the air-dried timber has not been exposed to rain before shipment and become saturated, allegations of this nature should be rejected. Whether timber is air-dried or kiln-dried, it will eventually adjust to the optimum moisture level compatible with its equilibrium relative humidity, developed in due course, through contact with the ambient air. Therefore, loading of air-dried and kiln-dried timber in the same ambient air will not affect the kiln-dried timber to any noticeable degree during the voyage.

If dry timber is stowed in the same hold as saturated timber, the moisture content of the outer planks of the dry timber will increase through absorption. Experience has proved that, in these circumstances, the inner planks within the bundles are not affected during the course of a normal sea voyage. It is also true that wet timber, or timber with too high a moisture content, will not dry, regardless of how well the bundles are ventilated in the

stow. On a normal sea voyage, the timber will not deteriorate. However, if the timber is not dried when discharged, it will eventually decay.

If timber is kiln-dried too quickly or the moisture level reduced too far, this can result in the timber cracking. Usually, any damage of this nature will not be seen at the time of shipment. Claims for this type of damage should be rejected.

## 15.4 Plywood

Plywood is transported in large quantities throughout the world. It is highly susceptible to damage and often insufficiently packed for shipment.

The manufacture of plywood has been described as *“the unrolling of logs of wood”*. Very long thin sheets are shaved from the log and, after being cut to size, they are glued together to form plywood of various thicknesses. These thicknesses vary from around 4 to 25 mm and the sheets vary in size, the most popular being 96 × 48 inches (244 × 122 cm). Moisture content of this manufactured product has been found to be about 9%.

The method of transporting plywood is to stack the sheets into bundles of about 50 sheets or more, depending on the thickness of the plywood, which are secured together with metal strapping bands across the width of the base of each bundle. It is not unusual for plywood to be transported in a completely unprotected condition. In some trades, the plywood is partly packed and, on rare occasions, it is completely packed and protected.

When packing is used, it is often deficient, failing adequately to protect areas that are vulnerable to handling damage, such as the corners of the bundles. One of the most common forms of packing is an arrangement where the stack of plywood is enfolded in a plastic sheet and placed on a wooden frame. The sides, ends and top are then covered with plywood sheets and strapped up with flat metal strapping bands. If carried out properly and with care, this packing can adequately protect the plywood from normal handling and stowage problems.



**Figure 15.1: Plywood bundle showing torn plastic sheeting and loose and broken strapping bands.**

Often, this packing is applied without sufficient care. Any deficiency or tear in the plastic sheeting can allow moisture penetration into the bundle of plywood. The strapping bands are sometimes of inadequate strength and the method of joining them is often unsatisfactory. This results in a lack of rigidity of the bundle, causing the plywood sheets to become misaligned during handling. In the worst cases, the bundle becomes loose, with the potential for considerable damage to the edges of the plywood. If the side, end and top packing is too short, corner damage may occur.

It is important, therefore, that bundles of plywood are examined by the ship's crew before loading, paying particular attention to the packing of the plywood. Deficiencies in packing should be noted and suitable remarks inserted on the mate's receipts and B/Ls.

Careful attention should be paid to stowage to prevent corner damage, both during the stowage and in securing of the stow. The stow should be properly secured to prevent movement of the bundles.

Plywood can be easily damaged by moisture. Therefore, proper ventilation should be carried out during the voyage to minimise any possible staining from condensation. If possible, stowage should be away from the hatch square to prevent the possibility of moisture dripping down, particularly where the plywood is totally unprotected.

### 15.5 Paper Pulp (Wood Pulp)

Paper pulp is primarily composed of cellulose fibres that are normally produced from timber, although certain other raw materials that have a high cellulose content, such as sugar cane residues, may be used.

Two basic procedures are used for separating cellulose fibres from timber. The first is a purely mechanical process, where logs are stripped of bark, knotted and ground, using water as a coolant and transport medium for the fibres produced. The slurry of fibres is passed through screens and strainers to remove oversized material, which is returned to the grinders. It then passes over a cylinder board machine to convert it into sheet form. The sheets then pass through hydraulic presses to remove excess water. The sheets of pulp may be baled at this stage but, for overseas trade, are normally further dried to a moisture content of about 10% before baling in hydraulic presses and banding.

Different grades of mechanical wood pulp are used for the manufacture of different types of paper or board.

The second process involves stripping and knotting, after which the timber is cut into wood chips. The wood chips are the raw materials for a chemical treatment process that produces pulp.



**Figure 15.2: Discharging bales of wood pulp, each weighing two tons.**

The pulp may be bleached to varying degrees to produce white pulps for paper or board manufacture. Cargo shipments of paper pulp usually involve the carriage of bleached material in the form of compressed bales.

The bales are banded under compression using special equipment. If the bands are broken, it is not possible to restore the bales. This is of particular significance because modern paper/board-making processes rely on bales being in sound condition up to the time the pulp sheets are fed into a repulping machine.

For this reason, the same paper pulp that forms the sheets within the bales is used to form the protective outer wrapping. Shippers/receivers often claim that the outer protective wrappers form part of the contents.



**Figure 15.3: Unitised wood pulp. Note the use of airbags to secure the stow.**

### **Wetting**

If bales become seriously wetted, the cellulose will absorb water, like blotting paper, and swell, breaking the bands, with consequent problems. Prolonged wetting, such as would occur if bales were partly immersed in water, can also affect the strength of cellulose fibres. High quality pulps that have been wetted are sometimes considered unsuitable for their original purpose and the pulp is sold for manufacturing a different product at a reduced price. Comparatively minor wetting can result in rusting of certain types of bands. Any resultant rust staining produces localised spots of discolouration on finished white papers, which is unacceptable. This type of wetting may be the result

of inappropriate ventilation of cold cargoes. It must be remembered that much of the wood pulp traded around the world is shipped from countries that experience very cold winters, and Masters must, therefore, ventilate cargoes and record their adopted ventilation regime.

In theory, localised wetting of paper pulp can result in mould growth on the surface. However, there is normally sufficient moisture transfer through a bale to prevent this occurring, particularly as cellulose does not provide adequate nutrition for most mould species.

There have been occasions when the swelling of seriously wetted bales has resulted in structural damage to the ship. While this is only a remote possibility, the consequences can be dangerous.

### **Soiling**

Although paper machines are fitted with strainers, magnetic screens and similar devices, soiling of the outside of bales may result in particles of foreign material being incorporated in finished paper or board. Soiled bales, particularly where the soiling consists of particulate material such as grain or plastics granules, may be unacceptable to receivers. They can overcome the problem by tearing off the outer wrappers, but this not only results in loss of material but is also labour intensive. In an industry that is largely mechanised, providing suitable labour may be difficult and is costly.

Regenerated cellulose, which is used to produce viscose rayon textiles and cellophane film, is produced from very high quality bleached cellulose pulp. Because this process involves ejecting a solution of the cellulose through fine dyes, any particulate matter in the solution can completely ruin the product. Pulp sold for this end use must be kept in scrupulously clean condition. It is important that cargo spaces are thoroughly cleaned, particularly following cargo sounds as grain can easily contaminate the wood pulp.

### **Taint**

Cellulose will absorb odour and become tainted, although many taints can be removed in the paper-making operation. Because massive amounts of water are used in paper making, the water is recycled. Paper makers are particularly wary of introducing tainting materials into the water because, in some instances, the taint may be absorbed by the finished product. Such tainting would not be acceptable in products to be used in the food or other sensitive industries.

### **Fire**

Paper pulp will burn. During handling, abrasion between bales can produce significant quantities of cellulose fluff, which is particularly flammable. If a fire in a paper product gains hold, a massive amount of heat is produced, which is sufficient to cause structural damage to a ship. Extinguishing a fire at this stage is a major operation, almost certainly requiring flooding of a hold.

Masters are advised that it is imperative that no smoking is allowed in or near a cargo of paper pulp and stringent precautions must be taken to avoid sparks from any source entering cargo holds.



Care must be taken to prevent bales of paper becoming contaminated with oil, particularly vegetable oil. Cellulose has a large surface area, so atmospheric oxidation of the contaminating oil can result in self-heating to the point of combustion.

### **Mechanical damage**

Although this is less of a problem with paper pulp than with paper reels, bad handling may result in the breaking of bands or puncturing and contamination.

## **15.6 Reels of Paper and Board**



**Figure 15.4: Reels of paper ready for shipment.**

Paper and board are manufactured from paper pulp. A large number of different types of paper may be produced by using different types of paper pulp and by various treatments during the paper-making operation, such as sizing, pacifying, treatment to produce wet strength, polishing (calendering), coating, etc. More complex papers are commercially more valuable than less complex papers. Paper products that are unacceptable for the intended purpose must either be sold for scrap or returned for repulping. The pulp produced will inevitably be used for low grade products.

Major uses of paper are for print (newsprint, books, etc) and the manufacture of corrugated fibre board. Newsprint reels are used on high-speed printing presses. Any interruption in the printing process, due to a fault in the paper, results in a substantial financial loss. Users take particular care to ensure that only sound reels, or reels that can easily be handled to make them sound, are accepted.

Although the users of kraft paper are not constrained by time in the same way as newspaper publishers, they also employ high-speed machinery of high capital cost and take the utmost care to prevent any interruption on a production line.

The two main forms of damage that cause problems with reels of paper are mechanical damage and wetting.

### **Mechanical damage**

This may take the form of tears, cuts or snags. Where such damage occurs, the reels have to be unwound until completely sound paper is reached.

Another form of mechanical damage is distortion, which may result from unsatisfactory use of clamp trucks or any form of impact. Where distortion occurs, the paper web is subject to non-uniform tension during unreeling on a press or other machine. Because the web is under considerable tension, any non-uniformity can result in rupture.

### Wetting

Newsprint reels are normally overwrapped with a wrapping system incorporating a waterproof barrier. Kraft reels are not so protected. However, significant wetting of newsprint can result in the reels themselves being damaged.

Wetted reels, even after drying, normally present the same problems as distorted reels and again must be stripped down to undamaged paper before they can be used. Due to swelling of the fibres, severely wetted reels are likely to split.



Figure 15.5: Reels of newsprint showing tears and cuts both in the wrappers and paper before shipment.



Figure 15.6: Reel of newsprint that has been standing in water before shipment.

All reels should be examined at the time of loading for evidence of damage. As paper frequently originates from countries that are very cold in winter, they may sometimes be coated in a thin layer of ice, which is not detectable without careful checking. When found during loading, damaged reels should be rejected. If this proves impractical, mate's receipts should be clausured giving details of affected reels, including the nature of the damage. B/Ls should be clausured in the same terms as the relevant mate's receipts.

Ship's holds should be clean and dry before loading commences and, preferably, the tank tops should be covered with kraft paper or boards.

Great care should be taken to ensure reels, which are always stowed vertically, are not subject to uneven pressure from such fittings as horizontal cargo battens or dunnage. Any objects that can snag reels, such as projecting nails, should be removed. Other projections should be cased in dunnage. Rough sawn dunnage should not be used in contact with reels. The most suitable contact material is plywood sheets. Reels should never be secured in a way that results in direct contact with wires or chains.

Reels of different widths are often loaded in one hold and special care must be taken to ensure a stable stow. Care should also be taken to prevent wetting on board. Hatch covers must be closed when rain is threatened. The ship should be watertight and,

if the ventilation system is used, ventilators should be closed whenever bad weather threatens. Paper reels originate from the same areas as wood pulp, ie often from ports where the temperature is very low in winter. Masters should either check the temperature of the reels, which is difficult to do as there may be significant variation through a reel, or assume the reels are at the same temperature as the ambient atmosphere and adopt a ventilation regime accordingly.

Ventilation should not be used after loading in ports where the temperatures are low and when proceeding through/to areas of higher ambient temperatures.

Conversely, there have been claims due to wetting of relatively warm reels by ship's sweat when atmospheric temperatures are falling or when ventilation is interrupted during a period when the outside air temperature is lower than the dew point of the air in the cargo compartment, ie the ambient air surrounding the reels that is influenced to a degree by the peculiarities or characteristics of the actual cargo.

Another problem that may give rise to claims is taint. While this is discussed in relation to paper pulp in Section 15.5, it is not always easy to detect taint to paper reels, particularly when it originates from residual odours from previous chemical cargoes. For example, a case arose where bleached board was used for the manufacture of milk cartons and no taint was detected until complaints were made by consumers. The taint was traced to an earlier cargo of herbicides.

Masters should check, or arrange for surveyors to check, that holds to be used for paper products are not only scrupulously clean but also odour free. Detection of odour is very difficult when the atmospheric temperature is low and, therefore, when loading takes place under such conditions, it is recommended that known properties of earlier cargoes are reviewed.

Wetting and mechanical damage may occur at the time of discharge. Officers should supervise discharging operations and, where damage is seen to arise as a result of mishandling by stevedores, the occurrence and nature of such damage should be reported in writing to the stevedoring company and recorded in the ship's logbook.

## 15.7 Carriage of Wood Pellets



**Figure 15.7: Wood pellets.**

Wood pellets are the most common type of pellet fuel. The manufacture and carriage of wood pellets has increased because of their use as a renewable heating fuel. The main areas of manufacture are North America and Scandinavia.

The pellets are typically produced from sawdust and wood shavings. Pellets can contain additives and/or binders or be additive/binder free. As such, different pellet types are listed separately under the IMSBC Code.

During production, the sawdust and shavings are dried and then milled into particles of up to approximately 2 mm particle size. These are then compressed approximately 3.5 times into pellets that are typically 10 to 20 mm long and 3 to 12 mm in diameter. The compression leads to an increase in temperature. The pellets typically have a moisture content of 4 to 8% and vary in colour from blond to brown, depending on the types of wood used.

Due to transport movements and physical handling, some breakage of the pellets occurs and this means that the material loaded for transport consists of pellets, pieces of broken pellets and wood dust.

The wood pellets are combustible and may be ignited by a range of ignition sources. In addition, the dust associated with the pellets, when dispersed and ignited, may give rise to a dust explosion under certain conditions of containment. Stored bulk piles of wood pellets can self-heat in parts with a high moisture content and it is reported that this process can lead to the spontaneous combustion of the material after a long period of

time. This is especially likely when the moisture content is over 15%. High levels of dust concentration from the handling of wood pellets also carries an explosive risk.

In addition to the combustion hazards, wood pellets also undergo oxidation to produce carbon monoxide (CO) and carbon dioxide (CO<sub>2</sub>). In a closed space, such as an unventilated ship's hold, this can lead to a dangerous reduction in the oxygen concentration and the development of a dangerous concentration of CO, which is toxic and flammable. Therefore safe entry procedures must be followed at all times by all personnel.



**Figure 15.8: The loading of wood pellets.**

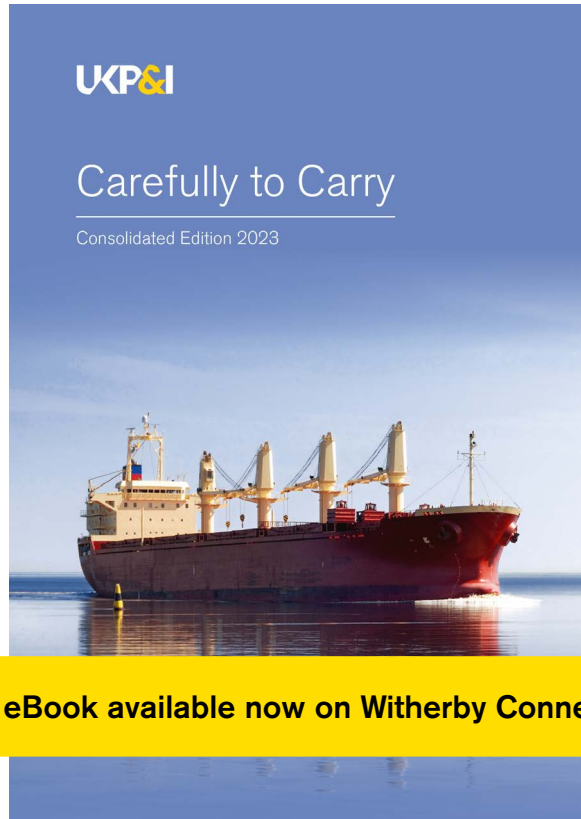
In one example, a CO concentration of approximately 1% was measured in the sealed cargo hold of a ship containing wood pellets some 18 days after the cargo was loaded. Furthermore, the oxygen concentration at this time was less than 1%. Emission rates for CO from wood pellets of up to 100 to 885 mg/ton/day have been reported.

It is well known that CO is produced when wood products are burned in reduced oxygen environments, but the low temperature emission of the gas from wood products may be unexpected. It has been suggested that the gas is generated by the autoxidation of fats and fatty acids in the wood, but the factors that promote the production have not been fully identified.

The CO hazard associated with wood pellets was referenced in the 2016 and subsequent editions of the IMSBC Code (Reference 17). The hazard associated with oxygen depletion and the generation of CO is now recognised. Safe entry procedures should be followed and all personnel should routinely employ gas detectors in spaces that contain or have contained wood pellets.



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