ITTO PROJECT PD 179/91
INDUSTRIAL UTILIZATION AND IMPROVED MARKETING OF SOME GHANAIAN LESSER-USED TIMBER SPECIES FROM SUSTAINABLY MANAGED FORESTS

PRODUCT DEVELOPMENT RESEARCH

REPORT ON STUDIES INTO VENEER AND PLYWOOD MANUFACTURING PRACTICES IN A GHANAIAN PLYMILL-BONPLEX

LOGS STORAGE AT LOGYARD

According to the millers, logs hardly stayed in the bush for more than 2 days before they were sent to the mill. Logs were brought to the mill by trucks which were then off-loaded with the aid of a mobile crane. New logs were usually placed on the tope of old ones. However, a programme would soon be in place to re-arrange the logyard so that first-in logs could be first used (FIFO basis).

It was observed that some logs got damaged during storage especially the easily decayed species like Koto, Ceiba, Otie etc. It was also observed that the decision as to which logs would be processed depended on requests or orders available. Certain logs could stay in the yard for a long time and some of them especially Otie showed severe end-checks which resulted in deep cracks extending into the log. The logs had no protection against the weather since an open air logyard is in use.

STEAMING

Before some logs were processed they were steamed for at least 24 hours in covered steam pits with indirect steaming. The purposes of the steaming process included:

(1) making bark of logs easier to peel

(2) obtaining veneer which did not tear during peeling or slicing.

(3) making peeling or slicing easier in some species.

(4) obtaining veneer with very smooth surfaces.

(5) changing or altering colour of veneer from some species.

(6) destroy the internal tension in the wood so that it would not crack later.

(7) level the moisture content of the logs at about 60%.

Some of the species did not require steaming. These included: Daniella ogea(hyedua) and Bombax brevicupse (Onyinakoben). Pterygota macrocarpa (koto), Antrocaryon micraster(Aprokuma) and Pycnanthus angolensis (Otie) were among those that required steaming. Whereas Koto for example, required steaming for about 2 weeks, Aprokuma required 24hrs. There were 3 steam pits for steaming of logs. Logs were grouped into species and put in

either of the pits depending on time required for steaming each species. Similar ones are usually steam at between 200^0 C and 240^0 C.

Effect of Over-Steaming

Over steaming could result in some soft species becoming too soft and tearing excessively during peeling. It could also result in severe checking of ends of the logs e.g. Otie. Ends of logs, like Otie, could also split excessively. The colour of the veneer produced from the species could also be very different from known colour of the species.

Under steaming

Understeaming results in a less tight veneer, rough surface, cracks on the loose side of the veneer and variations in the veneer thicknesses.

Bucking

Logs from the steam pits or straight from the logyard (for those not requiring steaming) were bucked into shorter lengths. Logs were bucked into the following lengths for reasons stated:

100cm and 130cm - for peeling into cross-core veneer of plywood 230cm - for peeling into veneer for plywood doors.
260cm - for normal length of plywood.

The lengths stated above included about 20cm extra length as tolerances to accommodate defects during manufacture of plywood. These are trimmed to specified lengths.

Debarking

The barks of logs were removed after bucking before peeling would begin. Debarking is done manually. These ease of debarking varied from species. Pterygota and chenchen for example are difficult to debark hence required long steaming duration. Such species are debarked using axes instead of small tools like cutlasses. Aprokuma was also said to require steaming before debarking. Species whose barks were easier to remove required no steaming for that purpose. The barks of some species could be removed from one end of the log to the other whereas others could be removed in pieces.

Peeling of Logs

Logs were peeled to produce rotary veneer for plywood manufacture. This was done just after debarking of the logs. The maximum diameter for the machine to handle was said to be 160cm. Larger sizes of logs were sent to the company's sawmill for lumber processing. A log was peeled until a core of about 26cm. was reached. The (minimum) core size or limit of peeling was determined by the following factors:

(1) the holding capability of the peeler

(2) the presence of defects in core

Peeling Characteristics of Some LUS

Difficult to peel: the wood of Kyenkyen is naturally difficult to peel.
Otie is very difficult to handle since the veneer tears so much during peeling, resulting in very low recovery. Wawabima (*Sterculia rhinopetala*), like Otie, is a species which had great tendency to tear during peeling. Areas around ends of Otie veneer tended to stain if log was left so long in logyard.
To prevent excessive tearing, speed of peeler was reduced, so that peeling was done slowly.

Easy to Peel: Aprokuma, Ceiba and Ogea, are species which peeled easily. The veneer peeled easily as the log rotates like unfolding a sleeping mat.

Blunting of Knives: For species like Ogea, Koto,Kyenkyen and Wawabima cutting knife had to be changed after 6 to 8 hours of usage. Poor or rough cutting resulted if the knife was not changed. For species like Bombax, Ceiba, Aprokuma and Otie knives had to be changed only after 24 hours of usage.

Excessive Moisture Content: Ogea, Ceiba and Otie had very high moisture content which could be seen during peeling. However, the moisture in Aprokuma and Wawabima was relatively low. Otie possessed the most excessive moisture than all the others. Even during peeling it sometimes had moisture content above 50%.

Veneer Recovery: High veneer recovery always resulted from logs with straight and cylindrical boles. For species like Ceiba, Ogea, Aprokuma and Bombax, about 80% of log could be peeled into veneer because the logs were usually straight and cylindrical. Species like Koto and Otie were usually not cylindrical and recovery from log was low. Generally, species with high recovery are, Aprokuma, Kyenkyen and Bombax. Those with low recovery include, Ceiba, Ogea, Otie and Koto.

Observed Peeling Characteristics of Daniella Ogea (Hyedua)

(1) The log was not steamed since it is naturally soft and steaming could cause wood fibres to tear during peeling as it would be too soft.

(2) Peeling was very easy as the knife could cut easily the fibres with little blunting.

(3) Debarking could only be done with an axe since the log was not steamed.

(4) Peeled veneer was smooth and not-fibrous.

Improving Quality of Peeled Veneer

Knots, dead of defective wood etc were usually removed before or during peeling (machine was stopped), using an axe. Such defects as knots tended to break tips of knives resulting in scratches or lines on surfaces of veneer. Veneer quality is hence affected.

Knife Characteristics

Knives were sharpened to 18^0-30^0 in the study mill. For the slicer, the knife was usually sharpened to 19^0 and for the peeler 20^0. In both cases, clearance of 0.5^0 was allowed for smooth and unimpeded movement of knives.

In the case of the peeler a gap equal to the thickness of the veneer and minus an allowance of about 10% movement was usually allowed. Gaps varying from 0.m and above were common.

For both, the slicer and peeler, the knives should be well sharpened and straight-edged. Pressure bar should be level and accurately set. The degree of the pressure bar was usually between 65^0-70^0.

Factors Governing Limit of Peeling

Bolts were usually peeled to a limit of about 26.c. which is a little more than the diameter of the dog (25.c). The peeler was observed to have been automatically set to stop at this specific limit so that the knife would not touch the dog. Thus dog size determined the limit for peeling.
Whereas the above dog was used for large size logs, a smaller dog of 15 cm diameter was used for small size logs leaving a core of about 18cm.

Using a smaller dog for a large size log, especially in the case of soft species, resulted in dog penetrating the log ends. This situation was referred to as "biting".

Col.our of cores of some species also differed so much that they could not be peeled further.

How to Further Increase Peeling

- This could be done by stopping the process and changing the bigger dog with the smaller. This was said to impede progress and affect production targets.
- Modern machines possessing various sizes of dogs which can automatically switch or change dogs as peeling progresses is recommended. Such a machine should also have devices to hold the smaller core during peeling to avoid breaking.

- A batch of workers, for example, night shift workers, could be made to further peel larger size core left over during the day, using smaller dogs.

It was argued that cores of some species were very soft especially for young trees and unuseful eg. Ceiba, Otie etc, and that the cores left over were used as firewood for boilers. Cores could also be sold as lumber. However, it was concluded that peeling could still be done to further increase recovery. Where there is excessive colour change in the core, then an alternative use could be made of it.

FLITCHING

Logs/boles to be sliced into sliced veneer were first prepared into flitches using a bandsaw machine. Flitching, is the process of cutting the bole into appropriate shapes or sizes ready for slicing. to obtain the required texture, figure etc. on the veneer. The logs were flitched after debarking. Slabs on log sides were first sawn-off before flitching. There were about four flitching patterns in use at the mill. They included:

(1) Quarter cut: where only boles with diameters greater than 90cm were cut in four parts along the log diameters. The principle is to reduce large diameters for easy handling.

(2) Half cut: where the bole was split into two halves before slicing. This was done for bole diameters between 70cm and 80cm.

(3) Flat cut: in this case after removing the slabs around the bole, slicing begun without cutting the bole into parts. Flat cut was adopted for smaller diameters below 70cm.

(4) Rift cut: this pattern was adopted for any size of bole with many defects. Cutting is done to reduce the effects or

presence of the defects on the sliced veneer.

SLICING

Slicing is the process of cutting logs/boles into sliced veneer. Sliced veneer is produced from boles/flitches using a slicer machine which cuts a specified thickness of the flitch from one end to the other. Only horizontal slicing was done at the study mill.
Thickness of sliced veneer produced ranged from 0.55-5mm. All the sliced veneer produced by the company were for export.

Species for Sliced Veneer

Not all species are used for producing sliced veneer. Some of the species, sliced into veneer included: Akasaa and Kyenkyen. (Makore, Sapele, Asamfona, Mansonia, Cocollei, Koto, Edinam' Mahogany, Ofram, Utili, Hyedua, Walnut and others).

Directions of Slicing

Quarter slicing: Slicing was done along either of two radii in the quarter cut bole. Quarter slicing produced straight grained veneer.

Half slicing: Slicing along cut diameter and resulted in half fancy design or half straight grained figure on veneer.

Flat slicing: Slicing the bole from one end to the other without cutting into parts resulted in flower patterns or full fancy design on the surfaces of the veneer.

Production capacity: The study mill could produce about 400 000 ML^2 of sliced veneer per month.

Efficiency of slicing: In order to improve the slicing efficiency, the machine and the bole should be so set that all cut edges are parallel and straight. For two ends of a flitch, and from one edge to the other end of a flitch should be the same as at the other end. At the study mill, a difference of about 1cm always occurs.

Veneer Drying: The process of drying veneer reduced the moisture content to about 6% in the study mill. No initial moisture content with regard to drying regime is measured prior to the drying.

Kinds of Dryers: There were two types of dryers - the roller type and carpet or belt type.

Roller type: Used for drying thicker veneer eg. 3.5mm thick. This type is faster in operation and using it for thinner veneer would result in the veneer getting torn in the dryer.

Belt/Carpet type: Used for drying thinner veneer below 3.5mm. This type is slower in operation compared with the roller type.

Regulating Drying: Steam is produced from boiler and distributed to each of four dryers in the mill. At steam gauge of 4 bars (Kg/cm) temperature of about 112^{0}C was almost constant for drying. Whenever the steam gauge changed resulting in higher drying temperature, the roller speed was altered from the normal 15 units resulting in shorter drying times. At the normal speed, it took about 25 minutes to dry Ceiba peeled veneer of 1.5mm to 6% moisture content. For sliced veneer, it took about 1 minute to dry i.e.(0.6mm thickness).

Problems Encountered During Drying:

Ceiba: veneer easily got torn during handling before and after drying.

Bombax: face veneer did not tear so often as Ceiba.

Ogea: face veneer also got torn very often.

Otie: 3.3mm core veneer got torn very often but did not shrink: so much. It has little moisture than Ceiba.

Surface buckling: veneer surfaces buckled after drying due to overheating. Speed of rollers were than adjusted to shorter rater of drying.

Shrinkages: veneer dimensions usually reduced after drying to about (5 to 10%) Tolerances are provided to accommodate shrinkages.

Overdrying: veneer surface around steam pipes in dryers sometimes over-dried. Speed of rollers were then re-adjusted to obtain moisture content of about 7% for other areas whilst areas around steam pipes obtain about 6%. Overdrying results in buckling of the veneer and makes it more propel, leading to unnecessary damages.

Colour changes: the usual colour of veneer usually changed after drying, becoming lighter in colour. This was due to moisture loss from the veneer. Bombax, Ceiba, and Ogea became more lighter in colour.

Staining: veneer from the lighter coloured species could get stained if left overnight without drying. Efforts were made to dry all veneer produced in a day.

Tolerances: tolerances were provided on the dimensions of veneer before drying to accommodate shrinkage during drying. For example 1.5mm thick fresh Bombax and Ogea veneer became

1.32mm thick after drying. Usually tolerances were also provided in width of veneer. For example, 135cm width reduced to 127cm whilst length of 250cm did not reduce much. It has been observed that the light coloured species like Ceiba, Bombax, Ogea, etc. shrink more than the primary species like Mahogany. Tolerances provided in the lighter coloured species were greater than the redwoods. In Mahogany, width of 134cm could reduce to 127cm.

Drying schedule for Ceiba: 3.6mm peeled veneer took between 40-45minutes to dry when roller speed was 20 units and steam gauge was 4 bars generating a temperature of 120^{0}C.

Trimming: Both edges and ends of sliced veneer were trimmed. The purpose of trimming was to remove sapwood and other wood defects to improve quality of the veneer.

Trimming resulted in both shorter or narrower veneer in some instances. These were also included in orders and tied together with the helping of machines. Veneer off-cuts were sent to boiler as firewood.

Grading of veneer: Flitch grading principle is in use. There are Thirty-two sheets in a packet of veneer. The grading process is the determination of how frequent certain defects appear in veneers in the bundles in a flitch. The flitch is then graded into one of 3 grades. - Face, Interior and Backing. Sub-back grade is also available.
Thus visual grading principle is in use.

Backing defects:

The following were defects which put a flitch into the backing grade:

Pin knots; large knots; bar knots; flashes; irregular grain directions; black spots; black streaks; red streak; uneven colour.

Interior grading defects:

Defects which put a flitch of veneer into the interior grade were mentioned as:

- Grain: Slightly wavy grain.

- Pin knots: there should be few knots but should not be scattered.

- Colour: only slight discoloration permitted.

- Flashes: only few flashes due to natural tree growth pattern permitted.

Face quality grading:

A flitch of veneer is put into the face grade where:

- there should be 100% heartwood with no blemish or manufacturing defects.

- there should be only straight - grained veneer

- only occasional pin knots admitted

- there should be no discoloration.

Manufacturing defects

Manufacturing defects considered in grading included:

- raised fibres and

- tension wood causing surface roughness (the log should be well steamed to soften the wood).

Factors affecting quality of veneer

The way logs are bucked results in the different grades of sliced veneer. The presence of large buttresses in logs and long tapering logs usually produced varied grades of veneer. Where straight cylindrical boles were cut from the log, the veneer produced were usually straight grained. Boles with knots usually produced veneer with pin knots. Uneven-grained veneer resulted from tampering bolts and bolts having buttresses.
Discolored veneer resulted from logs which had overstayed in the logyard. The presence of mineral deposits in the wood eg. Asanfona(this is related to its site) also affect quality of veneer.

PLYWOOD MANUFACTURING

Plywood of various thickness are produced by the study mill both for export and local markets.

Thicknesses produced are: 4m; 6m: 9mm; 12mm; 15mm and 18mm. For special orders 25mm and 26mm plywood can also be produced.
Plywood is produced by gluing peeled veneers together under steam pressure.

Constitution of the Glue

Only interior quality glue-Urea Formaldehyde - is used in plywood production in the study mill. The glue is mixed in the mill in the form of powder and water. The powdered component comprised Aerolite FFD, Hardener TH8A and Extender TH8B. The mix proportion: Aerolite: Hardener:Extender = 100kg : 7.5kg: 12.5kg.

These proportions are mixed with 100-105kg of water and well mixed to obtain a uniform and homogeneous liquid which should have a viscosity of about 50-60 sec. in a viscometer. The viscosity of the glue is measured by the time in seconds taken for a quantity of glue to pass through a viscometer. The order of mixing the glue is as follows:

(1) the extender is first put in water and mixed for about 15 minutes until well mixed.

(2) the aerolite is then added and well mixed for about 15 minutes.

(3) the hardener is finally added and mixed for about 15 minutes before use.

The extender can also be the common wheat flour.

<u>Mode of Plywood Construction</u>

- The 4mm or 1/8" plywood comprises 3 plies of veneer. 1.2mm face veneer; 2mm cross-core veneer (which passes through glue on both faces) and 1.2mm back veneer.

- The 6mm or 1/4" plywood comprises 3 piles of 1.2mm face veneer. 4mm cross-core and 1.2mm face veneers.

- The 9mm or 3/8" plywood comprising 5 piles of 1.2 face, 3.3mm cross-core, 1.2mm long core, 3.3mm cross-core and 1.2mm back veneer.

- The 12mm or 1/2" plywood comprising 5 plies of 1.2 face, 3.3mm crossed-core, 3.3.mm long core, 3.3mm cross-core and 1.2mm back veneers.

- The 15mm or 5/8" plywood comprising 7 plies of 1.2mm face, 2.7mm cross-core, 2,7mm long core, 2.7mm cross-core, 2.7mm long core, 2.7mm cross-core and 1.2mm back veneers.

- The 18mm or 3/4" plywood of 7 plies of 1.2mm face, 3.3mm cross-core, 3.3mm long core, 3.3mm cross-core, 3.3mm long core, 3.3mm cross-core and 1.2mm back veneers.

. It was noted that only cross-core surfaces pass through glue for the plywood manufacture.

. There were usually alternate cross-cores and long cores which was expected to increase dimensional stability of thicker plywood.

. In all cases, the face and back veneers were 1.2mm thick.

. Whereas quality of long and cross-core veneers for plywood manufacture was not very important, the face and back veneer quality was of utmost importance.

. For any thickness of plywood the construction thickness was greater but reduced to the final required thickness after pressing and sanding.

Veneer Condition and Quantity of Glue Used

The following surface conditions of veneer cross-cores resulted in excessive glue in order to obtain good bond:

- veneer from species having uneven moisture content distribution eg. Ceiba, Otie, Bombax and Aprokuma.

- core veneer having wooly surfaces eg. Ceiba.

- core veneer having rough surfaces.

- too smooth cross-core surfaces eg. Otie

Glue Spread Determination

One cross-core veneer of 250 cm x 127cm was cut into two along the length and each half weighed. The two halves were both pushed into the gluing machine simultaneously and then re-weighed. The difference in weight of each half between the new and the original weights was calculated. The difference in weight was compared within a standard weight e.g. for Ceiba 460g. The difference could also be divided by the total surface area of a the veneer and the spread obtained. For Ceiba a spread of 289g/cm^2 is suggested. If the expected difference in weight is not obtained, the correct spread will also not be achieved. Causes of the difference should be sought. Hot veneer quickly dried-up glue and more glue would be required before pressing plywood. Wrong adjustment of machine could cause the difference and must be re-adjusted and process restarted. Throughout a working day, about 4 tests should be conducted to check glue spread.

The Press

The plywood press is hydraulically controlled and steam temperature used.
The pressing time and usually varies with the thickness of plywood being produced. The temperature of the press was normally the same as that coming from the boiler (105c). The thicker the plywood the longer the pressing time and the higher the pressure. Should the steam temperature from the boiler increase, the pressing time is reduced.
In order to prevent glue on cross-cores from drying up as a result of assembled plywood having to stay for a long time, construction assembly time was such that only 4 panels are ready at a time awaiting packing into press.

Pressing Pressure

The hydraulic pressure applied for plywood bond should be well regulated. If too great pressure is applied on plywood from very soft species like Ceiba, the panel can be destroyed. However, without applying an adequate pressure, poor quality bonds resulting in low grade plywood will result. In the study mill, the same pressing time is used to press plywood of the same thickness irrespective of the wood species. However, the pressure used usually varies from species to species. For example, for a 4mm Ceiba plywood, 156 bars ($2200 lb/in^2$) pressure is used to press for maximum of 3 1/2 minutes. Larger times is used to press thicker plywoods.

The magnitude of the pressure used depends on the make or type of press. Thus two different presses may use different pressures to press the same thickness of plywood.
Before panel pressing begins, the press is initially heated to 120^0 C for about 1 to 2 hours and then regulated to 110^0C maximum before panels are put in. The usual temperature varies from 100^0 C to 110^0 C but the average is 105^0C.
The panels should always be properly arranged in the press before the pressure is applied to ensure uniform application of pressure at all points.

Problems Encountered in Pressing

(1) Blisters: Blisters are the pulling-up or raising of face or back veneers of plywood. This is usually caused by one of the following:

- when there is too much glue at a particular spot, not all can be used in the bonding process, resulting in blisters. Glue spread should be checked.

- where there is too much glue at a particular spot, not all can be used in the bonding process, resulting in blisters. Glue spread should be checked.

- where there is excess moisture as in Ceiba, Otie etc. the glue is not effective and tends to dry up during pressing. The spot is therefore not bonded.

- fast drying of glue on cross-cores before put in press. May be due to very hot veneers, wooly veneers etc.

(2) Poor Glue Bond: The entire face, back or long core bonds may not be adequate resulting in poor quality plywood. This is either due to inadequated pressure applied during pressing or insufficient glue spread on cross-cores as a result of improper glue application or hot veneers or even woolly veneers. Another cause may be aa sudden increase in press temperature which causes quick dry up of glue before proper bond strength achieved.

Improving Durability of Plywood

(1) Some level of chemical preservation is carried out to improve the quality of plywood produced, especially from the white species. Aa quantity of about 1/2 kg of chemical is usually added to the glue mix proportion. This is expected to improve resistance against insects and fungi to some extent.

(2) To improve the quality and durability of plywood from Ceiba, Otie, etc. redwood cores are sometimes used.

(3) Testing quality of glue bond: This is done as a routine. For U.F.glues, the simplest method used is cutting samples of plywood with knife. Strong bond is difficult to separate. Alternatively, putting a sample of plywood in water to find how long veneers take to separate is another method. Poor bonds separate in matter of seconds.
Phenol formaldehyde glues are however, boiled to find length of time taken to separate.

Jointing

Short lengths of veneer are joined together by machine (Joiner machine). The procedure is as follows:

- Edges of the veneers are straightened by trimming in a machine (package clipper).

- White glue (Rakol 30) is applied at edges of both pieces of veneer to be jointed.

- The two glued edges are brought together carefully and heated together as they pass through the joiner machine to become one wide veneer. Several short widths are brought together to obtain the required size.

Under this method of jointing, kyenkyen, kyere, Makore are among species noted to be difficult to join due to the fact that the veneer surfaces are not smooth and the joint formed can be weak. Ceiba, Otie and Bombax however, give no jointing problems. Alternatively, two veneers are stitched together by machine using a nylon thread (Kuper Spule). This process uses water, air and heat to melt the nylon thread on the joint. In the end, the thread is shown melted on only the top side of the joint. The thread can later be removed by pulling to separate the joint (if necessary). In certain cases, veneer is stitched by this method across the width both top and bottom of veneer to prevent splitting or tearing.

Sorting of Veneers

Before plywood was manufactured, rotary peeled veneers which have been jointed together where necessary, were sorted into face and back quality. Very good quality faces and backs were used for producing plywood for export. Back-quality veneers for the manufacture of export plywood was the type usually used for face veneers for locally marketed plywood.

Sizing and Sorting of Plywood

Tolerances were usually allowed on the lengths and widths of veneers for plywood production so that breaking/tearing at edges could be accommodated. The plywood so produced was then sized (ie trimmed) both along the lengths and widths. The sizing machine is equipped with double saws (a big one up and small one below) to obtain clean and smooth cut.
It was observed that Ceiba, Otie and Kyere were easy to size due to their soft nature. Bombax and Kyenkyen were however, aa bit difficult to size since they are a bit harder than the three species mentioned above.
During sizing, plywood is sorted into locals, export and rejects. The selection is done visually and best face and back quality plywood are chosen for export. These are sent for puttying before sanding. Rejected ones are those with edge/end breaks, poor surface quality and defects such as blisters etc. Good quality plywood not chosen for export are sold locally.

Sanding

Sanding is the process of surface treatment, using sandpaper to improve the colour, appearance, and quality of the finished plywood./ In the study mill mainly plywood for export is sanded, using a sanding machine, on both face and back.

Decorative veneers are usually sanded as a necessity. Ceiba plywood for export are sanded to remove surface market is also sanded. This improves its unpleasant colour appearance and surface roughness.

Ceiba and the other soft species are usually sanded easily. Problems encountered during sanding were mainly due to manufacturing problems such as buckling, bending etc in which case poor sanding results.

Final Inspection of Plywood

Before plywood is sent out to the export or local market, a final inspection is carried out in the study mill. Serious inspection is usually carried out in the export grade. The following defects are usually considered during the inspection process:

(1) Bad edges	(2) Short cores	(3) Short face
(4) Rough surface	(5) Blisters	(6) Heavy overlapping
(7) Sander damage	(8) Press damage	(9) Open core

- Bad edges usually resulting from poor sizing are rejected from the export grade plywood. This may be sold locally.

- Short cores usually resulted from a situation where plywood cores were not up to the required dimensions. At the edges of the plywood open space can be seen within the plywood. These may also be sold locally. For special orders of 26mm thickness, short cores were trimmed lengthwise, since width dimension was not important.

- In situations where faces were not up to the required length at some points, short faces resulted. These were sold locally or in severe cases sold out as rejects.

- Rough surface plywoods resulting from poor peeling were sold locally.

- Blisters usually resulting from, insufficient or excessive glue at a point, excessive moisture at some points usually common with species with uneven moisture distribution such as Ceiba, are checked for in every plywood for export.

(a) For 4mm and 6mm thick plywood, blisters are detected when bent lengthwise. Blisters show up and knife used to remove it.

(b) For thicker plywood, the defect can be detected by knocking the surfaces. Deep noise heard easily through experience identifies aa blister. A knife is used to remove it.

Plywood containing blisters are sold as rejects. Unless care is taken to safeguard against the occurrence of blisters, the defect can result in substantial loss of revenue.

- Overlapping occurs if one side of a core veneer overlaps the other. After pressing a projection in the form of a line across the plywood surfaces indicates the occurrence of the defect. Such plywood is not included in the export parcel.

- In situations where the sander fails to sand the edges or some portions of the plywood surfaces, sander damage results. The affected plywood cannot be sanded again, since thickness will reduce. It is then sold locally.

- In a situation where an unwanted object on a surface of veneer panel is pressed into the plywood, a grove is left on the surface resulting in press damage. This cannot be corrected even by sanding. This plywood is sold locally.

- During the assembling of veneers for plywood manufacture, a situation where two veneer cores fail to come close together, leaving a space in between can result. After pressing, a long groove in the form of a line across the plywood is observed. This is referred to as open core. Such plywoods do not go to the export market but sold locally. Where open core defects occur only at edges of the plywood, those short open cores are puttied and exported. At the end of every inspection, rejected plywood pieces are proof inspected before they are taken away.