

A Study on Analysis of Product Quality Problems in Plywood Production of No (2) Plywood Factory in Myanmar

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ABSTRACT

Nowadays, plywood market is wide and trend is toward not only local but also international. Global plywood market size also is anticipated large and increasing demand for easy to install and ready-made furniture are furling the growth of the plywood market. To keep the competitive advantage, quality improvement is one of the marketing strategies to lead plywood market. The main aim of this research is to analyse the root cause of the quality problems and develop solutions in the plywood manufacturing processes. The data was collected from the No (2) plywood Factory of Myanma Timber Enterprise After analysing the manufacturing processes and defect data, the main quality problems of plywood manufacturing processes of the factory were uneven thickness and high moisture content and these two problems are toward the low-grade product. To reduce the nonconforming items, some statistical process control SPC tools were applied for finding the root cause of the problems. Finally, the proposed solutions were developed to solve the root cause of the quality problems of plywood production of No (2) Plywood Factory.

KEYWORDS: Plywood Manufacturing Processes, Root Cause Analysis, Quality Problems, Quality Improvement, SPC Tools

INTRODUCTION

History of plywood, probably the first veneer was manufactured in ancient Egypt around 3000 BC. Plywood was invented in the 19th century by Immanuel Nobel, Alfred Nobel's father. Nobel realized that several thinner of wood bounded together would be stronger than one single thick layer of wood and invented the rotary lathe used in plywood manufacturing. The first factory for the production of veneers was built in Germany in the middle of the 19th century. The quick development and improvement of the rotary peelers gave an impetus to the plywood industry prior to World War I. the manufacturing process of plywood was established in France in 1860s [1]. Plywood is a very strong and durable composite panels made from three or more wood veneer bonded together with and adhesive. There are many types of plywood and these are three ply plywood, five ply plywood and multi ply plywood [2]. Global plywood market size is anticipated large and increasing demand for easy to install and ready-made furniture are furling the growth of the plywood market. In urban area, consumer prefer to buy durable and lightweight

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furniture, which furniture make with plywood so the market is growth. Plywood has gained popularity over the year due to its good strength, flexibility, workability and reusability. In addition, it offers excellent insulating properties for the end product and is very weather and water-resistant Plywood is used for construction and flooring application due to enhanced mechanical strength and considerably decreasing the overall weight of the product.

Plywood is a building material made of veneers (thin layers or layers of wood) glued together with adhesives. There are two types of plywood; softwood plywood and hardwood plywood. Soft plywood is usually made from cedar, sprues, pine and is widely used for construction and industrial purposes. Hard plywood is usually made from the birch plant. Birch plywood is characterized by its excellent strength, rigidity and creep resistance. It has a high planar shear strength and impact resistance, which make it especially suitable for heavy-duty floor and wall hardness and damage and wear-resistance.

In Myanmar, the first plywood factory, No. (2) Plywood Factory was started in 1959, it is one of the government factories. Today, there are more than 100 plywood factories in Myanmar. Plywood market are facing with high competition. Therefore, companies use marketing strategies to achieve and communicate a sustainable competitive advantage over competing companies. The 4P's is Marketing Mix strategy, there are the product (the good or service), price (what the customer pays), the place (the location where a product is marketed), and promotion (the advertising). 4P's of Marketing Mix only product variable has proven to be significant toward customer loyalty. Therefore, companies should focus increasing the product quality and reduce the non-conforming items.

Myanmar plywood factories were confronting with defect product in the production process. The impact of defect of product manufacturing is loss customer and less profit for organization. Increasingly strong competition in the plywood market is forcing the companies to improve their production process [3]. Six key points of plywood quality control are essential for quality improvement and management, these 6 key point factors (5M1E) are Men, Method, Material, Machine, Measurement and Environment. To be effective in plywood quality management, analyzing the production process were analyzed by using statistical process control (SPC) tool, it's a useful tool for quality improvement [4]. In this

research, applying the SPC tools such as Check Sheet, Pareto Chart, Histogram and Cause and Effect diagram.

PLYWOOD MANUFACTURING PROCESSES

Manufacturing process is the turning raw materials or parts into finished goods through the use of tools, human, machinery and chemical processing. The process of plywood manufacturing has eleven steps as shown in the Figure 1 and the function of manufacturing processes are shown in the Table 1. All steps are not strongly affected to finished product quality but peeling and drying process are essentially change physical and chemical surface properties of veneer manufacturing process [5]. The influence of wood veneer thickness is more related with peeling equipment [6]. Moisture content can affect many physical properties and strongly affect the final strength and durability of joint [7].

Figure 1 Plywood Manufacturing Process

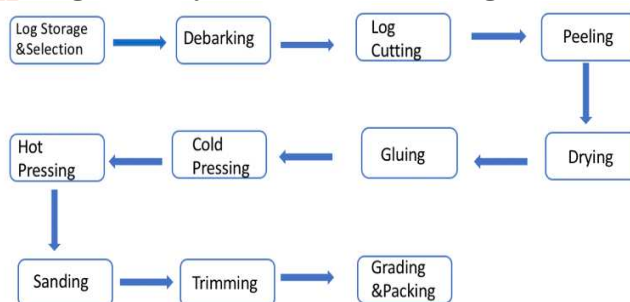


Table 1 Function of Manufacturing Process

Step	Process	Function
1	Log Storage And Selection	There are Two types of log storage that are log yard and natural log pond. Selection is based on physical properties (Maturity, Straightness and Roundness).
2	Debarking	The logs are debarked to get round diameter and remove the hard material, sand and other dust.
3	Log Cutting	The logs are cut to suitable length and ready for peeling.
4	Peeling	Peeling veneer is used rotary lathe. The log is rotated around its axis and peeled off like a carpet roll.
5	Drying	Green veneers are dried in drying machine to get moisture content limit 6 to 12% of dry veneer.
6	Gluing	Glue is spread on veneer by passing them through the rollers of a glue spreader.
7	Cold Pressing	The assembled veneer is cold pressed to facilitate the bounding process and ensure good adhesive.
8	Hot Pressing	Hot pressing is set a time between heated platens at a set temperature and time to achieve proper bounding.
9	Sanding	Sanding is sanded for face quality
10	Trimming	Trimming is trimmed to precise dimension.
11	Grading & Packing	Defined four grades (grade I, II, III and reject) - Grade (I) Feature is smooth, sanded surface without knots - Grade (II) Uneven thickness, woody surface, inaccuracy size - Grade (III) babbling, losses glue - Reject, Crack sheets

METHODOLOGY

The present research paper is related to the quality improvement of plywood manufacturing with the purpose of identifying the major root cause and effect of critical factors for non-conforming. Firstly, the whole process of plywood manufacturing was studied and investigated. After analyzing the manufacturing processes, the critical processes were identified for the quality improvement of plywood manufacturing. And then the defect data was collected from grading section. After that the data was analyze by using check sheet according to the defective categories. And then the defective factors of the processes were analyzed with Pareto chart to know the main defective factors. After that cause and effect diagram was drawn to analyze the root cause of the main defective factors. Finally, the possible solutions were developed to solve the root cause of the quality problems.

DATA COLLECTION AND OBSERVATION

A. Data Collection

The correct data is supported the process of gathering and measuring information variable of interest. Data collection is one of the most important steps in research. In this research paper, the data come from primary data source which is an original data and directly collected by the researcher. The research area is No (2) Plywood Factory. The data are collected from Grading Section which is the final step of manufacturing process as shown in the Figure 2. The type of product is three ply plywood, size 8'x4' and 4 mm thickness. The duration of data collection is 12 days in October 2021. The production rate of factory is 1000 sheets per day and quality data of the productivity is shown in the Table 2. The method of data collection is random sampling and collected sample 12 sheets/day in 30 minutes interval as shown in the Table 3. After collecting the data, the sample defect data was compared with defect data of the whole productivity. Defect precents of sample data and actual data were similar. Random sampling is a subset of statistical population in which each sample has an equal probability of being chosen. Therefore, a sample chosen randomly is representation of the total population. In this research, the actual result of finished product is 85% (grade I), 9% (grade II), 6% (grade III) and 1% (reject) as shown in the Figure 2. The result of random sampling is the same outcome percentage with actual. So, the sampling data can represent the total productivity.

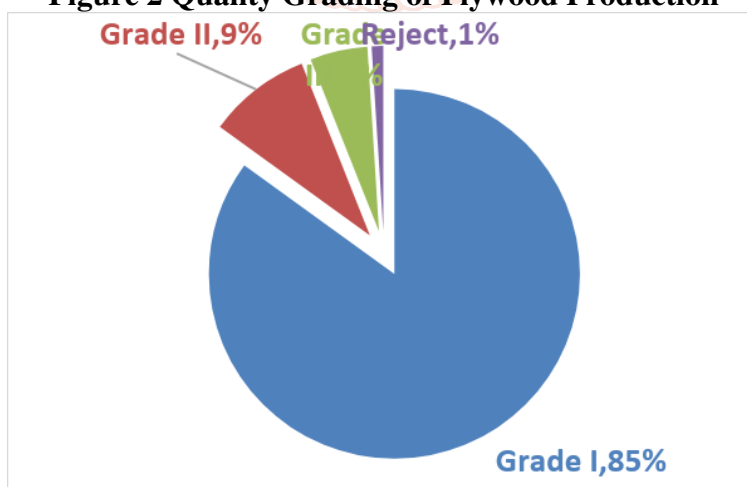
Table 2 Product Quality Data of 12 Days Production

Quality	Grade I	Grade II	Grade III	Reject
Production (Sheets)	1020	108	60	12
Percentage	85%	9%	5%	1%

Table 3 Random Sampling of Quality Data of 12 Days

Quality	Grade I	Grade II	Grade III	Reject
Production (Sheets)	336	37	26	1
Percentage	84%	9.25%	5.75%	0.25%

Figure 2 Quality Grading of Plywood Production



B. Data Analysis with Check Sheet

The check sheet, also known as the “Disability Concentration Diagram”, is basically a data collection sheet. By using check sheet, the frequency of defects was calculated. Check Sheet is relatively sample form used to collect data and it consist the category of nonconforming. Check Sheet is the simplest quality tool and it is useful tool to draw histogram and Pareto chart. Check sheet calculated percentage frequency and cumulated percentage frequency as shown in the Table 4.

Table 4 Data Analysis with Check Sheet

Defective Factor	Frequency	Percentage Frequency	Cumulative Percentage Frequency
Uneven Thickness	27	42%	42%
Loose glue	24	37%	79%
Inaccuracy size	8	12%	92%
Woody Surface	3	6%	96%
Babbling	2	3%	99%
Cracking	1	1%	100%
	64	100%	

C. Pareto Chart for Nonconforming

Pareto Analysis used to Pareto Principle and it call 80-20 rule (80% of problem stem from 20% of possible cause). Pareto chart for nonconforming uneven thickness and loose glue as shown in the Figure 3. The left vertical axis indicated the number of frequencies of each type of defective category and the right vertical axis indicated cumulative frequency. The horizontal axis is defective categories. In this Pareto chart, it is easy to see the uneven thickness and loose glue and these are the major nonconformities. Factory’s inspector should focus on the production process of peeling machine for uneven thickness and operation of drying machine for loose glue and babbling plywood for high moisture content.

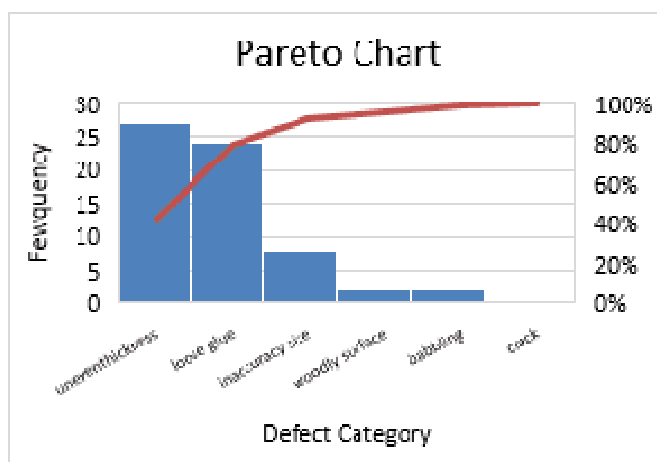


Figure 3 Pareto Chart for Defect Category

D. Cause and Effect Diagram

Cause and effect diagram (CE) are also called fishbone diagram or Ishikawa diagram and it is a tool for organization and displaying interrelationships of various root causes. In this study, root cause of the problems was analysed by using Cause and Effect Diagram. There are four areas for source the problem, which are Machine, Men, Material and Method. The possible causes of the problem from Machine, Men, Material and Method of the effect of uneven thickness for peeling process of plywood was showed in the Figure 4. And then the possible cause of loose glue and babbling for high moisture content percentage in drying machine was showed in the Figure 5.

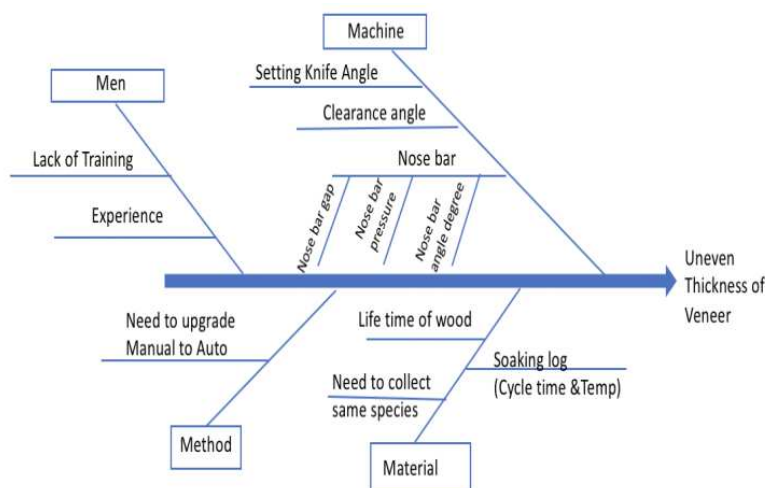


Figure 4 Cause and Effect Diagram of Uneven Thickness

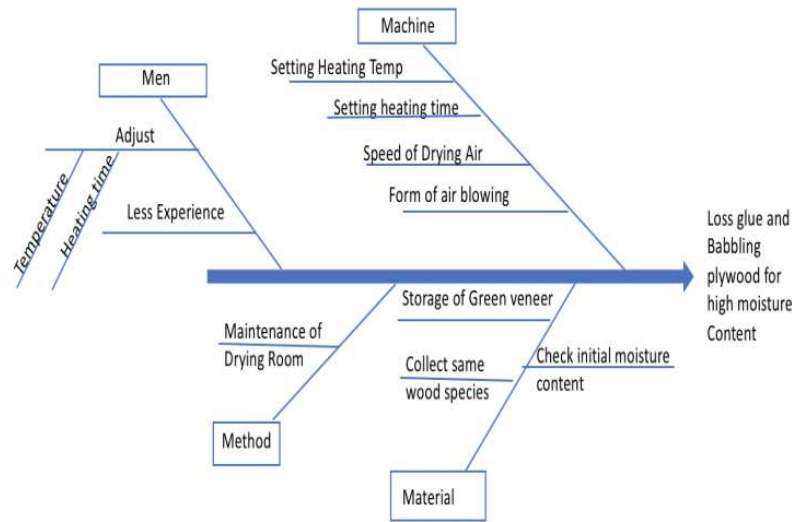


Figure 5 Cause and Effect Diagram of Loss Glue

E. Proposed Solutions

Proposed solutions of root cause of the uneven thickness and loose glue and babbling plywood for high moisture content were shown in the Table 5 and Table 6.

Table 5 Root Cause and Proposed Solution of Uneven Thickness.

4M Method	Root Cause of Problem	Proposed Solution
Machine	- Setting knife angle, clearance angle and nose bar pressure are large - Occurs machine is vibrating for loose of bolt and nut at knife section	- Adjust current knife assembly angle and nose bare pressure and if need, replace spare knife - Check before and after peeling operation and adjust bolt and knife
Men	- Less experience and lack of Training of operator and Mechanic	- Provide the suitable training
Method	- Machine are old and need to upgrade	- Replace with new machines
Material	- Some logs are over life time, not enough time and temperature at soaking and Impact off different species of wood peeling in the same batch	- Inspect carefully the logs before operations

Table 6 Root Cause and Proposed Solution of Loose Glue

4M Method	Root Cause of Problem	Proposed Solution
Machine	- Reach specific heating temperature and speed of air blown	- Schedule daily, monthly and annual maintenance plan
Men	- Did not know capacity and specification of machine	- Provide suitable training
Method	- Maintenance of drying machine	- Should check the maintenance system
Material	- Did not collect same species of wet veneer	- Design the format for storage system

CONCLUSION

This paper is the root cause analysis and proposed solution of the plywood manufacturing processes. The data was collected from No (2) Plywood Factory from Myanma Timber Enterprise in 1.7.2021 to 12 .7.2021. Data collection was done by random sampling method and this data are represented the total productivity of product. Statistical Process Control SPC tools were applied to analyze the root cause of the problems. Chart sheet showed the

frequency distribution of the defective categories and Pareto Chart showed the most possible defective factors, uneven thickness and high moisture content from defective categories. And then the root cause of the problem was analyzed by using cause effect diagram and filtered with Machine, Men, Material and Method. Finally, the solutions of root cause of the problems were explored for the quality improvement of plywood manufacturing process. These solutions can be applied for the implementation of quality

improvement of plywood product of No. (2) Plywood Factory.

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