Chapter 11

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ANALYSIS OF THE PRODUCTION PROCESS OF WOOD PRODUCTS USED IN HOUSEHOLDS

Abstract: This paper presents the results of a wooden fence post production process that can be used in many different households. The manufacturing process of wooden fence post manufacturing process is complex and consists of several stages of process operations. As the material for the production is wood, at each stage of work should be monitored, because in the course of treatment can lead to incompatibilities formation. The structure of the incompatibilities was based on Pareto - Lorenzo diagram.

Key words: fence post production process, Pareto - Lorenzo diagram

11.1. Introduction

Wood is the raw material obtained from felled coniferous and deciduous trees, which is later processed into various products, such as for construction purposes. It is a material of uneven construction. The mechanical properties as well as physical change depending on the grain direction (KOTWICA J. 2011).

Material, such as wood, is classified as the oldest materials used human. Currently used as a finishing material and design. Is a material often used because it is lightweight and has a sufficient strength properties for many applications. The wood is used among other things as a material for paneling, roof trusses, flooring, fencing, toys, furniture, houses. Wooden structures must be done with great care, because the

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wood as a natural material different from other building materials (KOKOCIŃSKI W. 2006., Sygut P., Krynke M., Mielczarek M. 2012., KLIMECKA-TATAR D., SYGUT P. 2012).

The physical properties of wood are the features that can be explored without compromising the chemical composition and structure of the wood. The physical properties of wood are limited appearance, moisture, swelling and contraction, conduction of water absorption, insulation, density and durability. Durability of wood is determined by its resistance to the destructive action of external factors that result in tissue degradation. The greatest stability was found in wood of coniferous trees.

Disadvantages of wood

For the defects which may occur in the wood, are eligible irregularities of its construction, damage, and natural features which act on the material properties. In the design of structural elements are important incompatibilities in the construction of wood that make them unsuitable for safety and quality of the work under (KOTWICA J. 2011).

Quality of the wood defines the standard PN-79/D-01012:

- Knots:
  - healthy and fused together - knots with a diameter up to 10 mm are not taken into account. Accepted single knots with a diameter of 1/4 in width, 1/3 width of the board,
  - knots partially fused together, rotting, falling out and knot holes are not permitted.
- Cracks:
  - shallow are acceptable,
  - deep - are allowed cracks extending a length not exceeding the width of the board. Are unacceptable cracks caused by pallet nailing.
- Coloration:
  - Permissible is not too intense blue stains coloration.
- Rot and mildew is unacceptable.

- Disadvantages of wood construction:
  - Fibers torsion - a board must not exceed 5% and 20% in the brackets,
  - Core - open is allowed only in the brackets, and closed shall be permitted in pine and other types of wood are acceptable in three palette brackets,
  - Resin Blisters are unacceptable to the upper and lower external boards surfaces of, while the other is allowed up to 50 mm,
  - Zakorki are unacceptable.
- Larval galleries - active sidewalks are not tolerated. However inactive, and a single small diameter of 3 mm are allowed (PN-79/D-01012).

Types of construction wood

In the construction industry need different softwood which are fir, spruce and pine and hardwood or oak and beech (KOTWICA J. 2011). Table 11.1 shows the most common wood used in the construction industry.

Table 11.1. Types of wood used in construction

Type of wood	Characteristics	Application
Pine wood	saturated with resin, easy to work with	in construction, carpentry, mining, the railway sleepers, for paper, plywood and wood wool
Fir wood	prone to cracking, is a lightweight wood with a white	in aqueous construction, mining, paper production
Spruce wood	difficult to machined, the white color with yellow clearances	in construction, carpentry, boat building, mining, the production of high quality

		paper, for the manufacture of wood wool
Oak wood	in the machining of hard, tough and very durable	in construction, furniture making, the manufacture of veneers
Beech wood	clear jars, white color, a tendency to swell and rupture, impermanent	for furniture, plank flooring, plywood air and carpentry
Maple wood	clear jars, white and yellow color	for furniture, paneling, veneer, leather goods, toys, shuttles, small items of business
Acacia wood	timber with a white, hard, difficult to handle	for the manufacture of leather goods, small items of business
Mahogany wood	brown-red color, easy-to-machined	for furniture, veneers, paneling, pattern making, in sculpture

Source: Own calculations on the basis of http://portalwiedzy.onet.pl/33715,,,,drewno_rodz aje,haslo.html

To harden the wood to adverse external influences and biological pests, wood is subjected to the impregnation process. We often use the impregnation of the surface, but the depth of penetration into the wood of fungicides is low. Raw materials such as wood can be impregnated in an immersion tank with fungicides, as well as the method of vacuum-pressure in the autoclave. This method of causing a better penetration of the product into the structure of the material.

A big disadvantage of this timber is that it is a flammable material. wood that is more dry, it's easier to burn. Unfortunately, there are no measures that can completely prevent the raw materials from fire. There are only preparations which may make it difficult to ignite. Ammonium Compounds and bicarbonates of sodium and potassium are the non-flammable gas emitting means. There are also flame retardants. All the

measures used to protect the wood from the fire must be accompanied by the relevant documents (KOTWICA J. 2011).

11.2. The process of the wooden fence manufacturing in technological terms

The manufacturing process grooved wooden fence is complex and the manufacturing process consists of several stages of technological operations (Fig. 11.1).

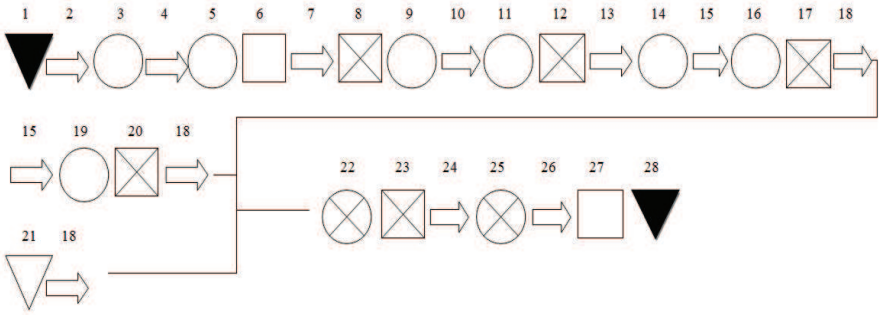

Fig. 11.1. The technological process of the wooden fence post in the analyzed company.

Source: Own elaboration

1- Storage of wood logs into production. Wood is stored in the open air, in specially designated for that square next to the plant.
2 - Transport of raw wood, in the form of balls, a van, to a position next to the plant.
3 - The wood is peeled to remove the bark from the logs. 4 Transport wood for drying using carts rail.
5 - Drying in the dryer. Wood is in the dryer until achieve proper humidity, which is about 18%. Wood drying is an obligatory process, as this is possible to further efficient processing of the material.

6 - It is carried out at this stage of pre-inspection of the material. Checking of the humidity of the wood. This is done using a hygrometer. Humidity measurement is carried out in three measuring points.
7 - Planks of wood are transported on rail trucks to the shop floor, where the raw material is further processed.
8 - Interop control. It is a visual inspection, carried out by qualified professionals, which is selecting the wood. For further treatment is not suitable wood that has such deep cracks, rot, mechanical damage. The control is carried out according to standard PN-79/D-01012.
9 - Planks of wood are cut into boards of appropriate thickness.
10 - Transportation board on roller conveyors.
11 - Cut the planks and strips of a particular width and thickness.
12 - Control of the thickness and width of the received parts.
13 - Boards and slats are transported by conveyor roller for chain saw.
14 - Cutting boards and slats to length with cross-cut saws.
15 - The materials are transported on pallets with a forklift.
16 - The device, which is followed planer boards grooves cut.
17 - Control of the individual boards and gauge depth. Boards are checked at random.
18 - Semi-finished products are transported on pallets with a forklift to the hall, where he will be installation of all components.
19 - At the same time the operations taking place in section 16 shall be carried out other operations. The cut strips with a router connecting moulder are cut pivot.
20 - Quality control joints cut with a depth stub.
21 - Storage fasteners (screws and stainless steel pins).
22 - During this stage of the installation is made fence. Well trained staff carry out assembly operations that rely on proper citation fence boards in the frame, the tenon joints. Installation is performed on a special table, which is a template. Each connection is reinforced pivot pin using staplers - a device that allows invisible combining elements. In addition, the fence boards are nailed to three vertical stainless steel strips arranged at equal distances from one another Air Pressure Nailer. Assembled

fences are placed on pallets of 25 units between the fences in the four corners of the cube are nailed sztyftami spacers to maintain the gap between the fences. This procedure is necessary to obtain adequate impregnation.
23 - Some parts of the fence are subjected to a visual inspection, checking the quality and strength of the connections.
24 - Fences on pallets of 25 units are transported by forklift to the room where it can be impregnated.
25 - Fences in the paint shop are set on pallets, where the pressure impregnation.
26 - Impregnated fences are transported by forklift to the warehouse.
27 - Final inspection of batches of fences on the quality of impregnation.
28 - Storage of finished products.

11.3. Quantification of quality problems in the production of the fence based on Pareto-Lorenz diagram

To quantify the quality problems used Pareto-Lorenzo diagram (BORKOWSKI S. 2004.). For this purpose, the defects are identified during the production of wooden fence and collected information on the frequency of their occurrence.

In the production process there is a wooden fence nine discrepancies that have a negative impact on the quality of the product. Discrepancies that arise during the period are as follows:

- convexity boards,
- camber boards blue stains boards intense color,
- unevenness on the surface elements,
- deep cracks elements,
- resin pockets,
- instable construction of the fence,
- knotholes,
- scratches on the elements of the fence,
- bad fixing strips.

In table 11.2 are shown occurring incompatibilities and the frequency of their occurrence.

Table 11.2. The type occurring incompatibilities and the frequency of their occurrence during wooden fence production in the analyzed company

Designation incompatibility	Description incompatibility	The incidence of [units]
N1	convexity boards	300
N2	camber boards blue stains boards intense color	600
N3	unevenness on the surface elements	500
N4	deep cracks elements	150
N5	resin pockets	400
N6	instable construction of the fence	3000
N7	knotholes	100
N8	scratches on the elements of the fence	2500
N9	bad fixing strips	1000

Source: Own elaboration

All incompatibility were ranked in descending order (Table 11.3), on the basis of these data formed Pareto-Lorenz diagram (Fig. 11.2).

Two incompatibility instable construction fence (N6), and scratches on the elements of the fence (N8) account for 20% of total incompatibility (2 of 9 incompatibility) and are responsible for 64.33% of all incompatibilities products produced on the production line a wooden fence in the period 12 months . Can be concluded that 64.33% of the costs incurred as a result of incompatibility corresponds to only 20% of non-compliance. Proposals for improving the production process may result in an increase in quality even at 64.33%.

Table 11.3. The percentage and the cumulative percentage of any incompatibility

Designation incompatibility	The incidence of [units]	Share [%]	Accumulated share [%]
N6	3000	35,09	35,09
N8	2500	29,24	64,33
N9	1000	11,70	76,02
N2	600	7,02	83,04
N3	500	5,85	88,89
N5	400	4,68	93,57
N1	300	3,51	97,08
N4	150	1,75	98,83
N7	100	1,17	100

Source: Own elaboration

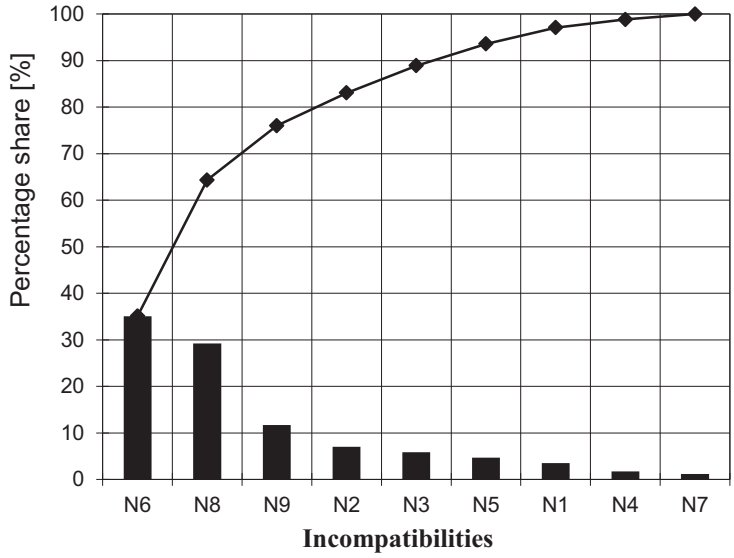

Fig. 11.2. Pareto-Lorenz diagram for wooden fence production in the analyzed company.

Source: Own elaboration

11.4. Conclusion

Based on the study of the production process of wooden fence, it can be concluded that:

- control wood from the manufacturing process is an important factor due to its construction and performance;
- implementing production process fence comes a proliferation of non-compliance;
- based on the analysis of Pareto-Lorenz main causes that generate the formation of more than 60% incompatibilities are instable fence design elements and features of the fence.

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