ASSESSING THE EFFECT OF THE PRESSING PARAMETERS ON THE SHAPE STABILITY OF WATER-RESISTANT PLYWOODS

Pavel Král – Jaroslav Hrázský – Miroslav Rousek – Zdeněk Kopecký – Michal Provazník

Abstract

The paper analyses causes of disorders of the shape stability of water-resistant plywoods. Deformations of plywoods are caused by many reasons, such as wood structure (the course of wood fibres), plywood construction (the construction balance as for size and material regularity), the moisture of processed veneers and boards, glue spread, actual pressing process, the storage and climatization of finished plywoods. Basic technological parameters affecting the shape stability of plywoods were analysed, such as parameters of the hydrothermic preparation of raw material, parameters of veneer drying and the moisture of peeled veneers after drying as well as pressing parameters.

Key words: *veneer; plywood; plywood construction; moisture; thickness; longitudinal and cross deformation; shape stability*

INTRODUCTION

Deformations mean very serious damage to a plywood sheet and according to the degree of damage they can result in its total inapplicableness. Deformations are measured by a deviation in mm from an absolute level being expressed in absolute values or in percents per one m diagonal or plywood edge. At the production of veneers, the highest importance is shown by a condition when wood is most plastic and particular components of wood are least degraded. When physical factors (temperature and moisture) predominate at the hydrothermic treatment (plastification) such a condition can be achieved just at the moment of completing the hydrothermic treatment. Plasticity can be expressed by total plastic deformation, which can be achieved without the permanent disturbance of wood structure. It becomes evident by the decrease of some quality indicators (KRÁL, 2006).

Veneer drying is carried out with the aim to decrease the moisture of wet veneers (30 to 150%) to final moisture 8 to 10%, for the manufacture of water-resistant plywoods to 4 to 6%. The reason of decreasing the plywood moisture is an endeavour to prevent the origin of fungi or subsequent twisting. The final moisture of veneers after drying determines the quality of gluing and the quality of plywood. Veneers have to be stored in such a way protection against unfavourable weather conditions to be ensured and the relative air humidity and temperature to ensure the determined moisture of veneers.

Through pressing the contact of glued surfaces is achieved, their fixation until hardening the adhesive and creation the thin layer of adhesives in the joint. The working pressure is derived from a specific pressure and the plywood area. It is measured by a manometer (KRÁL, HRÁZSKÝ; 2006).

MATERIAL AND METHODS

Within this analysis, all measurements were carried out at an important producer of veneers and water-resistant plywoods in the CR. The hydrothermic treatment of wood is carried out in pits by direct steaming when water vapour is blown through a warming pipe into the steaming pit. To control the hydrothermic treatment regime a manual way is used. The environment temperature is taken by a sensor placed on the side wall of a steaming pit. Regimes of the raw material hydrothermic preparation are prepared for the winter and summer season. According to available data, following regimes are used for coniferous species in the studied plant:

- spruce – summer season 12 to 18 hours, winter season 24 to 30 hours
- pine – summer season 16 to 24 hours, winter season 30 to 36 hours

According to technological regulations the steaming of logs should be carried out at a temperature of 90 to 95°C. The period of emptying the pit takes about 3.5 hours. A night hours, steam is not supplied to the heating system of steaming pits. Within the analysis, following steps were gradually carried out:

- temperature measurement of the plasticization environment
- determination of the moisture of logs intended for peeled veneers before plasticizing
- moisture measurement of veneers after peeling
- thickness measurement of produced veneers
- moisture measurement of veneers after drying in a kiln and on a veneer yard.

RESULTS AND DISCUSSION

Within the analysis, check reading the temperature of the steaming pit thermometer was carried out. An actual temperature 50 and 60°C was found out. The moisture of logs for rotary-cut veneers was also determined. The sample was taken from the stem half after barking in a cross-cutting station. Moisture was determined by a weight method from the sapwood and heartwood part of a stem. Mean values of the measurement in 3 samplings ranged from 32.27 to 37.15% in the heartwood part and from 114.54 to 140.99% in the sapwood part. In connection with lower temperatures of the plasticizing medium compared to technological instructions it was found that the temperature of a rotary-cut veneer beside a peeler was low (lower than the human body temperature). Therefore, check measurements of the log temperature were carried out on a residual cylinder before peeling and after peeling. Following temperatures were determined:

- the log surface temperature 24 – 26^{o}C
- temperatures on the residual cylinder surface after peeling 28 – 29^{o}C
- temperatures on the butt end 24 – 26^{o}C

Therefore, temperature measurements were also carried out by a laboratory thermometer (used for the temperature measurement of pressing plates of a laboratory press). The length of a bored hole for the thermometer was about half of the diameter of a residual cylinder and the cylinder temperature

- (cylinder length = 2.5 m) ranged from 50 - 51 to 55°C
- (cylinder length = 1.3 m) ranged from 50 - 56 to 60°C

Substantially different temperatures from 25 to 30°C were determined. In addition, check measurements were carried out of the veneer moisture behind the peeler. The moisture of veneers ranged within the limits 30 – 31 – 34%. The moisture of veneers after steaming (plasticizing) at peeling was determined both from the heartwood and sapwood parts. In veneers produced from the heartwood part, the moisture ranged from 25.85 to 30.89%, in veneers produced from the sapwood part from 113.64 to 148.54%. Check measurements were also carried out of the veneer thickness behind the peeler. The veneer thickness (spruce 2 mm) ranged behind the peeler within the limits 1.95 – 2.20 – 2.45 mm.
Finally, check measurements of the veneer moisture were carried out. Behind a drier (Raute), the veneer moisture (spruce 2 mm) ranged within the limits 0.55 – 1.0 – 1.4%, in the yard of dry veneers moisture ranged from 1.80 to 5.7%. The veneer moisture ranged markedly below the usual value 5 – 7%. Within the analysis, check measurements were carried out of the veneer moisture before a glue spreader. Before the gluer, the moisture of veneers (spruce 2 mm) ranged within the limits 1.40 – 1.80%. In Fig. 1, the moisture of veneers is displayed. It was measured before presses.

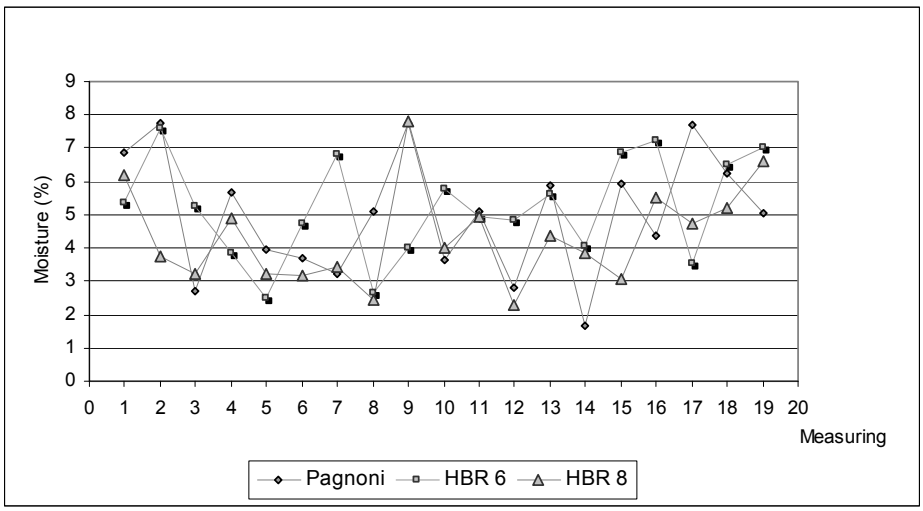

Fig. 1 The moisture of veneers at presses

Values of moisture given in Fig. 1 showed that the moisture of peeled veneers before presses ranged within the limits 1.02 to 8.46%. The moisture fluctuated within a considerable interval (differences reached even 7.44%). Fluctuation of the mean moisture of veneers ranged within the limits 1.68 to 7.82% in October, 1,79 až 7,80 % in November. Fig. 2 display the moisture of veneers measured before presses and the moisture of pressed plywoods.

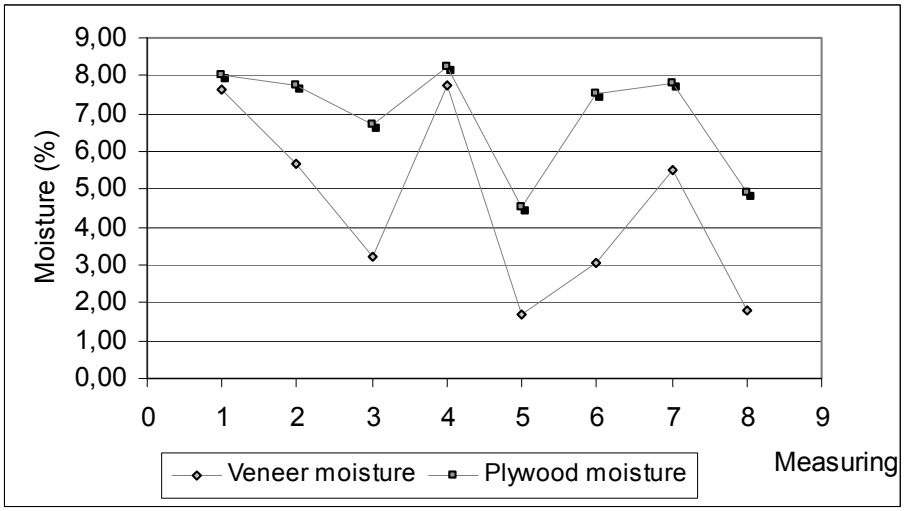

Fig. 2 The moisture of veneers and plywoods

Values of moisture given in Fig. 2 show that the moisture of peeled veneers before the presses ranges from 1.68 to 7.74% and the moisture of plywood from 4.54 to 8.25%. Check measurements were carried out of the veneer moisture after pressing and in the store of finished products.

- After pressing, the moisture of plywoods ranged (spruce 8 mm) within the limits 6.00 – 10.0%.
- In the store, the moisture of plywoods (spruce 9.5 mm) ranged within the limits 7.50 – 11.0%.

Figs. 3 and 4 display the moisture of plywood measured behind the presses and in the store of finished products.

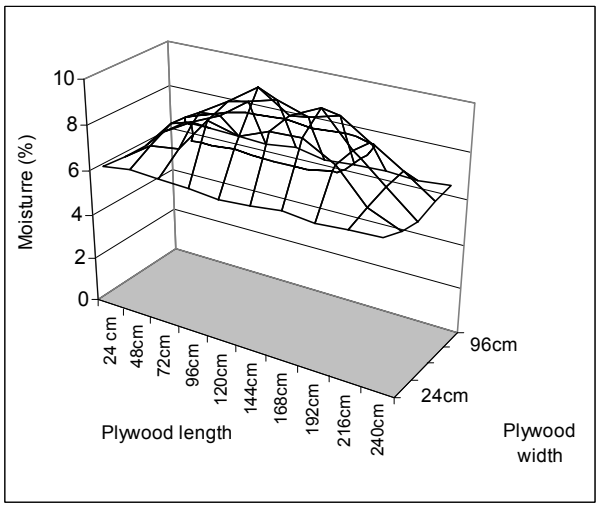

Fig. 3 Distribution of moisture in pressed plywood 8 mm thick

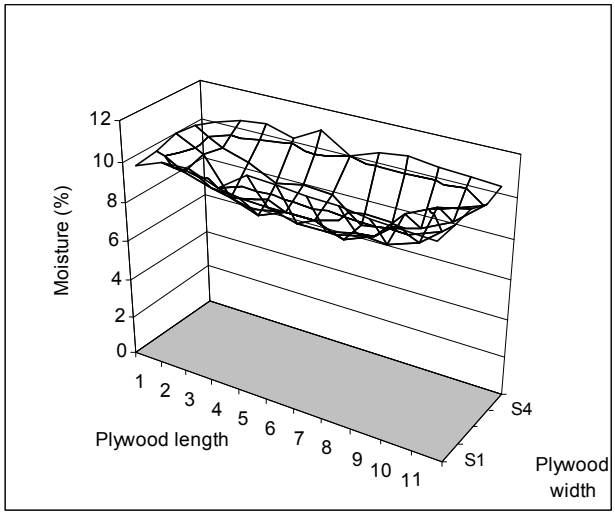

Fig. 4 Distribution of moisture in pressed plywood 9.5 mm thick In the store

Figs. 3 and 4 show that although the mean moisture ranges within the limits 7.5 to 11%, its distribution is, however, markedly uneven. After pressing, moisture in the centre of the plywood surface is 9.2 – 10% and, on the other hand, along the plywood edge, 6.0 – 7.6%. The moisture of plywood in the store of finished products shows diametrically different distribution. In the centre of plywood, moisture ranged from 7.5 to 8% and at edges from 10 to 11%. It means the moisture change within the plywood area even by 5%, namely always diametrically: in the centre from 10 to 7.5% and at the plywood edges from 6 to 11%. Plywood, which did not show warping, was characterized by the most even distribution of moisture within the plywood area.

CONCLUSION

Some technological parameters were tested with following results:
Spruce logs show markedly differentiated moisture zones of the initial moisture. From the aspect of the plywood log processing the proportion of the surface moister zone amounts to 30% and that of the central heartwood zone with lower moisture 70%. The central zone moisture did not exceed 40% in any measurement. The distribution of moisture zones is similar in fresh/green logs and in logs protected by spraying. By the long-term storage of logs on a dry log dump the moisture of both zones is gradually balanced. At checking the parameters of steaming it was found that temperatures ranged within the limits 50 – 60°C and the log surface temperature and the cylinder surface temperature between 24 and 29°C.
Through the temperature measurement by a laboratory thermometer (used to measure the temperature of pressing plates by a laboratory press) the cylinder temperature ranged from 50 to 60°C. Substantially different temperatures were obtained with a difference 25 to 30°C.
Check measurements of the veneer moisture was carried out behind a peeling machine with a result 30 – 34%. The moisture of logs for rotary-cut veneers before steaming determined by a weight method reached 32.27 – 34.15% in the zone of mature wood and 114.54 –

130.34% in the sapwood part. Likewise, differences were also determined in the log central and sapwood parts reaching almost 100% (mature wood: 25.85 – 30.89%, sapwood: 113.64 - 148.54%).

The veneer thickness (spruce 2 mm) behind a peeler ranged within the limits 1.95 – 2.45 mm at check measurements. Behind the Raute drying room, the moisture of veneers (spruce 2 mm) ranged from 0.55 to 1.4% and in the yard of dry veneers from 1.80 to 5.7%.

At drying spruce veneers from the whole log to the required final maximum moisture 5 – 7%, as many as about 45% veneer are unproportionally highly overdried. Before spreading the gluing mixture, the moisture of veneers ranged within the limits 1.40 – 1.80%. On the basis of measurements carried out in September – November, the moisture of rotary-cut veneers before presses ranged from 1.02 to 8.46% and the moisture of plywood from 4.04 to 8.57%.

The mean moisture of plywoods ranges from 7.5 to 11% the distribution within the plywood area being uneven. Plywood, which was not warped, showed most evenly the distributed moisture within an area out of all analysed plywoods.

REFERENCES

1. KRÁL, P., 2006: Assessing the effects of the thickness of beech veneers on compressibility of plywoods. Drvna industria 57 (1): 26-32 pp. ISSN 0012-6772.
2. KRÁL, P., HRÁZSKÝ, J., 2006: Effects of different pressing conditions on properties of spruce plywoods, Journal of Forest Science 52 (6): 285-292 pp. ISSN 1212-4834.
3. MAHÚT, J., RÉH, R., 1996: Technológia spracovania dreva II. Metódy zisťovania fyzikálnych, mechanických a technologických vlastností dýh a preglejovaných materiálov. Zvolen. TU: 86.
4. SOINÉ, H., 1995: Holzwerkstoffe. Herstellung und Verarbeitung. 1. vyd. Stuttgart: DRW Verlag. 368 pp. ISBN 3-87181-340-0.