Annals of Warsaw University of Life Sciences – SGGW
Forestry and Wood Technology No 72, 2010: 414-417
(Ann. WULS-SGGW, For and Wood Technol. 72, 2010)

Losses and raw material yield of wood sawing processes

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Abstract: *Losses and raw material yield of wood sawing processes*. Below paper presents method to determine absolute and relative material losses as well as material efficiency in wood cutting process.

Keywords: wood cutting, circular sawing machine

INTRODUCTION

Basic objective of wood cutting process is to procure the most possible volume of properly shaped objects from given volume of raw material. In general case, the difference between volume of raw material and volume of procured objects is material waste. In wood cutting process, material losses are result of both machining process and manufacturing process. Losses of machining process are created during machining and are directly connected to machining process itself [ORŁOWSKI]. Manufacturing losses are result from cutting method or preparation for cutting and are only indirectly related to machining process.

Further part of the paper is analysis of only direct losses of cutting process which are material losses of machining process.

DETERMINATION OF LOSSES AND MATERIAL EFFICIENCY

Independently on location of real thickness of cut element in the range of $<G_{min}, G_{max}>$ in relation to assumed thickness from range of $<G^*_{min}, G^*_{max}>$, maximum value of the slot R is always absolute material loss (fig.1).

In theoretical cutting system it is assumed that maximum value of the slot R is equal to total span of tooth blades S_t $(R=S_t)$.

In real system, in general case (fig.1, slot 1), maximum slot value R is a sum of total tooth blade span S_t and precision of axial location of the tooth blades in relation to cut material B.

$$R = S_t + B \quad (1)$$

In case where changes of axial location of tooth blades in relation to cut material are slow, what results in surfaces on both sides of the saw are circular (fig.1, slot 2), then precision of axial position of tooth blades in relation to cut material B is equal to surface roughness after cutting Rt $(B=R_t)$, and then maximum value of the slot R can be determined by sum of total tooth blade span S_t and surface roughness Rt

$$R = S_t + Rt \quad (2)$$

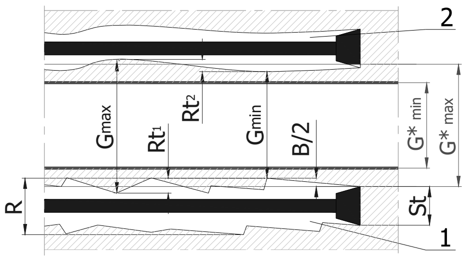

Fig.1. Thickness changes of procured element and slot size, where :
G^*min, G^*max – min. i max. values of assumed thickness,
Gmin, Gmax – min. i max. values of real thickness,

In cutting process, apart from absolute losses, significant are also relative material losses. Those losses show what part in total material usage is the absolute material loss. Relative material losses have particular meaning in cutting process, where procured are thin elements with thickness *G* comparable to slot size *R*. In such case, to procure one element, relative material loss Q in general condition might be determined from :

$$Q = \frac{R}{G_{\min} + R} \qquad (3)$$

where: $G_{min}+R$ – is quantity of material USD to manufacture one element in cutting process.

Apart from relative material losses, in many cases it is easier to use relative material efficiency. This feature describes what part in total material usage is finished element. To procure one element, relative material efficiency *W* in general case can be determined from :

$$W = \frac{G_{\min}}{G_{\min} + R} = 1 - Q \qquad (4)$$

In industrial reality, determination of losses and material efficiency is based on comparison of quantity of finished elements procured from given raw material.

In case when raw material on its whole length *L* has equal width *G* and height *H*, then very simply one can compare :

- number of procured elements from the same width of raw material
- or width of raw material to get the same number of finished elements.

However often in industrial reality finished pieces are procured from raw material whose width and height change along its length.

Sample of such cutting is shown in fig.2.

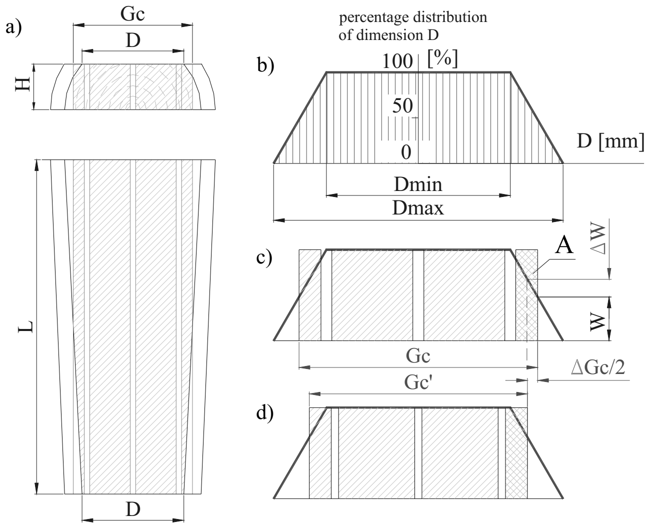

Fig. .2. Material with width and height changing along its length

In presented case, shape of raw material (fig.2a) causes that width of raw material with height *H* along length *L* is changing. The smallest value of material width with height H is dimension *D*. In the batch of material which comes to cutter, the smallest dimension *D* can change in range of <*Dmin, Dmax*>. During cutting of big batch of such material it can be assumed that probability of cutting raw material with size *D* in range of <*Dmin, Dmax*> is the same (linear distribution of dimension *D*). Percentage distribution of dimension *D* in batch of such material is shown in fig. 2b. In case when from such raw material one procures elements like in fig. 2c, for which total width of *Gc* is required only *W*% of elements *A* can achieve height *H* along whole length *L*. Usage of cutting technology in which to procure the same elements total width of *Gc'* is needed (fig. 2d) causes that quantity of elements *A* with dimension *H* along whole length *L* will increase by ΔW %. That increase of element *A* efficiency, for $D_{min} < Gc < D_{max}$ rusting assumed (linear) distribution of dimension *D* in batch of pieces to cut, can be determined from :

$$\Delta W = \frac{\Delta Gc}{D_{\max} - D_{\min}} \cdot 100 = \frac{Gc - Gc'}{D_{\max} - D_{\min}} \cdot 100 \ [\%] \qquad (5)$$

From (5) it results that during procurement of finished elements from raw material as in fig.2, the material efficiency depends both on necessary total *Gc* width of procured elements, and on value of spread of smallest dimension *D* with full height *H*.

SUMMARY

A method to determine material losses and efficiency during wood cutting process depends on objective of the analysis. Knowledge of the dependencies describing material losses and the material efficiency enables suitable selection of cutting conditions to decrease

material losses what significantly influence economical and ecological effects of cutting process.

REFERENCES

1. K. ORŁOWSKI, Materiałooszczędne i dokładne przecinanie drewna piłami, Politechnika Gdańska, Monografie 40, Gdańsk 2003.

Streszczenie: *Straty i wydajność materiałowa procesu przecinania drewna.* W niniejszym artykule opisano sposób wyznaczania bezwzględnych i względnych strat materiałowych, jak również wydajności materiałowej w procesie przecinania drewna.

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