ANNALS OF MTeM FOR 2007 &

PROCEEDINGS

OF THE 8TH INTERNATIONAL CONFERENCE
MODERN TECHNOLOGIES IN MANUFACTURING
CLUJ-NAPOCA, 4th-5th OCTOBER 2007

EDITOR: Cs. GYENGE
EDITOR'S NOTE
This Publication was reproduced by the photo process, using the manuscripts and soft copies supplied by their authors. The layout, the figures and tables of some papers did not conform exactly with the standard requirements. In some cases the layout of the manuscript was rebuilt. All mistakes in manuscripts there could not been changed, nor could the English be checked completely. The readers are therefore asked to excuse any deficiencies in this publication which may have arisen from the above causes. The editor and the MTeM Cluj–Napoca are not responsible either for the statements made or for the opinion expressed in this publication.

Copyright 2007 ©by MTeM CLUJ-NAPOCA
Abstracting and nonprofit use of the material is permitted with credit to the source. Libraries are permitted to photocopy for private use of patrons. Instructors are permitted to photocopy isolated articles for noncommercial classroom use without fee. After this work has been published by MTeM Cluj-Napoca, the authors have the right to republish it, in whole or part, in any publication of which they are an author or editor, and to make personal use of the work. Any republication, referencing, or personal use of the work must explicitly identify prior publication in the MTeM Cluj-Napoca of the 8th International Conference "Modern Technologies in Manufacturing", Editor Cs. Gyenge.

Descrierea CIP a Bibliotecii Nationale a Romaniei
INTERNATIONAL CONFERENCE MTeM
(8;2007; Cluj-Napoca)
Proceeding of the 8-th International Conference MTeM,
Cluj-Napoca, 4-th – 5-th October 2007 /
Ed:Cs.Gyenge – Cluj – Napoca:
 p. ; cm 21/29,7
Bibliogr. 
Index.
ISBN 973-9087-83-3
Editura Mures

Tiparul executat la S.C. CROMATIC TIPO S.R.L.
Targu Mures, str. Calarasilor nr. 58
Tel./fax: 0265-215597
E-mail: cromatictipo@cromatictipo.ro
Web site: www.cromatictipo.ro

Additional copies can be obtained from the publisher:
MTeM CLUJ-NAPOCA, TECHNICAL UNIVERSITY OF CLUJ-NAPOCA
DEPARTMENT OF MANUFACTURING ENGINEERING,
B-dul Muncii 103 – 105, 3400 CLUJ-NAPOCA, ROMANIA
PHONE:0040 64 415051 FAX: 0040 64 415054
E-MAIL: cgyenge@tcml.east.utcluj.ro
INTERNATIONAL SCIENTIFIC COMMITTEE

Gh. ACHIMAS (ROM)  N.M. DURAKBASA (AUS)  S. LEGUTKO (POL)
M. BADIDA (SKV)  S. EKINOVIC (BOH)  T. MIKAC (HRV)
N. BALC (ROM)  J. GAWLIK (POL)  L. MONOSTORI (HUN)
I. BALIC (SLO)  H. GIURGIUMAN (SWI)  R. MUNTEANU (RO)
D. BANABIC (ROM)  Cs. GYENGE (ROM)  P.H. OSSANA (AUS)
P. BERCE (ROM)  U. HEISEL (GER)  P. PETER (ROM)
I. BOYADJIEV (BGR)  J. HESSELBACH (GER)  O. ROS (ROM)
P.D. BRINDASU (ROM)  B. HULL (UK)  T. UDILJAK (HRV)
M. BULGARU (ROM)  H. IANCAU (ROM)  K. VELISEK (SLO)
R.I. CAMPBELL (UK)  T. ICLANZAN (ROM)  I. VUSCAN (ROM)
DAIZHONG SU (UK)  N.V. IVAN (ROM)  A. WEECKENMANN (GER)
J. DANYI (HUN)  B. KATALINIC (AUS)  E. WESTKAEMPER (GER)
I. DRSTVENSEK (SLO)  I. KURIC (SKV)  P. XIROUCHAKIS (SWI)
I. DUDAS (HUN)  Gh. LAZEA (ROM)

ORGANIZING COMMITTEE

Cs. GYENGE  chairman  ROM
V. ANNA  co-chairman  SKV
B. BARISIC  co-chairman  HRV
L. LAZARESCU  secretary  ROM

MEMBERS

Gh. ACHIMAS  Gh. CIUTRILA  M. MERA
M. ANCAU  D.S. COMSA  R. PACURAR
M. ARGHIR  A. COSTEA  D. PAUNESCU
N. BALC  M. DAMIAN  O. ROS
V. BOCA  D. FRATILA  A. TODEA
M. BORZAN  S. GROZAV  D. URSU
A. CAREAN  H. IANCAU  I. VUSCAN
EFFECTS OF SOME FACTORS ON WOOD MANUAL SANDING

Julean, D.; daunt.julean@staff.utcluj.ro
Nedezki, C.; claudiu.nedezki@muri.utcluj.ro

Abstract: Effects of the grit sizes of the sand belt, and the thrust pressure of the sander on the surface roughness of the wood parts were investigated. Surface roughness parameter, average roughness (Ra), obtained from wood part surfaces were used in the analysis. The analyzed sanding factors and their interactions were found to have a significant effect on the surface roughness of the wooden surface. It is envisaged that the research done will lead to a proper characterization of the surface finish performances for different wood species in manual sanding applications.

Key words: sanding, surface roughness, wood, surfaces, grit size, pressure

1. INTRODUCTION

In woodworking, sanding is one of the most common practices for smoothing surfaces the process of surface and so for increasing the surface quality of wooden products and enhancing their aesthetic appearance, or to prepare them for future treatments as staining, painting, lacquering or gluing. On industrial scale or as a manual application the process of sanding is essentially peripheral in nature, where each abrasive grain operates as an individual cutting-edge. When manual sanding is done, the coated abrasive leaves small grooves relative to the grit size of the paper used. Sanding with progressively finer grains makes these grooves smaller and thaw a direct connection between grain size and the obtained surface roughness can be made. Another important factor related to hand sanding is the thrust pressure applied on the working surface. Due to thrust pressure applied by the belt or disc sander, the depth of cut is created and thus the efficiency of sanding is influenced. Pressure has important influences on cutting power, on surface and tool temperature, on tool life and grain “loading” and even on surface roughness. The result of manual sanding is also dependent on other parameters like sander manual feeding rate and sanding direction relative to the wood fiber direction (Taylor, et al. 1999). It seems apparent that quality enhancement in manual wood sanding processes, requires a sound understanding of the fundamentals associated in the coated abrasive, manual sander machine and workpiece relationship. There is little literature that has been uncovered to assist in wood sanding and there is no specific information about the effect of key parameters in the sanding process and their interactions (Hedarto, B et al., Taylor et al 1999). Recently due the new reconsideration of natural materials, researches have been done regarding industrial wood panels sanding or sanding some exotic wood species (Samolej & Barcik, 2006, Burdurlu, E., et al. 2005, De Moura & Hernández 2006, Ratnasingam, J., 2002). The objective of this study is to add to the present results an analyze upon the influences of grain size and thrust pressure as input variables on surface roughness in case of belt sanding of different species of wood that may be sanded in manual applications.

2. EXPERIMENTAL PROGRAMME

A total of 24 samples of solid wood samples with the dimensions 25 mm×25 mm×125 mm and with final moisture contents of 12 ± 2% were used in this study. The sanding experiments were carried out using commercial 76 x 457 mm electro-corundum abrasive belts with three different levels of sanding grit sizes: 80, 100, and 120 (#FEPA) on a commercial
belt sander having the following features: 650W power, 2.6 kg weight and 76x130 mm sanding surface. The belt speed and feed rate were maintained at 4 m/s and 0 m/s, respectively. The thrust pressure had two constant levels (4.9 and 9.8 kPa) and was maintained constant during the tests by using the set-up presented in figure 1. A specific problem in wood sanding is that the material is natural and varies among different species and other environmental conditions.

![Experimental set-up](image)

This is way, four species of wood has been used as subject in the experimental program: beech (Fagus sylvatica), sycamore maple (Acer pseudoplatanus), fir (Abies Alba) and oak (Quercus robur). The samples were carefully prepared and their initial surfaces were machined in the same conditions. The weights had been chosen to produce the two levels of thrust pressure comparable with those produced by manual sanding. Each sample has been sanded for 15 seconds in the same direction parallel with the fibers and then the surface roughness was measured by using a stylus type profilometer (Mitutoyo SJ-301). A total of 120 measurements, across the fiber direction were taken from the sanded surface of the specimens. The roughness parameter characterized by ISO 4287 (1997) standard, respectively, average roughness (Ra), was considered to evaluate globally the sanded finish surfaces.

Roughness values were measured with an accuracy of 0.5 µm. Measuring force of the scanning arm on the specimens was 4 mN. The length of tracing line, the cut-off, measuring speed, stylus tip radius were: 12.5 mm, 2.5 mm, 0.25 mm/s, 5 µm, respectively. Measurements were conducted at room temperature and calibration procedure before the tests has been done.

3. RESULTS ANALYSIS

The Ra values obtained after five repeated run roughness tests, on each sanded surface, according to the samples and the principles presented above were processed with Minitab 15.1.1 Statistical Software. The General Linear Model with four main factors and interactions has been adopted. Analysis of Variance for Ra as respons variable, using Adjusted SS for Tests have been processed and the results are displayed in Table 1. Assuming the commonly chosen α-level of 0.05, the results indicate the following: The p-value for the subject factor wood is given as 0.000. This means that the actual p-value is less than 0.0005. Since this is less than the chosen α-level of 0.05, it means the effect of wood species on roughness is significant. In other words, the mean roughness is different for the different wood species. The same comments are valid for both grain size and thrust pressure factors. The p-value for the interaction terms are less than 0.05 too. Thus, the interaction of the subject factor and treatment factors are significant, and you are not free to consider the effects of the individual factors separately. Fig. 2 can be used to visualize the effect of the factors on the response variable Ra and to compare the relative strength of the effects.

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>Seq SS</th>
<th>Adj SS</th>
<th>Adj MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood</td>
<td>3</td>
<td>87.358</td>
<td>87.358</td>
<td>29.119</td>
<td>60.97</td>
<td>0.000</td>
</tr>
<tr>
<td>Grain</td>
<td>2</td>
<td>322.281</td>
<td>322.281</td>
<td>161.141</td>
<td>337.38</td>
<td>0.000</td>
</tr>
<tr>
<td>Wood*grain</td>
<td>6</td>
<td>41.230</td>
<td>41.230</td>
<td>6.872</td>
<td>14.39</td>
<td>0.000</td>
</tr>
<tr>
<td>Pressure</td>
<td>1</td>
<td>4.524</td>
<td>4.524</td>
<td>4.524</td>
<td>9.47</td>
<td>0.003</td>
</tr>
<tr>
<td>Wood*pressure</td>
<td>3</td>
<td>19.205</td>
<td>19.205</td>
<td>6.402</td>
<td>13.40</td>
<td>0.000</td>
</tr>
<tr>
<td>Grain*pressure</td>
<td>2</td>
<td>16.122</td>
<td>16.122</td>
<td>8.061</td>
<td>16.88</td>
<td>0.000</td>
</tr>
<tr>
<td>Wood<em>grain</em>pressure</td>
<td>6</td>
<td>6.328</td>
<td>6.328</td>
<td>1.055</td>
<td>2.21</td>
<td>0.049</td>
</tr>
<tr>
<td>Error</td>
<td>96</td>
<td>45.852</td>
<td>45.852</td>
<td>0.478</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>119</td>
<td>542.900</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

S = 0.691104  R-Sq = 91.55%  R-Sq(adj) = 89.53%
Because the lines are not horizontal, main effects are present and due to the different slopes the preponderance of grain size factor versus pressure is displayed. In the interactions plot (Fig. 3) lines are not parallel to each other, so there may be some interactions present. The graphical interpretations on Fig. 1 and 2, just indicate patterns so statistical tests are needed to get statistical significance. Within the GLM analysis the Tukey's Multiple Comparisons Method had been applied to get the sets of confidence intervals for the differences between pairs of means, and as individual hypothesis tests, for the differences between means. By analyzing the confidence intervals generated by the Tukey's method one may evaluate whether two means are different. From all pairwise comparisons done, the confidence intervals generated by the Tukey's method, do not contain zero, and there is a statistically significant difference between all the corresponding means. The figures 4 and 5 present the graphical results regarding the normality of residuals obtained after the statistical analysis. In the experimental programmed done, the results confirmed the significant power action of the main factors on Ra as a response variable. More then that, they suggest also, that interactions should be considered when different wood species will be sanded. The four wood species subjected to this analyze presented different performances from sanding point of view. The oak and beech species proved to be less finishable then the fir and sycamore species, in the conditions of the experiment. It is true that these findings are experienced by a skilled worker who subjectively will adapt the way of conducting the process by taking in account the wood species, hard or soft, and adapting the thrust pressure using a subjective appreciation on how sanding is running and the quality of surface obtained.

This study suggested also that thrust pressure is not so important to get the required finish, so when manual sanding is done the optimal thrust pressure will be obtained using other criteria, like removal rate and belt loading. These factors will be taken in account in the future research with the goal of finding some practical rules to get an optimal manual sanding process. Further work must be done to compare these findings with industrial belt sanding where new
factors like feed rate thickness precision and sanding direction must be included.

6. CONCLUSIONS

After the experimental research, significant statistical difference was found between surface roughness characteristics for different wood species samples, sanded with six different conditions had been found. The study suggests that there is an interaction between the main sanding factors that has to be considered when practical sanding process is done. The results indicated that the individual effect of pressure is less significant throughout all grit size levels, so it is not too important for the proper selection of grain size and belt characteristics to get a required finish.

7. REFERENCES

➤ Burdurlu, E. , Usta, İ., Ulupinar, M., Aksu, B., Erarslan T. Ç., The Effect of the Number of Blades and the Grain Size of Abrasives in Planing and Sanding on the Surface Roughness of European Black Pine and Lombardy Poplar Turkish Journal of Agriculture and Forestry., no. 29, 2005, pp. 315-322. ISSN 1303-6173

➤ De Moura, L.F., Hernández, R.E., Effects of abrasive mineral, grit size and feed speed on the quality of sanded surfaces of sugar maple wood Wood Science and Technology vol. 40 no 6, August 2006, pp. 517-530 ISSN 1432-5225


➤ Samolej, A., Barcik, Š., Experimental investigation of sanding process on disc sander Drevarsky Vyskum/Wood Research Vol. 48 (1-2), pp. 36-42, ISSN 0012-6136