CHARACTERIZATION OF *EUCALYPTUS* SP. TIES FOR USE IN BRAZILIAN RAILWAYS

Felipe Hideyoshi Icimoto¹, Fabiane Salles Ferro², Carlito Calil Júnior³

**ABSTRACT:** In 2012 the Brazilian federal government announced a package of concessions with the private sector for construction of 10,000 km of railways. Among the woods already used to sleepers in Brazil are: maçaranduba, ipe, jacarandá and aroeira. Due to the shortage of these traditional species, arose the need to use new materials and other woods to serve this demand, such as the *Eucalyptus* wood of planted forests. In 1904 the extinct Paulista Railroads Company began the growing of *Eucalyptus* developed by Edmundo Navarro de Andrade with the aim of supply the need of firewood, poles and sleepers to this company. The aim of this study was the characterization of sleepers of five species of the genus *Eucalyptus* for use in Brazilian railroads, comparing the results with the values established by ABNT NBR 7511/2013: Wooden Sleepers - Requirements and test methods. The results obtained from species studied show that the of *Eucalyptus paniculata* has reached the values for class I, the species *Eucalyptus cloeziana*, *urophilla* and *grandis* have reached values for class II and *Eucalyptus rostrata* has not reached minimum strength for use as railway sleepers.

**KEYWORDS:** Wood sleepers, Planted forests species, *Eucalyptus* sp.

1 INTRODUCTION

In 2012 the Brazilian federal government announced an investments plan in logistics with the private sector to the value of R$133 billion; this package of concessions included the construction of 10,000 km of railways [1]. Between the woods already used to sleepers in Brazil are: maçaranduba, ipe, jacarandá and aroeira. Due to the shortage of these traditional species, arose the need to use new materials and other woods to serve this demand, such as the wood of Eucalyptus planted forests. In 1904 the extinct Paulista Railroads Company began the growing of *Eucalyptus* developed by Edmundo Navarro de Andrade with the aim of supply the need of firewood, poles and sleepers to this company [2]. In 2008 the length of the Brazilian railway network was 28.538 km [3]. The aim of this study was the characterization of sleepers than five species of the genus *Eucalyptus* for use in Brazilian railroads, comparing the results with the values established by ABNT NBR 7511/2013: Wooden Sleepers - Requirements and test methods. The results were compared with the values of this standard.

2 MATERIALS AND METHODS

The experimental program included the evaluation of the performance of sawn wood sleepers using *Eucalyptus cloeziana* (EC), *grandis* (EG), *paniculata* (EP), *rostrata* (ER) and *urophilla* (EU), with dimensions corresponding to metric gauge sleeper: 2000 mm x 160 mm x 220 mm. The sleepers were characterized following the methodology of ABNT NBR 7511/2013: Wooden Sleepers - Requirements and test methods. The mechanical properties investigated were: Modulus of Elasticity (MOE) and Modulus of Rupture (MOR), Rail Seat Compression (*f*₉₀₉₀₈₈), Single Tie Lateral Push (*Ra*₀), Screw Pullout (*Ra*₉₀) and Janka Hardness (*f*₁₀₀). The results were compared with the values of this standard.

3 RESULTS

The standard ABNT NBR 7511/2013: Wooden Sleepers - Requirements and test methods establishes two grades for resistance to wooden sleepers. A Table 1 shows the results obtained to mechanical properties investigated and the standard values.

---

¹ Felipe Hideyoshi Icimoto, University of São Paulo, Av. Trabalhador São Carlense 400, São Carlos, São Paulo, Brasil  
Email: icimoto@usp.br  
² Fabiane Salles Ferro, University of São Paulo, Brasil  
³ Carlito Calil Júnior, University of São Paulo, Brasil
Table 1: Results obtained and their standard values

<table>
<thead>
<tr>
<th>Investigated properties</th>
<th>MOE</th>
<th>MOR</th>
<th>f_{c90,p}</th>
<th>Ra_{0}</th>
<th>Ra_{90}</th>
<th>f_{H0}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MPa</td>
<td>MPa</td>
<td>kN</td>
<td>kN</td>
<td>MPa</td>
<td></td>
</tr>
<tr>
<td>EC</td>
<td>12608</td>
<td>124</td>
<td>6.4</td>
<td>14</td>
<td>89</td>
<td>87</td>
</tr>
<tr>
<td>EG</td>
<td>10000</td>
<td>96</td>
<td>6.4</td>
<td>18</td>
<td>47</td>
<td>72</td>
</tr>
<tr>
<td>EP</td>
<td>18193</td>
<td>118</td>
<td>6.4</td>
<td>13</td>
<td>80</td>
<td>98</td>
</tr>
<tr>
<td>ER</td>
<td>9370</td>
<td>66</td>
<td>6.4</td>
<td>13</td>
<td>46</td>
<td>47</td>
</tr>
<tr>
<td>EU</td>
<td>11726</td>
<td>107</td>
<td>6.4</td>
<td>16</td>
<td>69</td>
<td>71</td>
</tr>
<tr>
<td>NBR G1</td>
<td>13000</td>
<td>50</td>
<td>5</td>
<td>10</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>7511 GII</td>
<td>10000</td>
<td>40</td>
<td>4</td>
<td>8</td>
<td>25</td>
<td>35</td>
</tr>
</tbody>
</table>

The species EP reached standard values for grade I. The sleepers with others tested Eucalyptus species reached the standard values for grade I in practically all properties except the flexural modulus of elasticity (MOE).

As we can observe in table 1 MOE is the limiting mechanical property for most of the species tested reached the grade I established by ABNT NBR 7511/2013: Wooden Sleepers - Requirements and test methods.

4 CONCLUSIONS

The sleepers made by the Eucalyptus paniculata species reach the standard values established for grade I. The Eucalyptus cloeziana, Eucalyptus grandis e Eucalyptus urophilla species reached values for grade II to sleepers. The sleepers made by the Eucalyptus rostrata did not reach the minimum strength for use as railway sleepers.

The property modulus of elasticity (MOE) is the limiting property for the tested Eucalyptus species reached the grade I established by ABNT NBR 7511/2013: Wooden Sleepers - Requirements and test methods.

The sleepers visual analysis also showed the importance to first make the visual characterization of the wood before the mechanical tests.

ACKNOWLEDGEMENT

The authors express their gratitude to CNPq for providing Scholarship, the Interdisciplinary Program of Materials Science and Engineering and the Laboratory of Wood and Wooden Structures USP São Carlos that made possible the development of this study.

REFERENCES


