Composite Materials Processing with the Band Saw Blade Crack Before and After the Experiment Analysis (1)

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ABSTRACT: This article takes the MJ3210 type woodworking band saw machine as the research object. Under no load, using advanced Beijing pop vibration analyzer and the Vib sys vibration signal acquisition, processing and analysis software for vibration signal acquisition and analysis, through the saw blade transverse vibration displacement, the power spectrum analysis: The saw blade transverse vibration displacement effect on the most significant factor as the spindle speed, followed by the tension of saw blade and belt tension is not significant factors. And draw the best process parameters. Adjust the saw under optimal process parameters. Use 120 mm width is 1.02 mm thick band saw blade type MJ3210 fine woodworking band saw machine, through to the saw blade crack before and after the vibration signal correlation analysis showed that the determination of lateral vibration displacement if between 4.48µm ~ 5.14µm microns, vibration main frequency between 494 Hz ~ 528Hz, and is the saw blade has had at least one more than 3 mm crack defects, need to timely change the band saw blade.

1 GENERAL INSTRUCTIONS

Band saw blade is processing composite band saw machine &tooling. Its working state will directly affect the machining quality of composite material. According to consult literature at home and abroad, it is lack of band saw blade under no-load and load analysis of crack defects. Therefore, this article proposed the preliminary study on the band saw blade cracks, and sums up its causes and change rule, and then understand deeply the inner relations of the factors of crack and fracture mechanism of the saw blade, in order to improve the quality of composite materials processing.

2 LABORATORY INSTRUMENTS AND EQUIPMENT

2.1 Laboratory instruments

Instruments used in the experiment are shown in table 1.

Table 1. Main instrument and equipment.

<table>
<thead>
<tr>
<th>Equipment name</th>
<th>Type (and number)</th>
<th>Suppliers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data acquisition instrument</td>
<td>WS-5942-2-50</td>
<td>Spectrum of Beijing century science and technology Development limited</td>
</tr>
<tr>
<td>Static resistance strain gages</td>
<td>YJ-35</td>
<td>Shanghai automation instrumentation limited shares Company (East China electronic instrument factory)</td>
</tr>
<tr>
<td>Proximity sensor</td>
<td>HZ-8500</td>
<td>Beijing vibration measuring instrument factory</td>
</tr>
</tbody>
</table>

2.2 Equipment and sensor installation

Table 1. Main instrument and equipment.

Equipment and sensor installation figure 1 below, test system shown in Figure 2-3 below

Figure 1. Device and sensor installation diagram.
2.2 Device and its parameter

2.2.1 Device and its parameter
This experimental research equipment for the University of North China Institute of forestry MJ3210 woodworking band saw machine woodworking machinery laboratory. Its structure consists of upper and lower the saw wheel, band saw blades, saw blade guides, tightening, dynamical system, rack, safe cover and other components. As shown in Figure 4.

2.2.2 Machine parameters
Equipment: Fine woodworking band saw machine Type: MJ3210 Saw blade diameter: 500mm Saw blade wheel speed: 831rpm. Motor speed: 1400rpm Saw blade parameter: 7550mm×120mmx 1.02mm (length x width x thickness GB/T 21690-2008 Fine woodworking band saw blade dimensions)

3 THE EXPERIMENTAL DATA PROCESSING AND RESULT ANALYSIS

3.1 Bby orthogonal test and analysis of significant

Table 2.Factors of orthogonal test and level.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-saw round spindle speed(rpm)</td>
<td>739</td>
<td>782</td>
<td>831</td>
</tr>
<tr>
<td>B-belt update tight force(N)</td>
<td>1234.9381</td>
<td>1234.9387</td>
<td>1234.9394</td>
</tr>
<tr>
<td>C-saw blade update tight force(N)</td>
<td>424</td>
<td>422</td>
<td>420</td>
</tr>
</tbody>
</table>

According to the fine woodworking band saw machine for experimental analysis of structure and movement, select the spindle speed, belt tension and the saw blade tension for the experimental factors, to determine impact significant factors of displacement of transverse vibration of band saw blades. 3 horizontal x 3 factors L9 (3^4), orthogonal, bit-level are shown in table 2 below.

Test analysis results for: the factors of primary and secondary order mainly → times: A-saw round spindle speed C-saw blade update tight force B-belt update tight force; A-saw round spindle speed C-saw blade update tight force for significantly factors, B-belt update tight force for not significantly factors; optimal program for A-saw round spindle speed 831rpm, and C-saw blade update tight force 122N, and B-belt update tight force 1234.9394N, following experiment in the with saw blade thickness are not variable.

3.2 Saw the wheel spindle speed of displacement of lateral vibration of cracked saw blades and the influence of primary frequency

Band saw blade tension to 422N, under the premise of the belt tension is 1234.9394N, have 3mm long crack on the intact blades and saws for data acquisition, are displacement transverse vibration of saw blade as shown in Figure 4, master frequency curve as shown in Figure 5.

All these texts fit in a frame which should not be changed (Width: Exactly 187 mm (7.36”); Height: Exactly 73 mm (2.87”) from top margin; Lock anchor).
By Figure 4, 5 visible, saw round spindle speed on with saw blade horizontal vibration displacement, and main frequency size effect very obviously, saw round spindle speed in 831rpm as saw round speed of increased Shi saw blade of horizontal vibration displacement and vibration frequency with of reduces, saw round spindle speed in 831rpm, as saw round speed of increased Shi saw blade of horizontal vibration displacement and vibration frequency rate with of increases, in saw round spindle speed in 831rpm Shi saw machine reached best work State.

Lateral vibration of a cracked saw blades displacement between 2.27μm~4.98μm, vibration frequency ratio between 494Hz~514Hz.

After cracking main frequency of vibration of the saw blades generally is less than perfectly preserved main frequency of vibration of the saw blade.

3.3 Saw blade saw blade tension crack of lateral displacement of vibration and the influence of primary frequency

Band saw machine spindle speed of 831rpm, under the premise of the belt tension is 1234.9394N, 3mm crack saw blades for data collection, are lateral vibration displacement curve band saw blade as shown in Figure 6, master frequency curve as shown in Figure 7.
Figure 6 visible, cracking and intact blade band saw blade vibration displacement curve movements is basically the same, but generally increased, resulting in defects cracked saw blades of horizontal vibration displacement between 3.48µm~5.14 µm. By contrast in Figure 7, increase blade tension, blade vibration frequency rate declined and cracks after the vibration frequency of the vibration frequencies generally is less than good saw blades. Their vibration frequencies between 525Hz and 528Hz.

3.4 Comparative analysis on defects of different width of saw blade vibration

Table 3. Comparison of different displacement of lateral.

<table>
<thead>
<tr>
<th>Saw blade width /mm</th>
<th>110</th>
<th>120</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good blade vibration transverse vibration displacement/µm</td>
<td>3.452</td>
<td>5.520</td>
</tr>
<tr>
<td>Displacement of lateral vibration of saw blade cracks/µm</td>
<td>3.652</td>
<td>5.710</td>
</tr>
</tbody>
</table>

110mm wide and 120mm wide cracks in blade crack of saw blades for data acquisition, saw blade crack 3mm Transverse vibration of blade displacement results as shown in table 3, master frequency data curve as shown in table 4.

Table 4. Comparison of different width of the saw blade saw blade vibration frequency.

<table>
<thead>
<tr>
<th>Saw blade width /mm</th>
<th>110</th>
<th>120</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good blade vibration frequency/Hz</td>
<td>550</td>
<td>570</td>
</tr>
<tr>
<td>Crack of blade vibration frequency/Hz</td>
<td>575</td>
<td>590</td>
</tr>
</tbody>
</table>

The table 3 and table 4 shows that there are wide blade transverse vibration displacement of defect was obviously higher than that of narrow blade, and the main frequency of the change is wide blade transverse vibration frequency is generally lower than the narrow blade. So in the judgment in the process of production will differ according to the width of the saw blade, saw blade defects from two aspects of vibration displacement and vibration frequency, respectively.

3.5 Equipment running time on defect impact vibration of saw blade

Pulley spindle speed is 831rpm, the belt tension is 1234.9387N saw blade tension to 422N, saw blades and 30mm wide, crack length 3mm, 20min collecting data, taking seven observation points draw a curve as shown in table 5, by spectral analysis, curve by the main frequency data as table 6.

Table 5. Complete saw blade and tooth defects comparison of transverse vibration displacement.

<table>
<thead>
<tr>
<th>Tree species</th>
<th>Poplar wood</th>
<th>Oak</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displacement of lateral vibration of saw blade tooth defect/µm</td>
<td>5.4</td>
<td>5.97</td>
</tr>
<tr>
<td>Complete saw blade vibration displacement/µm</td>
<td>3.31</td>
<td>3.37</td>
</tr>
</tbody>
</table>

After table 5 comparative analysis of curve, you can know the when I saw qiyeangmu saw blade vibration displacement smaller than the displacement of vibration when sawing oak, describes as the hardness of the cutting of timber increases, increase the vibration displacement. From a comparative analysis of primary frequency values, as shown in table 6, saw sawing oak qiyeangmu the frequency rate than master when frequencies of small, indicating as the hardness of the cutting of timber increases, clock speed also increases the rate and in the process of cutting, when the saw blade just touch wood when displacement is relatively large.
Table 6. Complete saw blade and tooth defects comparison of main frequency of vibration.

<table>
<thead>
<tr>
<th>Tree species</th>
<th>Poplar wood</th>
<th>Oak</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defects of tooth saw blade vibration frequency/Hz</td>
<td>570</td>
<td>680</td>
</tr>
<tr>
<td>Complete saw blade vibration frequency/Hz</td>
<td>550</td>
<td>660</td>
</tr>
</tbody>
</table>

After table 5 comparative analysis of curve, you can know the when I saw qieyangmu saw blade vibration displacement smaller than the displacement of vibration when sawing oak, describes as the hardness of the cutting of timber increases, increase the vibration displacement. From a comparative analysis of primary frequency values, as shown in table 6, saw sawing oak qieyangmu the frequency rate than master when frequencies of small, indicating as the hardness of the cutting of timber increases, clock speed also increases the rate and in the process of cutting, when the saw blade just touch wood when displacement is relatively large.

3.6 Devices running time on crack of blade vibration effects

Use the saw Wheel spindle speed 831rpm, saw blade tension 424N, belt tensioning force subject to 1234.9394N, 20min collecting data definitions of good saws and saw blades for data acquisition and analysis of crack defect by lateral vibration of band saw blade displacement as shown in Figure 8. Acquired data are derived from spectral analysis, are the main frequency as shown in Figure 9.

By the curve of figure 8 shows, 80 minutes, before changing with running time, the defects of the saw blade vibration displacement, slow after 40 minutes, on 80 minutes to achieve the best state. From figure 9 shows, the equipment operation began a period of time (40 minutes), band saw blade transverse vibration main frequency is large, as the run time increase vibration main frequency, 40 minutes later changes slow. And then instantly restore to a steady state, continue to fluctuate in this range. Watching tooth at the bottom of the saw blade off after 100 minutes, found in the drop tooth crack and the crack length increases from zero to 8 mm, teeth number has no obvious change.

4 CONCLUSION

After more than MJ3210 fine woodworking band saw machine testing and the handling of test data and comparative analysis, reached the following conclusions:

(1) By orthogonal experiments analysis showed that MJ3210 woodworking band saw blade vibration displacement is the most significant factor for the
spindle speed, followed by blade tension, belt tension for the less obvious factors.

(2) Experiments, MJ3210 fine woodworking band saw machine saw the best process parameters adjustment of saw blade Wheel spindle speed 831rpm, saw blade tension 122N, belt tension 1234.9394N, displacement as the minimum transverse vibration of saw blade.

(3) In adjustable saw best technology parameter, using 16mm width, 0.7mm thick of with saw blade of MJ3210 type fine woodworking with saw machine saw blade, produced crack of saw blade of vibration displacement will than intact saw blade of vibration displacement obviously increases, and vibration frequency rate is will obviously reduces, by can bear of maximum saw blade update tight force also will reduces, so, for MJ3210 type fine woodworking with saw machine, judgment saw blade is needs replaced, can from saw blade vibration displacement and vibration main frequency of changes to judgment, dang spindle speed, Belt tension, blade tension is adjusted to the optimal case, determination of transverse vibration displacement between 4.48um~5.14 µm, while the vibration frequency ratio between 494Hz~528Hz, you saw blades have produced at least a 3mm crack, the need for timely replacement band saw blades.

(4) Defective lateral vibration displacement is significantly higher than the narrow width of saw blade saw blades, defective lateral vibration frequencies generally above the narrow width of saw blade saw blade, practically judge the situation to be different according to the width of the saw blade saw blade defects, separately from the twofold vibration displacement and vibration frequency judgments.

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7 AUTHOR'S BRIEF INTRODUCTION

Jin-gui Gao The han nationality Jilin province dumpling river in December 1963, a professor at the postdoctoral School of materials science and engineering, Nanjing forestry university.Mainly engaged in the study of theory of composite materials and processing, composite processing machinery dynamic design theory and the research of fault diagnosis.

REFERENCES