EXPOSURE TEST OF SURFACE-TREATED STEEL PLATES ON PRESERVATIVE-TREATED WOODS

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**ABSTRACT:** In this study, some surface-treated steel plates on some preservative-treated woods were subjected to exposure test, and we observed the corrosion status of the steel plates continuously. The plates were evaluated on the visual deterioration degree, but it seems that the method have low-reproducibility. Then we tried to evaluate the corrosion status of the steel plates by the image analysis method. As a result, visual deterioration degree was almost same result to the deterioration degree by the image analysis method. But there are some problems that the determination of the wood adhered to the plate, the reddish part which is not rust, and the red rust near black, are difficult.

**KEYWORDS:** Timber structure, Metal joint, Durability, Preservative-treated wood, Exposure test

1 INTRODUCTION

In Japan, it becomes important that metal joints in the wooden houses because installation of metal joint were required by revised Building Standard Law in 2000 and the Act on the Promotion of Popularization of Long-life Quality Housing was enacted in 2008. However, knowledge about the durability of the metal joint is still less. So we are continuing to observe the corrosion status of steel plates which are attached on the preservative-treated wood and exposed outdoor [1].

In this test, we had evaluated the corrosion status of steel plates by the visual index. The method of the visual index has the advantage of their quickness and simplicity, but at the same time, it has the risk that repeatability is low. So we tried to evaluate the corrosion stats of steel plates by image analysis.

2 TEST AND ANALYSIS

2.1 TEST OUTLINE

Some steel plates treated with several different types of rust-proofing were exposed outdoor with attached on the preservative-treated wood. Outline of the exposure test was shown on Figure 1. Specifications of steel plates and preservative-treated wood were shown on Table 1 and 2. We observe corrosion status of the steel plates which surface was facing the wood in some intervals, and we evaluated the corrosion status by the visual index, which is 6 grade evaluation (Figure 2). We got the image data by scanning the plate. Then the plates which had been observed were returned to attach on the wood.

![Figure 1: Outline of the exposure test](image1)

**Table 1: Specifications of steel plates**

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zn5Cr6</td>
<td>Zn8Cr6</td>
<td>Zn5Cr3</td>
<td>Zn8Cr3</td>
<td>Z27</td>
<td>HDZ-A</td>
<td>HDZ23</td>
<td>Z60</td>
<td>HDZ35</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>N</th>
<th>O</th>
<th>P</th>
<th>Q</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zn+Al plating</td>
<td>Zn+Sn plating</td>
<td>Zn+Mg plating</td>
<td>Mg plating</td>
<td>Zn+organic coating</td>
<td>Zn+organic coating</td>
<td>Zn+organic coating</td>
<td>Zn+organic coating</td>
<td>Zn+organic coating</td>
</tr>
</tbody>
</table>

**Table 2: Specifications of preservative-treated wood**

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
<td>F</td>
<td>G</td>
<td>H</td>
<td>I</td>
</tr>
<tr>
<td>Thiametoxam</td>
<td>Dimefluslan</td>
<td>Bifenthrin</td>
<td>Ethofumesprox</td>
<td>Ethofumesprox</td>
<td>Boric acid</td>
<td>non-treated</td>
<td>non-treated</td>
<td>non-treated</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
</tr>
<tr>
<td>Trichlorfon</td>
<td>Dicofol</td>
<td>Bayleton</td>
<td>Endosulfan</td>
<td>Endosulfan</td>
<td>DowCorning</td>
<td>DowCorning</td>
<td>DowCorning</td>
<td>DowCorning</td>
</tr>
</tbody>
</table>

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2.2 IMAGE ANALYSIS

The procedure of the image analysis is shown below.

1) We extracted the RGB values of 30 points which were obviously red rust. And calculated average value and the standard deviation $\sigma$ of R, G, and B. We defined average values $\pm \sigma$ (range A) as the range of the red rust (Figure 3).

2) We resized the image into $100 \times 100$ pixels for reducing data size, and calculated the RGB values of each pixels.

3) If RGB values of the pixel are included in the range A (described above), the part of the pixel was determined as red rust. The ratio of red rust pixels to total pixels (10000 pixels) was called Red Rust Area Ratio. However, the pixel, which R/G value and R/B value was less than 1.1, was not determined as red rust, because the pixel, which R value was small and which G value or B value was large, was not counted.

3 ANALYSYS RESULT AND DISCUSSION

The extraction results of the pixels as red rust are shown in Figure 4 as an example. And the relationships between the visual index and Red Rust Area Ratio are shown in Figure 5. As a result, it is found that the visual index has certain accuracy, but it has the tendency to overestimate Red Rust Area Ratio at 4 or 5 grade of the visual index (Despite the plate was under 5% Red Rust Area Ratio, it was determined 4 grade of the visual index, and despite the plate was under 30% Red Rust Area Ratio, it was determined 5 grade of the visual index.).

4 CONCLUSIONS

We tried to adopt image analysis for the evaluation of the corrosion on the steel plates instead of the visual index. As a result, the visual index has certain accuracy, but some issues remained. The remaining issue is that it is difficult to determine the part which is red but not rust, the piece of wood attached to the steel plate, the shadow of the hole in the steel plate, and the red rust near black.

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REFERENCES