Research on the law of reflection coefficient of reflective film of traffic sign based on Angle

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Abstract. In this paper, a large number of digital printing reflective film retroreflectivity measurement. Based on the multi-angle test of the reflective film of the mainstream manufacturers in the market, the reverse reflection coefficient of the digital printing reflective film was obtained. Through the curve fitting of the measured values of the backreflection coefficient under different measuring angles by using the scatter plot, the variation law of the luminosity of the digital printing reflective film with incident Angle and observation Angle was obtained. The variation law of backreflection coefficient explored in this paper has certain significance to the application guidance of digital printing reflective film for traffic signs.

Keywords: Inverse reflection coefficient, Angle, Inverse reflection coefficient.

1 Introduction

Reverse reflection, also known as reflection, reflection, regression reflection, recovery reflection, directional reflection or reverse reflection, is a reflection of the reflected light from the opposite direction of the near incident light. This property can be maintained when the direction of the incident ray varies over a large area[1] [2].

Fig. 1. Retreoreflection.

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The technology, developed in the 1920s, involves shining a light on a cat's eyes at night, which emits a strong beam of light that clearly shows the cat's eyes[3]. Inspired by the cat's eyes, people began to study reflective science, in order to use it to reflect the lights of cars and solve the problem of traffic sign recognition[4].

Fig. 2. Reverse reflection schematic diagram.

2 Retroreflection coefficient measurement

2.1 Get the date

In this paper, the research of traffic sign reverse reflection dynamic measurement based on absolute measurement method is adopted[5]. By analyzing the principle of reverse reflection measurement and combining with the relevant research of reverse reflection measurement at home and abroad, the key elements of traffic sign reverse reflection dynamic measurement are put forward: geometric system, light source and receiver. As for uncontrollable variables such as ambient light, signs to be tested and vehicle driving state, further research will be carried out in the following work. The reverse reflection coefficient of traffic signs is tested according to the method specified in "The Common Plane Geometry Method for Testing Method of Reverse Reflection Coefficient" (JT/T 689-2007) [6]. In general, the rotation Angle $\theta$ of test is $0^\circ$ or $90^\circ$. Different rotation angles can also be selected for testing according to the requirements of the manufacturer or the entrusting party. The principle of measurement is shown in the figure below.

Fig. 3. Survey diagram.
In accordance with the current reflective film measurement standard requirements, we targeted at the current market mainstream reflective film manufacturers for sampling measurement. The selected samples are class IV digital printed reflective film, all of which are digitally printed. Under different observation Angle and incident Angle measurement conditions, the measurement data of white light and yellow light are obtained. The backreflection coefficient was sorted out from the measured data, and the sorting results were shown in Table 1:

<table>
<thead>
<tr>
<th>sequence number</th>
<th>observation angle</th>
<th>incident angle</th>
<th>testing result(white)</th>
<th>testing result(yellow)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>brand1</td>
<td>brand2</td>
</tr>
<tr>
<td>1</td>
<td>0.2°</td>
<td>-4°</td>
<td>1123</td>
<td>705</td>
</tr>
<tr>
<td>2</td>
<td>15°</td>
<td>926</td>
<td>697</td>
<td>416</td>
</tr>
<tr>
<td>3</td>
<td>30°</td>
<td>615</td>
<td>419</td>
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<tr>
<td>4</td>
<td>0.5°</td>
<td>-4°</td>
<td>483</td>
<td>468</td>
</tr>
<tr>
<td>5</td>
<td>15°</td>
<td>510</td>
<td>406</td>
<td>285</td>
</tr>
<tr>
<td>6</td>
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<tr>
<td>8</td>
<td>1°</td>
<td>127</td>
<td>100</td>
<td>57</td>
</tr>
<tr>
<td>9</td>
<td>30°</td>
<td>112</td>
<td>72</td>
<td>35</td>
</tr>
</tbody>
</table>

2.2 Curve analysis

Through the white light, yellow light reflection coefficient measurement of reflective film produced by mainstream manufacturers in the market, the measurement data of the reflection coefficient under different observation Angle and incident Angle are made into a scatter diagram, curve analysis is carried out, and the influence law of different observation Angle and incident Angle on the photometric performance of reflective film is obtained.

Fig. 4. Brand 1 reflective film photometric performance with the change of Angle(white).
Fig. 5. Brand 2 reflective film photometric performance with the change of Angle(white).

Fig. 6. Brand 3 reflective film photometric performance with the change of Angle(white).

Fig. 7. Brand 1 reflective film photometric performance with the change of Angle(yellow).
It can be seen from several figures that the reflection coefficient of reflective film basically shows logarithmic decreasing trend with the change of observation Angle and incident Angle. From this we get the market mainstream manufacturers of digital printing reflective film photometric performance and observation Angle, incident Angle of the rough relationship, which has a certain significance for digital printing traffic sign reflective film application.

References

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