The research of improving uniformity of backlight module after THB

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In 21st century,TFT-LCD plays a more and more important role in display industry, which has been used in Smartphone ,notebook and industrial devices. Industrial application requests steady image display in tough environment, which means high temperature such as 85℃ and high humidity. However, as the important element of the backlight, the lighting guide plate(LGP) which is usually made of polymethyl methacylate (PMMA) partial melt at about 85℃. Because it is the important element of the backlight and this action would affect the backlight's optical characteristics, especially luminousness and uniformity(aways lower than 75%). In this paper, we discuss a method to achieve good performance(uniformity aways above 80%) after high temperature and high humidity Operating Test (THB) by adjusting LGP pattern.

Keywords: uniformity high temperature LGP

Introduction

The backlight is to provide a uniform surface light source for a liquid Cristal display (LCD), which is usually consist of light source, light guide plate, prism sheets, diffuser sheets and a reflective sheet. Besides light guide plate which is made of PMMA, the others are made of PET. According to chemical Polymer Handbook, the PET's heat deflection temperature(HDT) is up to about 200℃, while PMMA's HDT is only 85℃. Therefore, when we put the LCD Module into high temperature and high humidity oven for about 500 hours, we must take consideration of the melting or deformation. Even the temperature of the oven is under or near to the melting point of PMMA, the lightbar will release a lot of energy when it keeps lighting on for 500 hrs. Then the edge closed to lightbar will first melt and effect inner light guiding. This is one of the reason that make the area near to LGP seems less brighter than the others. The other reason coursing light attenuation is is the increase of the gap between LGP and lightbar.

Traditional light guide plate pattern design

Traditional light guide plate pattern design will make the center of the backlight more brighter than around aereas. This design can ensure high illumination and uniformity. In order to describe this we take 9points luminous diagram for example. As seen in Fig.1, point 5 will brighter than the other area. As the material of light guide plate PMMA can't sustain high temperature, the LGP will melt and then change the light rays existing out of the LGP from emitting surface. After continuous operating 500hrs at 85℃, area 3,6,9 which near to the light sources will become darker than the other.

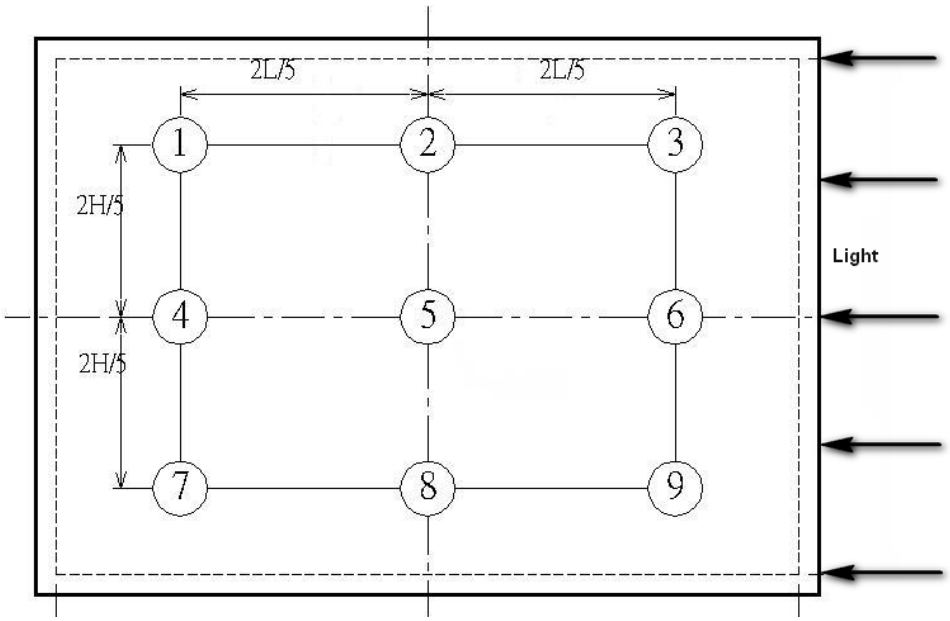
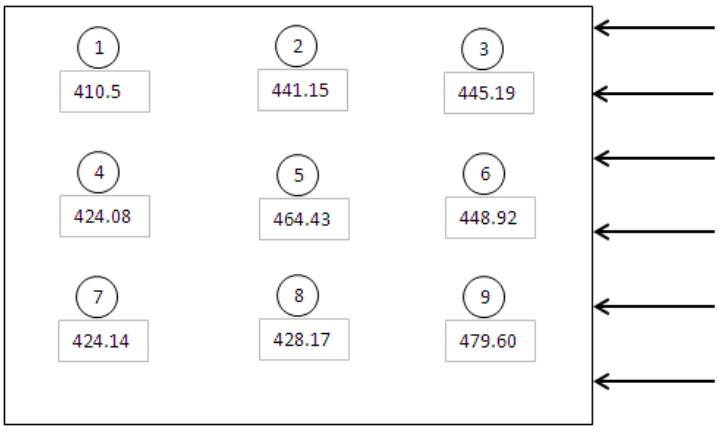


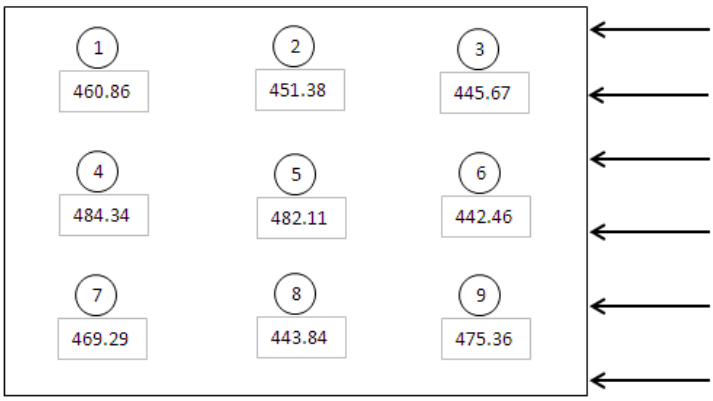
Fig. 1 Traditional LCD panel structure of section

The new design concept

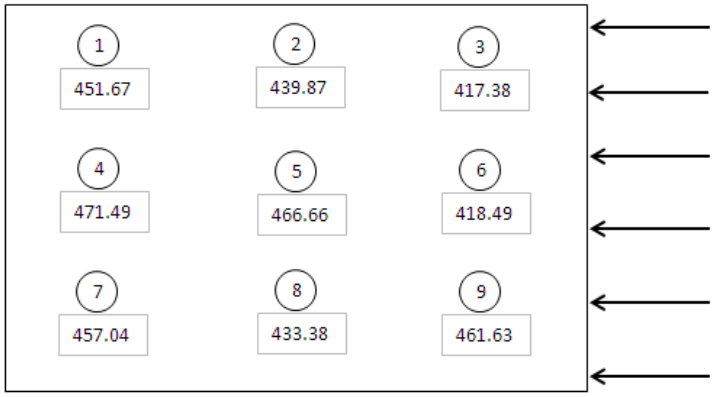
In this research, area3, 6, 9 are designed to be more brighter than light-existing side. Take uniformity and display quality into consideration, their luminance is still lower than the center point. In order to construct a reliable backlight model for optical simulation, it is necessary to compare optical data before and after high temperature and high humidity Operating Test. For this purpose, a 10.1-inch LCD module was investigated. The optical characteristics were investigated by using a optical device (DMS).
Fig.2 below show the luminance of the TFT-LCD module at initial time and after 72h, 150h, 300h operating in oven with a high temperature of 85℃ and high humidity of 50% .The data corresponds to the point of Fig.1.



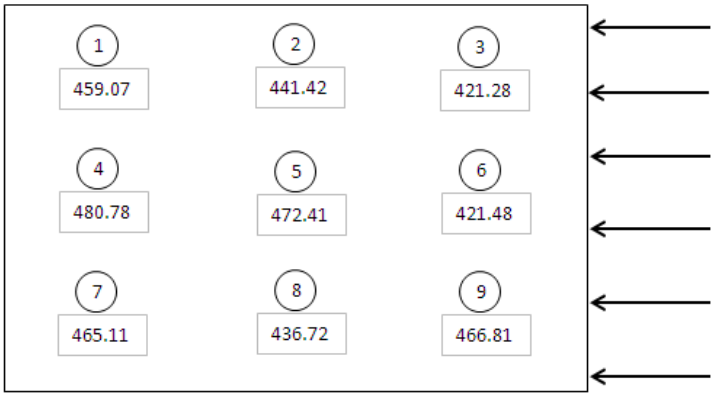
(a) Initial data before experiment



(b) Optical data after 72H



(c) Optical data after 150H



(d) Optical data after 300H

Fig. 2 optical data in experiment

When we put all data together, we can quickly catch the variation tend. As we see in Fig.3, the luminance at area 3,6,9 decreased while area 1,4,7increased to keep energy conservation. Then, the uniformity of the LCM is 87.62%. As a result, this change would ensure high uniformity both before and after RA Test.

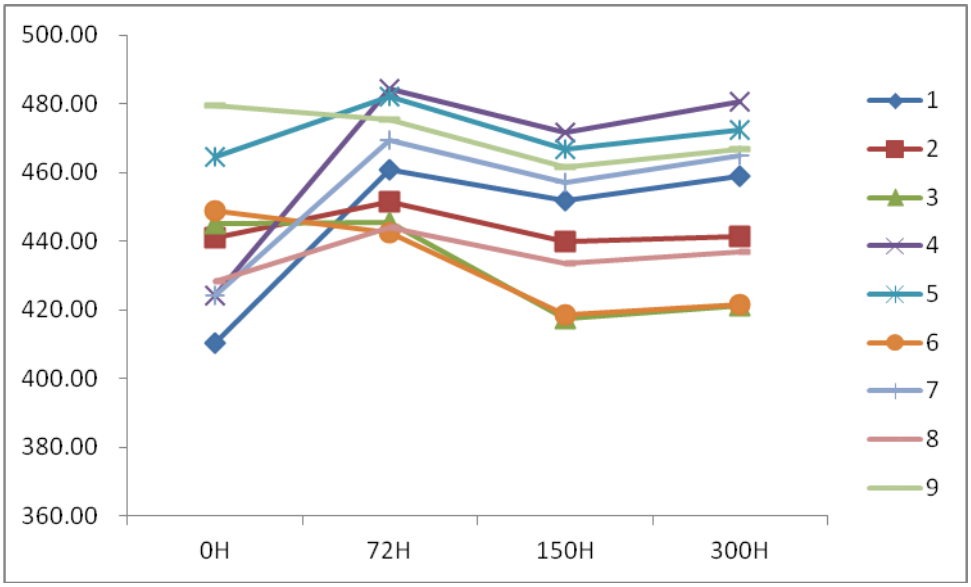


Fig. 3 optical data changing tend

Summary

In conclusion, we can adjust the pattern of the LGP to control the luminance, and to get enough uniformity of intensity in tough terms for industrial application. Compare with searching a new heat-resisting material to replace PMMA, the proposed design method in this paper can achieve a optimization performance at the present time.