UV Curing of Complex Three Dimensional Objects

A critical step in establishing whether an object can be successfully cured using UV energy is to determine the possibility of uniform exposure across all surfaces. The challenge with three dimensional objects is in reaching the valley regions prone to underexposure while preventing overexposure of the peak regions. Furthermore, vertical planes on the object are particularly challenging since UV energy is traveling parallel to those surfaces, in most cases.

Physical testing usually involves a great deal of time and expense because several attempts must be performed prior to discovering a perfect exposure path. By using *UV Intensity Labels in place of the actual UV curable coating, the evaluation process is greatly improved and simplified. ***(*For more information on UV Intensity Labels please see Appendix)***

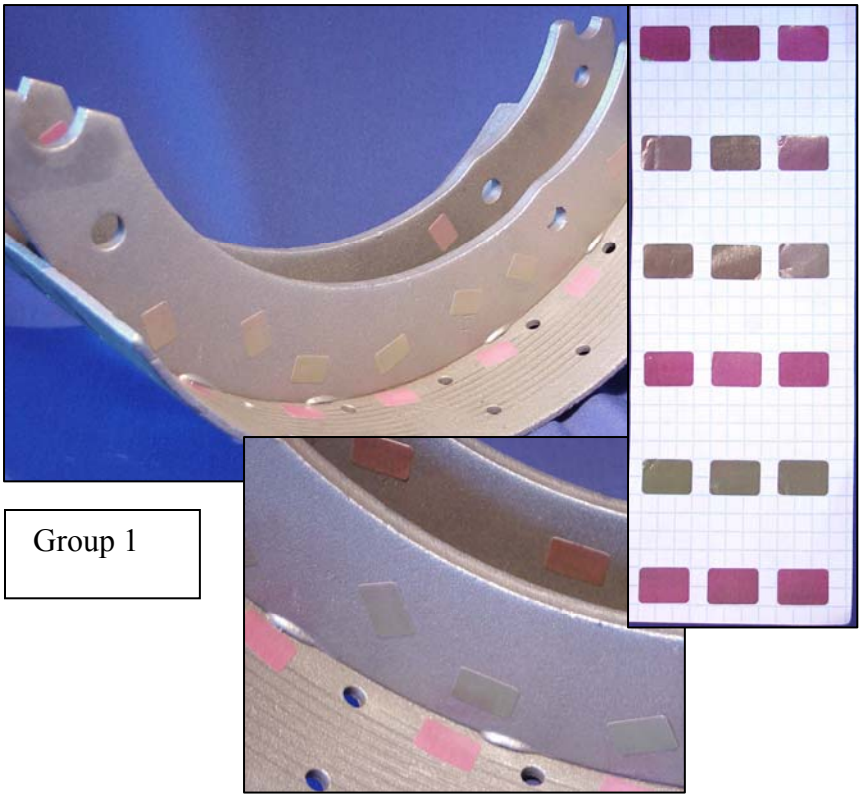
Test results from an exposure evaluation of Altec Carlisle Brake Shoes:

We configured our UV curing conveyor using a Lighthouse DualCure Irradiator, which we determined would provide optimum flexibility for this complex object.

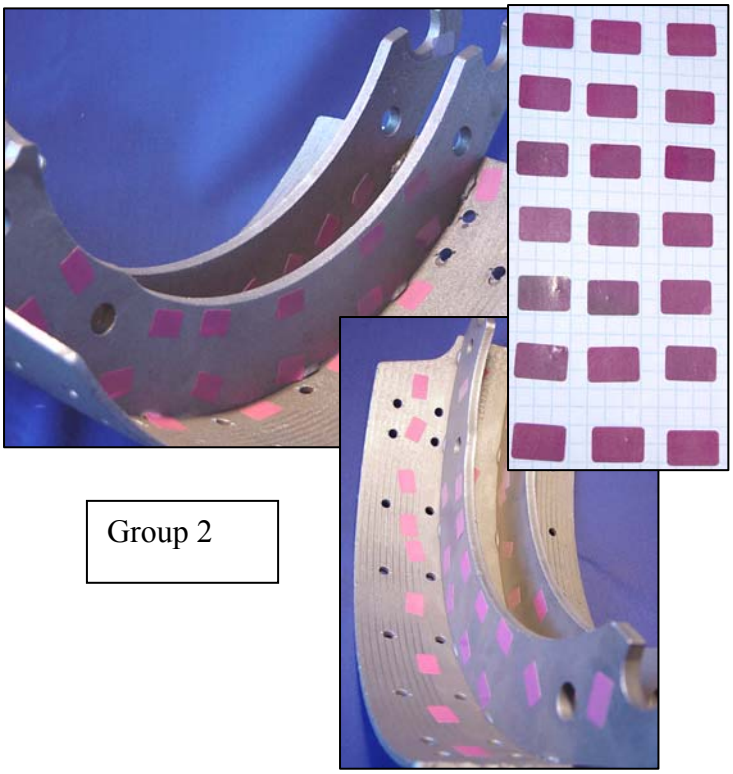
We applied Intensity Labels to the vertical and horizontal planes on the most complex side of the brake shoe. These surfaces included both the outer planes and the more difficult, shadow prone inner planes. We then ran the brake shoe through the path of the curing system. We performed three separate tests; one with the vertical planes parallel to the energy, another with the vertical planes perpendicular to the energy, and a final test with the vertical planes at a 45 degree angle to the energy. Upon close inspection, the following results were documented.

Detail of Group 1:

In the first test, we ran the brake shoe at an angle perpendicular to the light path. As clearly indicated by the UV Intensity Labels; the various planes on this three dimensional object received very uneven UV exposure. Pictured is a full view, a close up view, and finally we also removed the labels and placed them onto a sheet for easy analysis. Each horizontal row on the sheet contains labels from a different plane on the object.



Group 1



Group 2

Detail of Group 2:

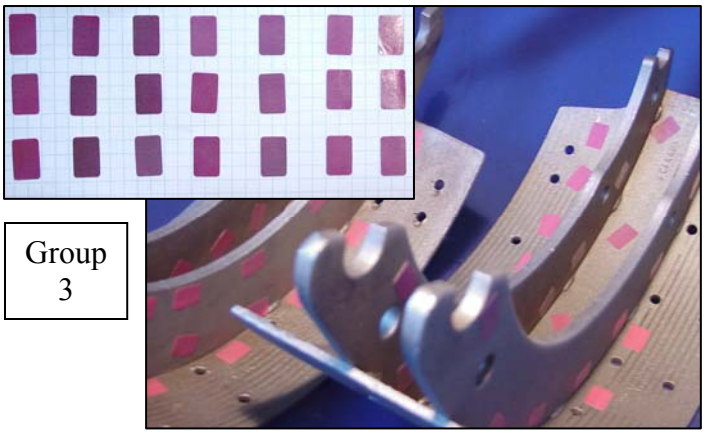
In the second test, we ran the brake shoe at an angle of 45 degrees askew to the light path. Now as indicated by the UV Intensity Labels; the various planes on this three dimensional object received a very uniform and even exposure. All the labels, even those within the inner vertical and horizontal planes, are uniform in color and therefore, uniform in exposure.

Detail of Group 3:

A final test run was performed with the object parallel to the light path. The performance at this angle was equally good with little to no significant exposure difference that could cause uneven curing.

Conclusion:

Through the use of UV Intensity labels we were able to determine that given the proper angle of incidence, this object can be successfully cured using UV Energy when exposed by our Dual Cure Lighthouse Irradiator.



Group 3

Appendix UV Intensity Labels:

The UV Intensity Labels are a reliable, low cost, simple, in-house method of monitoring UV radiation, EB or Gamma Ray dosage. When exposed to UV, EB, or Gamma Ray, these photochromic intensity indicator undergo a gradual color change from green to purple that is directly related to the energy value received.

The adhesive backed label is placed on a sample product or substrate and processed to the proper cure rate. The color deviation can easily be measured with a densitometer or by comparing the colors to test labels created to known operating standards to determine processing inconsistency.

Additional benefits from using UV Intensity Labels in testing procedures are:

1) Coating does not need to be applied to each part prior to exposure testing, resulting in a large number of wasted parts from failed exposure runs.
2) Time and resources are not required to set up a testing line identical to the actual production line of the customer's facility, including specialized coating application equipment.
3) Cost of the Intensity labels compared to the actual UV Coating is significantly lower.