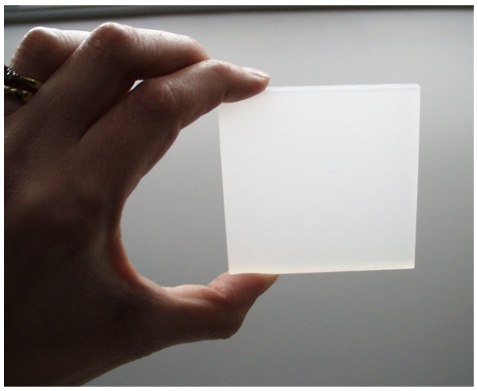
Applications Note

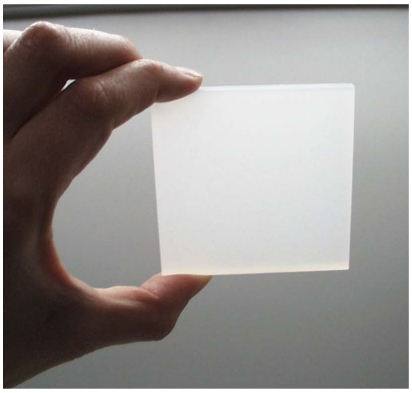
Insight on Color **Vol. 14, No. 10**

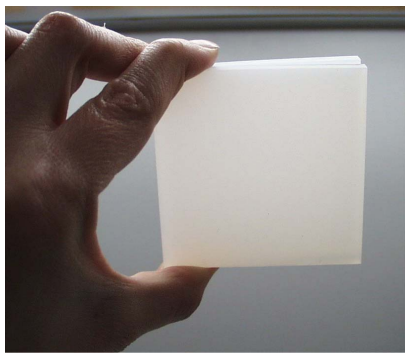
Path Length and the Measurement of Translucent Samples

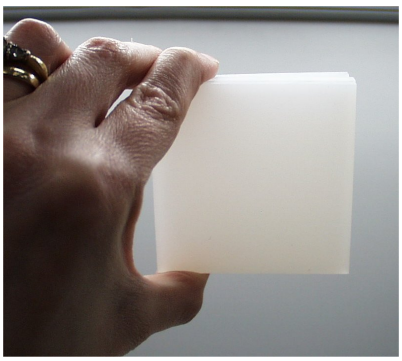
Translucent samples (such as plastic plaques, citrus juices, and semi-solids like salad dressing) reflect enough light that their reflected color may be measured, but they also transmit light. In the picture below, you can see the reflected whiteness of the plaque (the color reflected back to you from the surface of the plaque), and you can also see some light shining at you from behind the plaque (the transmitted light).



When you're looking at the reflected color of a translucent sample, the light that is transmitted through the sample is lost to the reflectance assessment. Thicker samples will lose less light to transmittance, as you can see in the picture below. These plaques are prepared from the **same** plastic resin, but with different thicknesses.





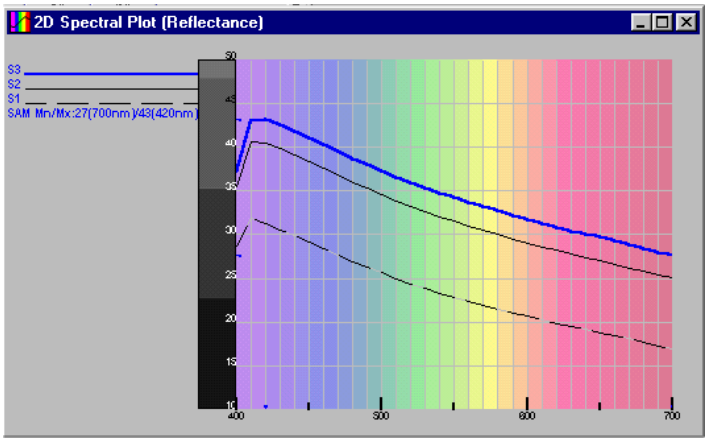


These samples do not look the same. You can see that the sample on the left, which is about 1/4- inch thick, allows more light to shine through it ("glows" more) than the ones to its right, which are about 1/2-inch and 3/4-inch thick, respectively, and appear more opaque. The samples look different to your eye with different thicknesses, or path lengths. Is the same thing true when you measure with an instrument? You bet.

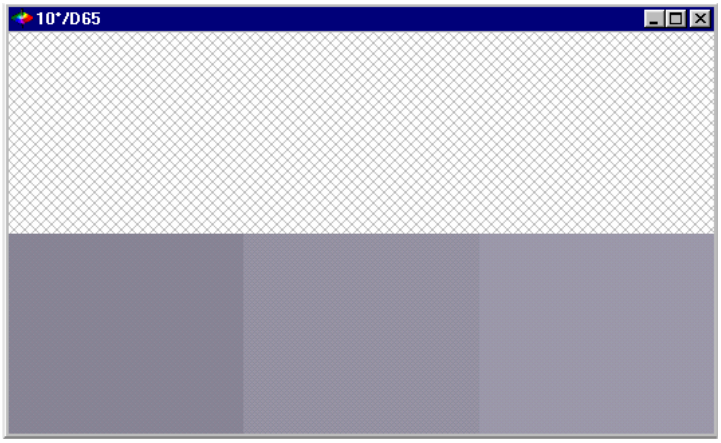
Each of the above samples was measured on a LabScan XE with a 1.75-inch area of view. The following color values were received (D65/10°).

Sample Thickness	L*	a*	b*
1/4 inch	55.09	-1.58	-9.68
1/2 inch	63.10	-1.52	-8.63
3/4 inch	65.29	-1.49	-8.19

Just as we had noted visually, the 1/4-inch thick sample appears darker (has a lower L*) because transmitted light is being lost from the measurement. The spectral plot and color rendering view shown below also illustrate the differences detected instrumentally.



The spectral reflectance plot for the samples. The top curve is the 3/4-inch thickness and the bottom curve the 1/4-inch thickness.



The color rendering (approximation of what the instrument sees) for the samples. The left box on the bottom is the 1/4-inch thickness, and the right box on the bottom is the 3/4-inch thickness.

So, what does all this mean? It means that for each type of sample you measure and compare, you need to choose one thickness, record that thickness as part of your measurement method, and stick with it. If you measure some samples at a 1-mm thickness and others at a 3-mm thickness, you will not be able to compare the measurements. So, what is the proper path length for your samples? That depends.

If a translucent solid is the final consumer product that you wish to measure, then you should measure it in its final form. If it is an intermediary or a precursor to extrusion and you have correlated the color of the final product to the color of the intermediary at a specific thickness, you should use that thickness. For liquids or semi-solids that are measured in a sample cup, the black plastic ring of the ring and disk set (HunterLab Part Number 02-4579-00) should be placed in the cup to fix the internal path length of light through the sample at 10 mm once the disk is placed on top. If you have not yet determined the optimum thickness for your measurements, then consistency in thickness is more important than the thickness you choose. However, in general the more opaque you can make your samples, the more accurate and repeatable your measurement results will be. Thicker samples are more opaque.

For Additional Information Contact:

Technical Services Department
Hunter Associates Laboratory, Inc.
11491 Sunset Hills Road
Reston, Virginia 20190
Telephone: 703-471-6870
FAX: 703-471-4237
www.hunterlab.com