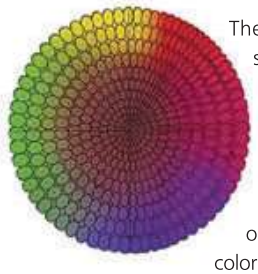
Industrial Coatings – A fascinating decoration

Patchwork might be good for quilts but certainly not for coated industrial goods. As many finished products consist of multiple components which are manufactured by different suppliers and at different locations, uniformity of color and appearance is crucial. Not only the paint batches need to be delivered with consistent quality, but also the production process of the finished product needs to be controlled.

According to Wikipedia the oldest transmitted paint formulation dates back to the 12th century. Since then a lot has changed. Industrial coatings with lower solvent content were introduced resulting in water based systems with almost no solvent. Increasing environmental demands during the last years and requirements for low VOC (volatile organic compounds) systems open the doors for powder coatings with 100 % solids content. Independent of the material, the optical properties of industrial coatings need to fulfill certain quality aspects before they can be applied on the final product.

Color and Gloss harmony

Color consistency from batch to batch is of course a "must" requirement for an industrial coating. The "correct" color has to be ensured across different material types and gloss levels. Color tolerances are dependent on the application and the hue. Studies have proven that CIELab color space is not uniform.



The diagram shows the CIELab color space divided into a multiple number of ellipsoidal micro-spaces. All colors within one ellipse are perceived as the same color. It can clearly be noticed that the size and shape of the ellipses are different dependent on the hue. Additional, chromatic colors have larger ellipses than achromatic colors and a difference in hue is more obvious than a difference in chroma.

Therefore, tolerances need to be defined by color families and differently for the individual color components (ΔL*a*b*C*H*). Over the years, new color systems and equations for solid colors were developed based on visual studies: e.g. ΔECMC– ΔE94 – ΔE99 – ΔE2000. They correct for the non-uniformity of CIELab color space and improve visual correlation. Additionally, the major advantage of these equations is that one tolerance can be used for all colors.

spectro2guide includes all new equations and even simultaneously measures 60° gloss to ensure complete appearance harmony.

BYK-Gardner Solution

Color & Gloss
spectro2guide

Objective Visual Evaluation
byko-spectra *pro*

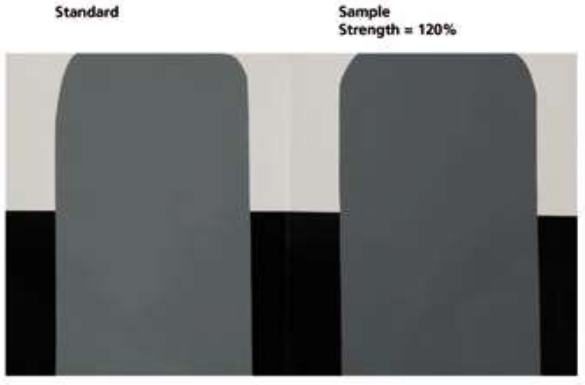
Determination of tinting strength

As tinting strength is directly influenced by the pigment type and concentration used in the coating system, it is an important economic factor when selecting one paint over the other. Differences in tinting strength result from batch-to-batch variations during colorant manufacturing and are therefore a crucial test for incoming QC at a paint maker. If the tinting strength of the colorant is not within the specified limits, the paint formula needs to be adjusted to achieve the required color shade. Tinting strength can be influenced by using an optimized wetting/dispersing additive at an optimized dispersing time.

Tinting Strength is the ability of a colorant or pigment to alter the color of a paint film. It is determined at the wavelength of maximum absorption using the absorption and scattering coefficients K/S of standard and batch. Tinting Strength is expressed in %.

$$\text{Strength (\%)} = \frac{\text{BatchK/S}(nm_{max})}{\text{StandardK/S}(nm_{max})} \times 100\ (\%)$$

Tinting strength of a colorant is always determined relative to a standard or reference paint of the same chemical type. The procedure is based on the dilution with a defined white paint. Drawdowns are then made on opacity charts at complete hiding i.e. minimum 98 % opacity. In order to create a uniform drawdown the use of an automatic film applicator is highly recommended. The drawdowns are measured with a spectrophotometer. Readings can be taken using an instrument with d/8 specular including or excluding or 45/0 measuring geometry. The standard is assigned with a tinting strength of 100 %. The tinting strength of the batch is determined relative to the standard and automatically displayed by the spectro2guide. If the batch has a tinting strength < 100 %, it means that it is weaker and more colorant is needed to achieve the required color shade. As differences in gloss can be mistaken for a weaker or stronger tinting strength, care has to be taken to keep surface properties of standard and batch alike.



The picture above shows the test results for a carbon black concentrate. By increasing the dispersion time from 20 to 30 minutes, the tinting strength is increased by 20 %.

References

ISO/DIS 18314-2	Analytical Colorimetry: Saunderson correction, Tinting Strength, Hiding Power
DIN 6172	Special Metamerism Index: Change in Illuminant

BYK-Gardner Solution

Automatic Film Applicator
byko-drive

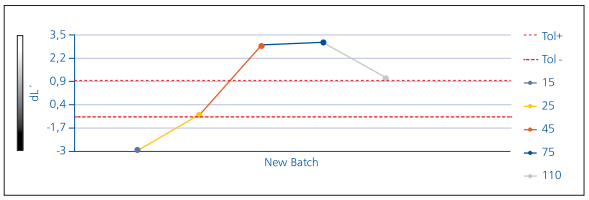
Drawdown Test Charts
byko-charts

Applicators
Bar applicatos

Color control of effect finishes

Special effect coatings play a dominant role in many applications as they make an object distinctively appealing: washing machines are no longer necessarily white, building facades shine in all kinds of metallic colors, and even mechanical engineering adopts the "noble" look of effect finishes.

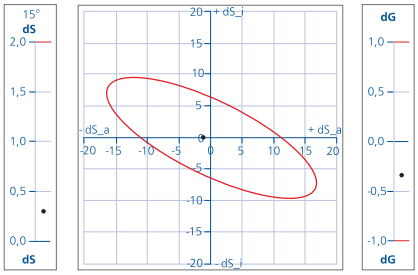
Metallic finishes show a lightness change with changing viewing angle. This effect is also referred to as "light-dark flop" and is e.g. an important quality criterion for architectural panels. The panels are either powder coated or coil coated. A reliable incoming QC procedure has to be defined so that panels with a different lightness flop are not assembled at the same building. Such a "mismatch" will become very obvious when viewed from a distance.



The above graph shows measurement data taken with the BYK-mac i multi-angle spectrophotometer. A new coil coating batch is compared to the defined standard. ΔL* changes from a negative value (= darker) at the near specular angle 15° to a positive value (= lighter) at the flop angle 75°. As both values are out of tolerance, the two panels will look differently when being assembled side by side.

Metallic finishes also change their appearance with lighting conditions. They start to "sparkle" when being viewed under direct sunlight, whereas under diffused lighting conditions a more or less distinct grainy pattern becomes visible.

The BYK-mac i measures these two attributes as sparkle and graininess. The graph below displays the measurement data of the new batch. Both values are well within tolerance.



For small parts, the BYK-mac i is also available with 12 mm aperture. To ensure repeatable sample placement and reliable measurement results, the use of a special sample holder is highly recommended. The holder is equipped with a mask to fit the aperture of the BYK-mac i 12 mm as well as, a tilting handle to fix the instrument. Application specific presentation tools are included.

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Multi-angle Color & Effect
BYK-mac i

Sample Holder
BYK-mac i 12 mm