



Colormatching and Control of Texture in Automotive Effect Colors

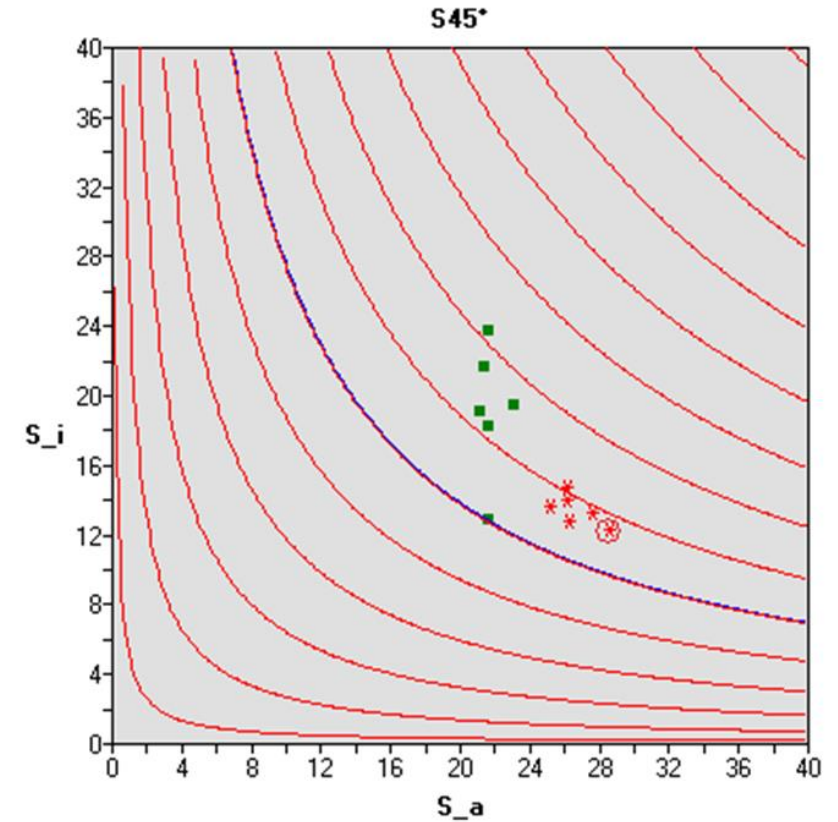
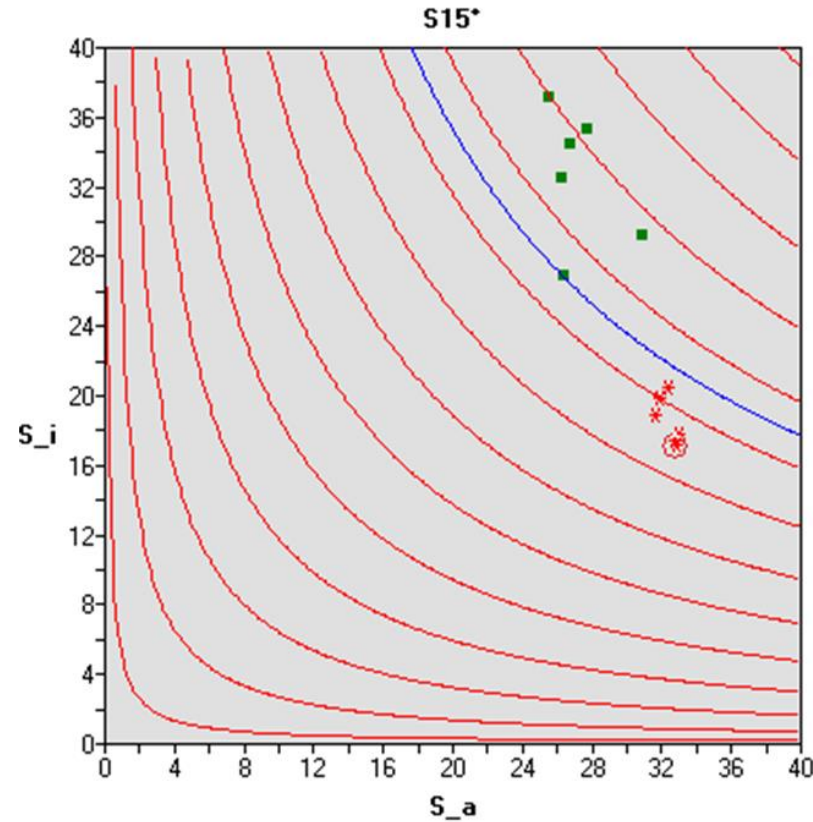
Vignolo EC/MP – Applied Colorimetric

Recap and future of texture for automotive colors OEM

- 10+ years of different experiences with BYK*mac*
- Aspects of the visual assessment of texture and the numerical correlation
- Start with xrite MA-TX
- Current status, outlook and needs

First experience 2006 with BYKmac

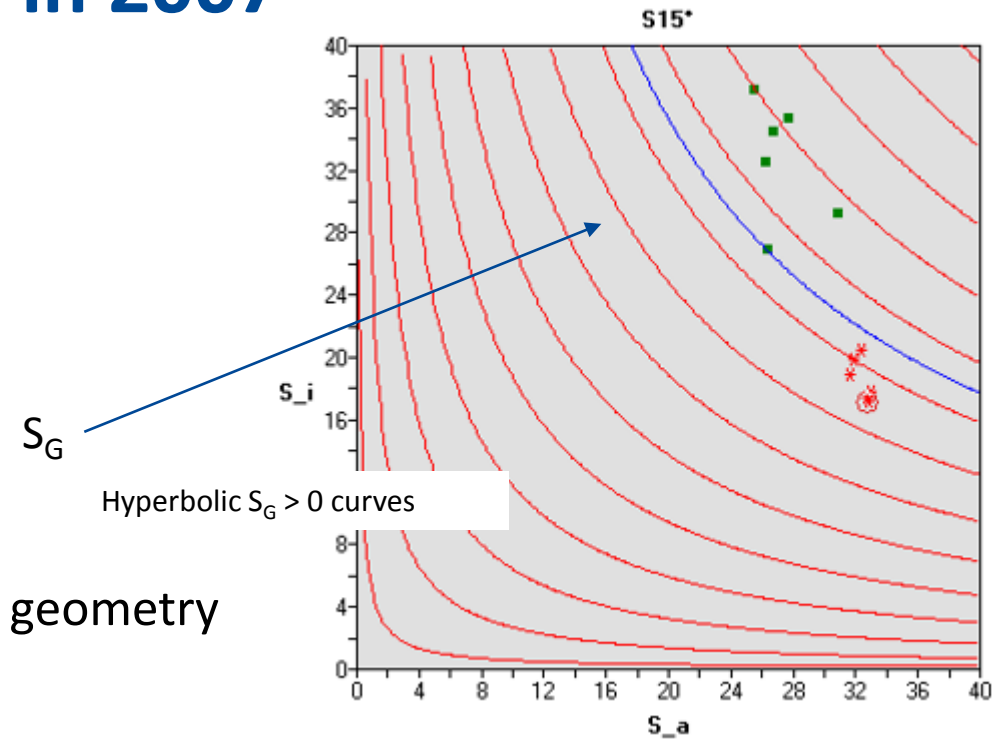
- Numerical evaluation of texture in new BMW “Xirallic®” colors through substitution with conventional micas



- Xirallic® concentration ladder 0,3%-2,0%
- * Replacement of Xirallic® with mica + silver dollar alu flakes 0,3%-2,0%

Trying to understand texture with BYKmac in 2007

- First automotive texture specification **BMW AA-0354**
- It includes the BYK-modelling of Sparkle (2D pixel based metric)
 - Sa = sparkle area
 - Si = sparkle intensity
$$S_G^2 \sim Sa Si$$
- 3 geometries 15°, 45°, 75° for Sparkle and 1 diffused illuminated geometry for “G” = “Graininess” (means diffuse coarseness > 0)
- Si values larger than 30 units are only achievable with Xirallics® or with glass flakes (80 units are possible!)
- Diffuse coarseness G > 10 units are almost impossible to reach (OEM, for feasible basecoat colors)



(Vignolo, First SP BYK-user meeting, Alicante, > 1000 real OEM colors)

2007 - 2010 with BYKmac

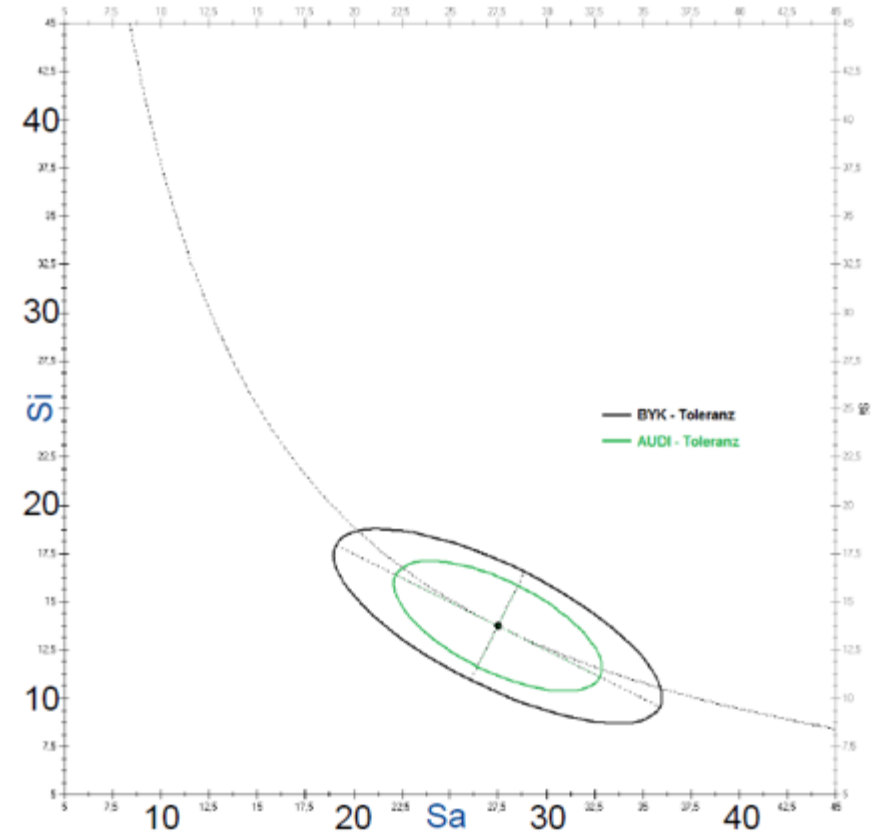
- Texture modelling implemented in ColorCARE®
- VW50195 standard (2010): new size of tolerance ellipse, dynamization of the S-Space (ellipse size dependent of Sa,Si)
- VW focused on Sparkle <dS> similar to <dE> with the Euclidean distance in the rotated space
- VW normalization to <dS> = 1.4 → acceptance normalized like <dE>

$$\langle dS \rangle = \sqrt{\left(\frac{dx}{G_F}\right)^2 + \left(\frac{dy}{G_R}\right)^2} = \sqrt{\langle dSx \rangle^2 + \langle dSy \rangle^2}$$

1 1

↘ $\sqrt{1+1} \sim 1.4$

Projection perpendicular or along the SG lines



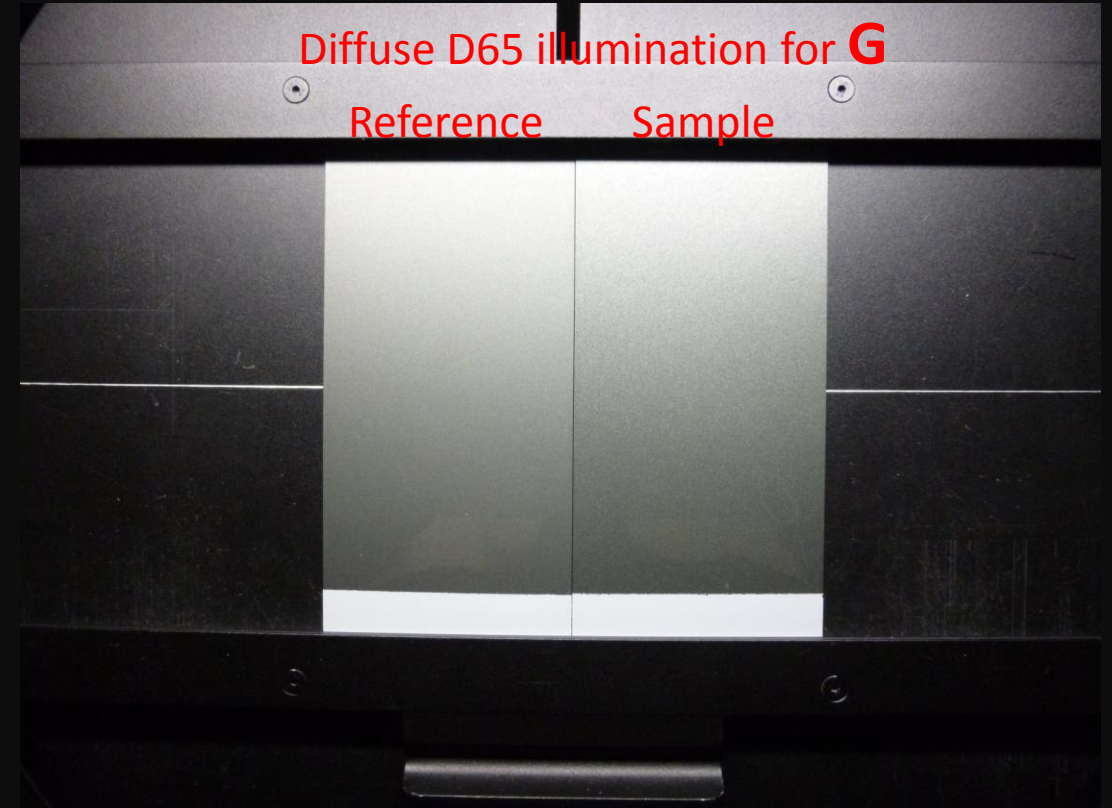
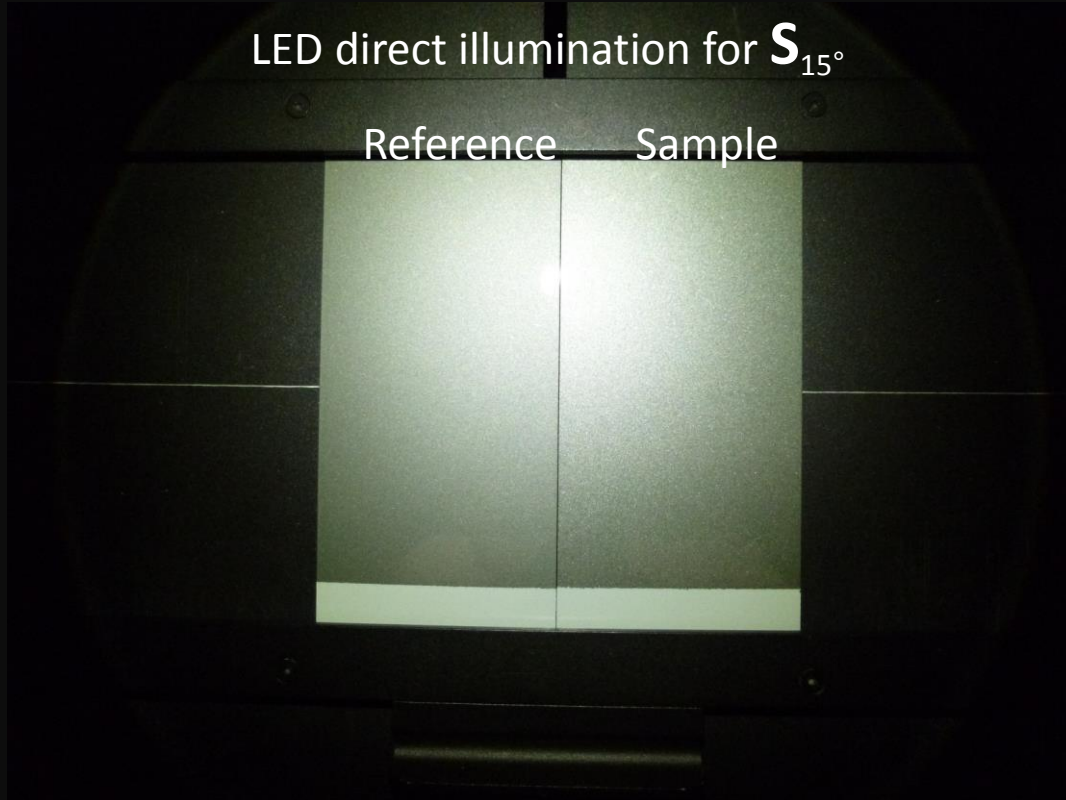
BMW = BYK
VW

→ $G_R : G_F = 1.0 : 3.0$
→ $G_R : G_F = 0.5 : 2.5$

2007-2010 visual assessments @byko-spectra effect

LED direct illumination, S_{15° = Sparkle @15°

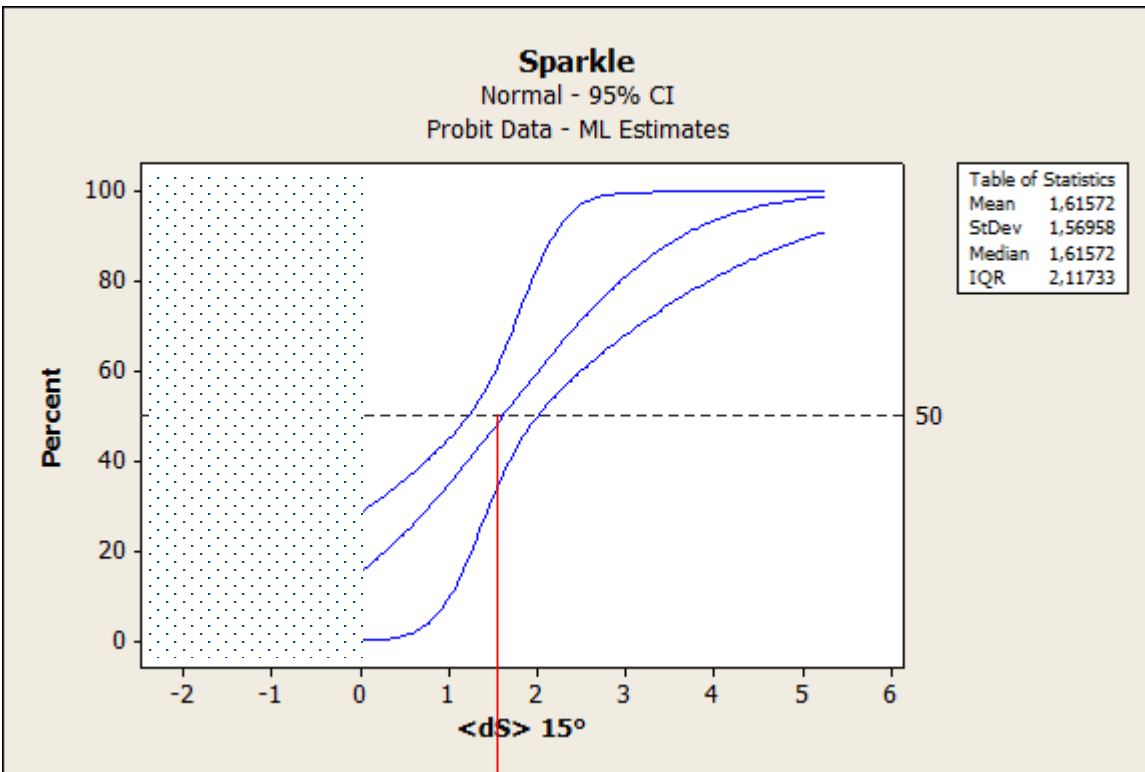
“diffuse” illumination, G = graininess



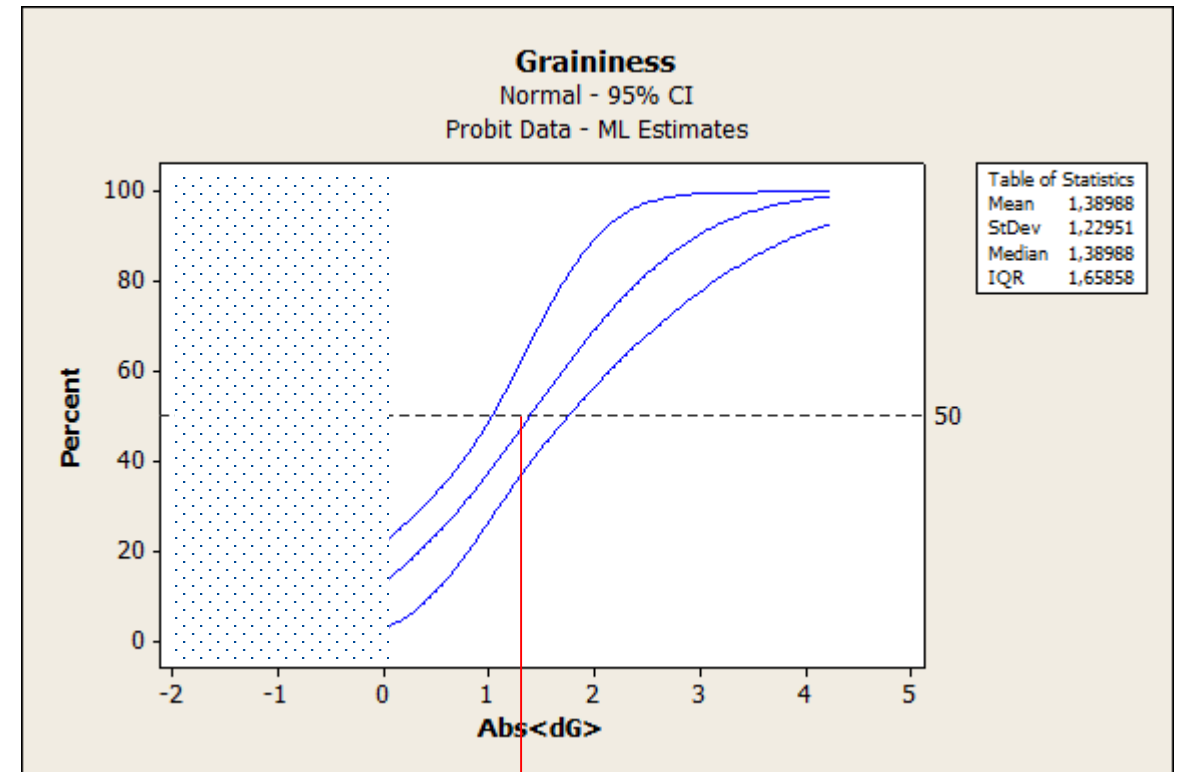
Only pairs with a “reasonable acceptable” color difference $\langle \text{m}dE \rangle < 2$

Setup: evaluation of limits normalization VW50194 $\langle dS \rangle, \langle dG \rangle = 1.4$

dose-response experiments-like used for evaluation of toxicities “LD50”



1.6 → 2.0 (overall assessment)

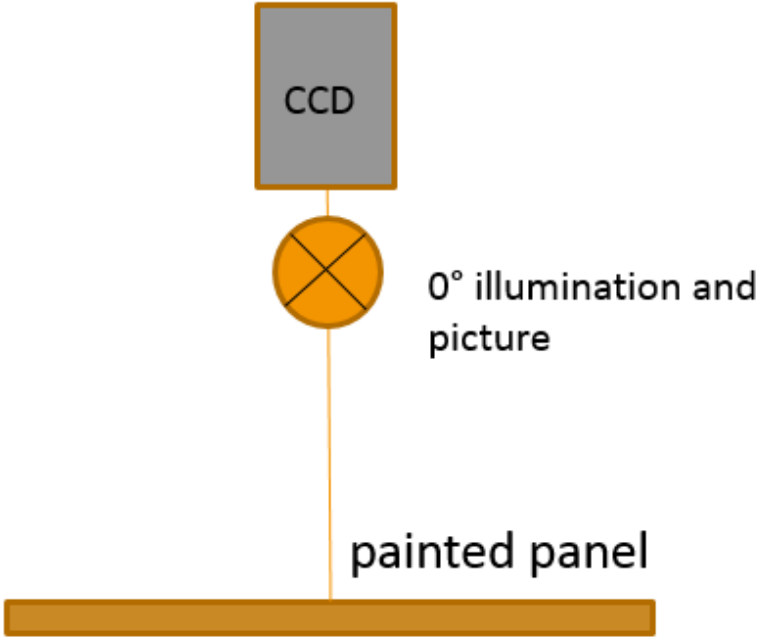


1,4

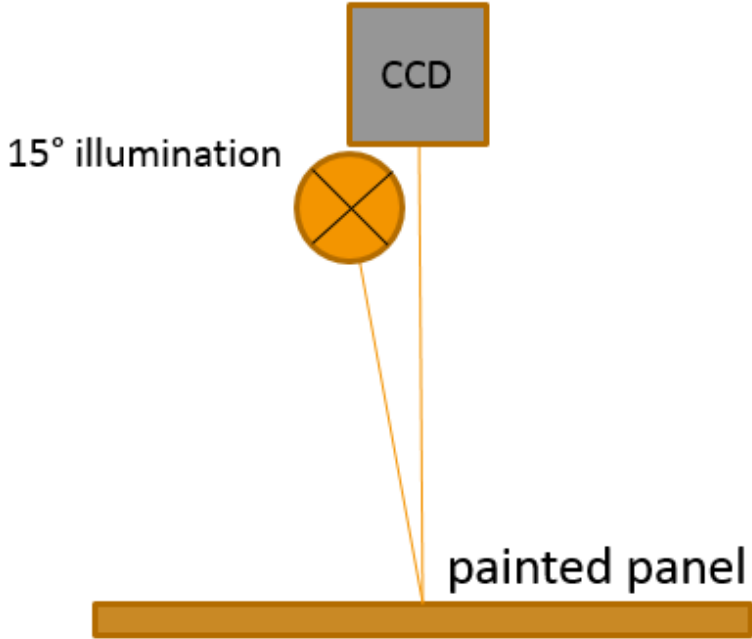
(Vignolo, Automotive Circle International Stuttgart, 2012)

Microscope check: can we understand the texture?

Microscope bright field pictures

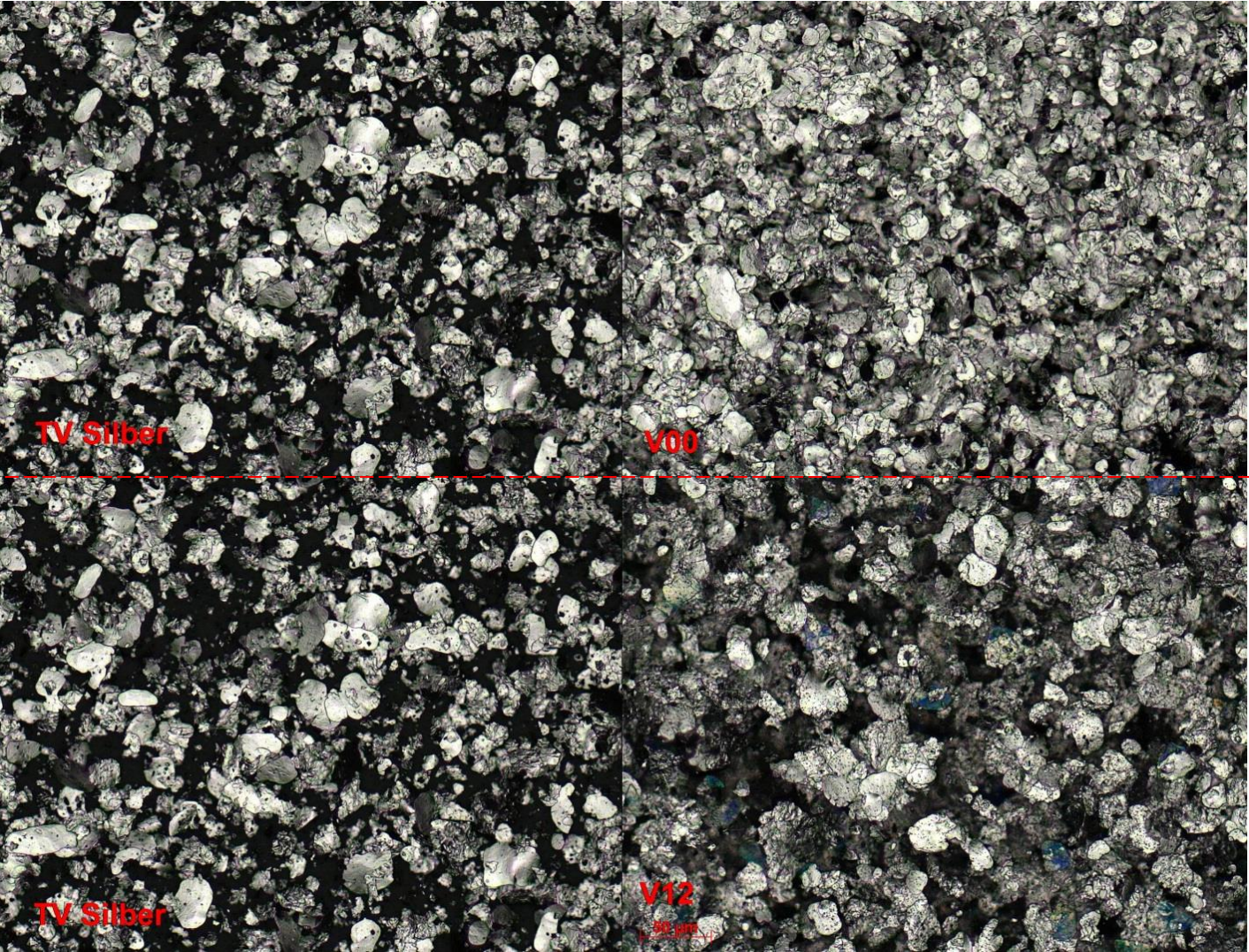


BYKmac 15° Sparkle measurements



Vignolo, BYK-user meeting 2014

Different colors were analyzed



Rotated "area" and "intensity"

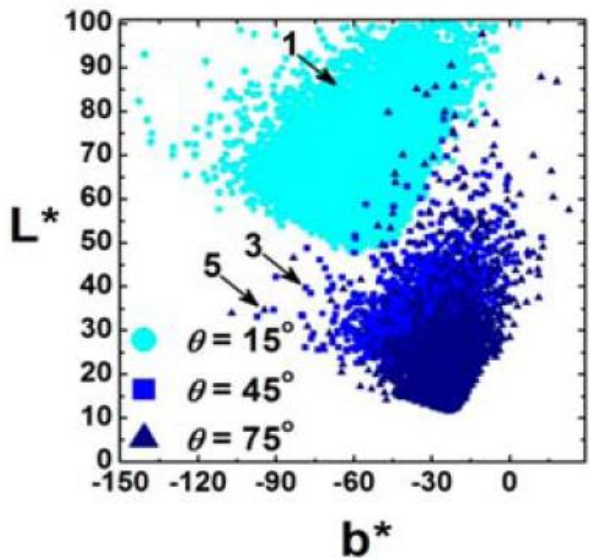
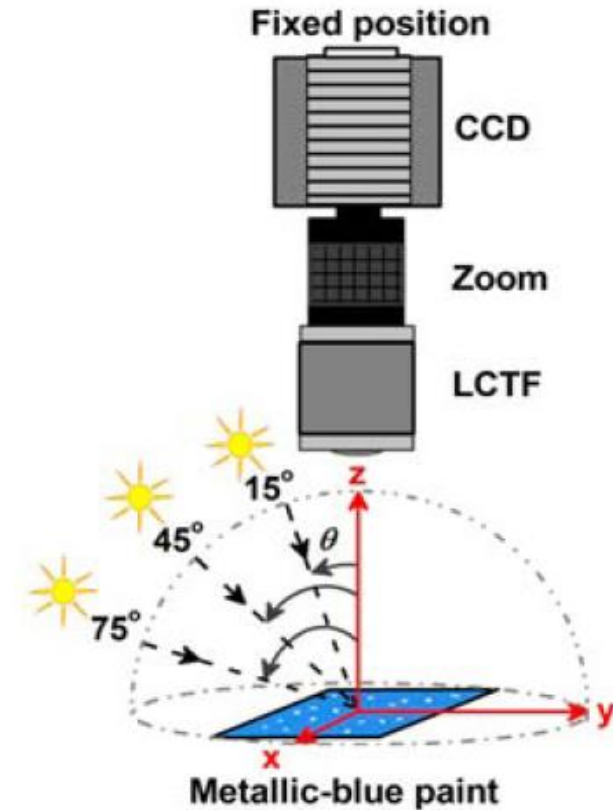
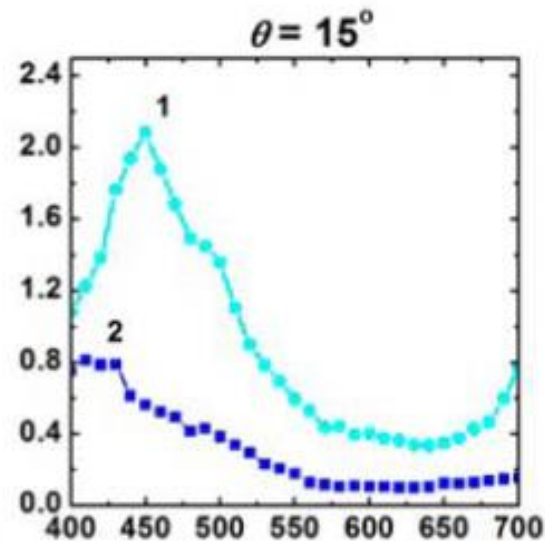
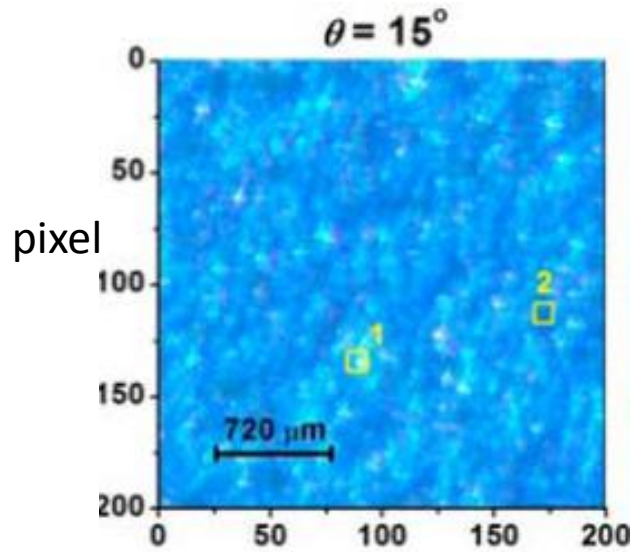
| Geo | <dSx> | <dSy> | <dS> | <dG> |
|------|-------|-------|------|------|
| S15° | -1,3 | -5,3 | 5,5 | |
| G | | | | -1,6 |

| Geo | <dSx> | <dSy> | <dS> | <dG> |
|------|-------|-------|------|-------|
| S15° | -0,53 | -2,90 | 2,95 | |
| G | | | | -0,76 |

VW texture normalization

Vignolo, SP BYK-user meeting 2014

Color pixel analysis with CCD camera 2014



Research Article *ACS* (2014) Medina, Díaz, Vignolo: For each CCD pixel, D65, 2° color coordinates were calculated using spectral analysis. Each pixel at the plot is represented by a single dot (multispectral CCD image). PCA + Box counting dimension characterized some texture patterns

Main outcomes or lessons learned until year 2017

- Test of the numerical acceptance of the VW50159 with LD50 verify (approx.) the defined limits through visual assessments @byko
- Numerical OK <dS> leads in estimated 80% of the case to visual OK. One can however always find approx. 20% of numerical nOK sample pairs with OK visual assessment
- The measured precision for sparkle is quite low compared with the visual acceptance perception
- No general discrepancies visual/numerical for <dG> were observed. Better instrumental precision than for the sparkle measurements is observed
- The measured texture results cannot be always understood under a microscopic observation
- It seems to be some sparkle patterns when analyzing the colored pixels of automotive coatings

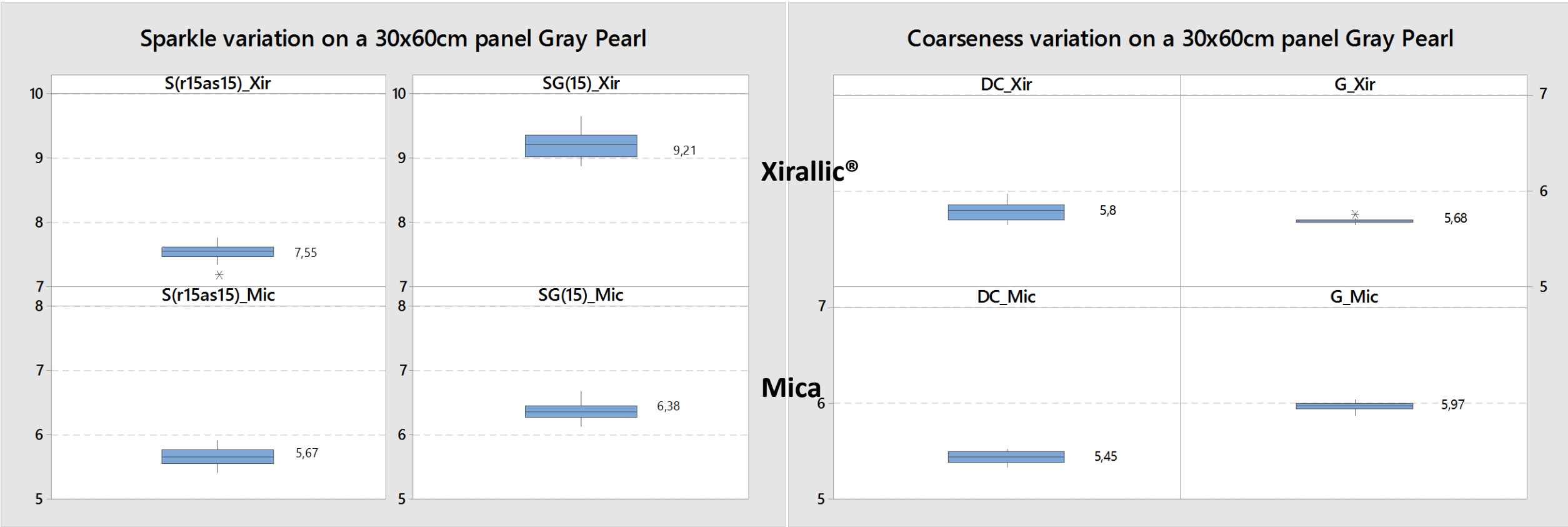
First experience 2017 with MA-TX

- Texture parameters calculated based on a 1D-spot based metric black/white acquired with a color camera
- New definition of the **SG** (sparkle assessment over the 1 dimensional “grade”)
- Instead of “graininess” a diffuse coarseness **DC** is being computed



Comparison Sparkle and Coarseness gray pearl with Xirallic® or Mica

(20 single measurements distributed on a 30x60cm sprayed panel)



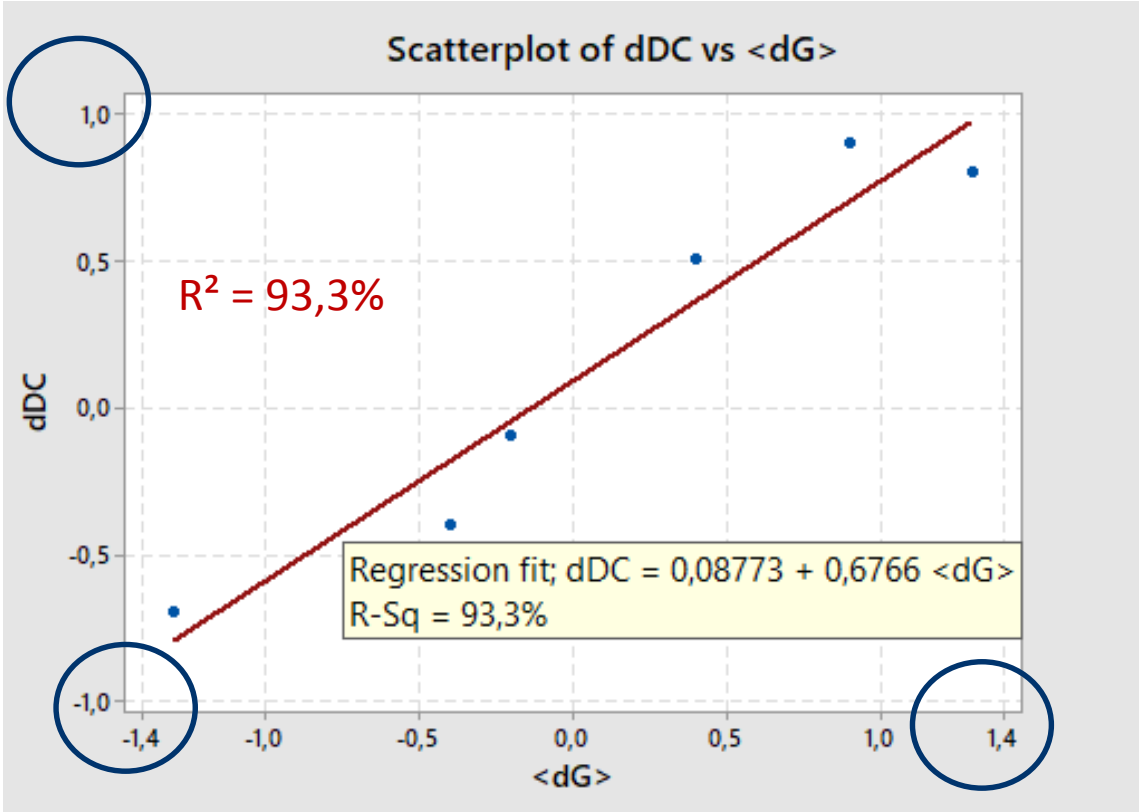
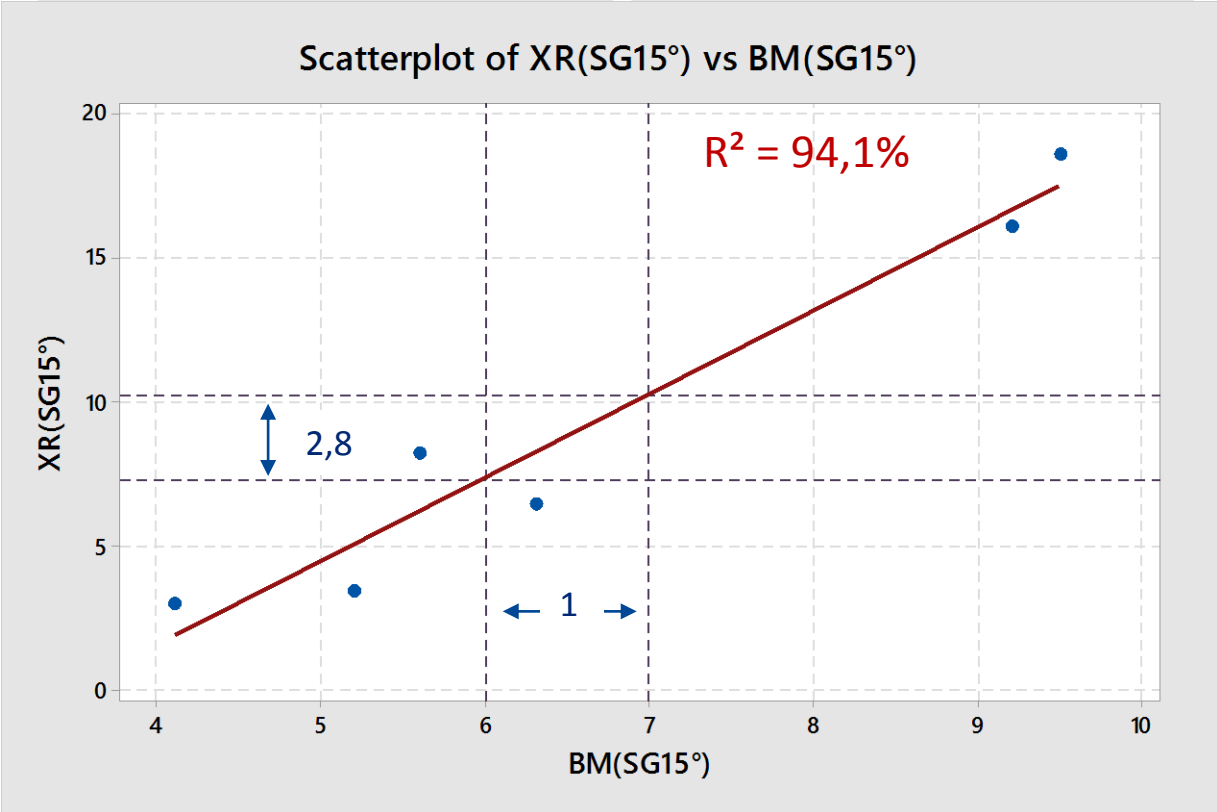
xrite

BYKmac

xrite

BYKmac

Correlation texture differences BYK-xrite in some sample pairs



Visual
check
sparkle-
pairs
numerical
not OK
(BYK) re-
checked
with MA-TX

| Name | BYKmac | | MA-T12 | | % OK visual |
|-----------------|--------|----------|--------|--------------|-------------|
| | SG15° | <dS> 15° | SG15° | abs(dSG 15°) | |
| sparkling brown | 9,2 | 0,4-2,2 | | | 87 |
| Light Blue met | 4,1 | 1,7 | | | 54 |
| dark mica red | 5,6 | 2,1 | | | 71 |
| dark brown | 9,5 | 2,2 | | | 80 |
| silver | 5,2 | 2,6 | | | 53 |
| blue mica met | 6,3 | 2,0 | | | 83 |

| | | | | | |
|---|--|--|--|--|--|
| <i>*strong variation (<dS> = 0,4 - 2,2)</i> | | | | | |
|---|--|--|--|--|--|

Final concluding remarks

- 10+ years experience with the *BYKmac*-texture parameters is observed as very valuable
- The control of the texture is very important in the colormatching phase to find out the right OEM pigmentation with visual acceptance. If nothing else is specified, we used in the past as internal tolerance the BYK model with VW acceptance limits
- The *BYKmac* texture values allow to drive the matching process numerically for approx. 80% of the cases although the measured sparkle precision is low compared to the visual acceptance tolerances
- The first impression of the MA-TX texture results are promising however the new sparkle modelling must be better understood (no direct correlation to the old **S**-metric, no background information at BASF is available). In the case of the coarseness apparently **DC** can be 1:1 correlated to **G**



We create chemistry