How to manage more than 100 BYK-mac units in your company

BYK-Gardner User Meeting “Color and Appearance Harmony”
November 17, 2010

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1. Introduction

Akzo Nobel Car Refinishes Business Segments:

- Automotive Plastic Coatings
- Vehicle Refinishes
- Aerospace Coatings
- OEM Commercial Vehicles

Asia Pacific: 14%
Americas: 35%
Europe: 51%

3 International Research Centers
4 Technical Centers
2 Color Development Centers
8 Manufacturing Sites
2. Use of the BYK-mac within Car Refinishes

Production of Mixing Machine Toners (MM Toners)

Getting the right car colors available for the car repair shops
2. Use of the BYK-mac within Car Refinishes

Quality Control

- Quality control and color adjustment of solid and effect toners is fully based on BYK-mac measurements
- Central maintenance of toners, QC mixtures and tolerances
- Central storage of batches with different search options (SPC)
- Direct link with SAP system

Car Color Information Collection

- Each year automotive industry introduces ±1200 new car colors
- ANCR collects standard panels, which are used to produce a “standard” color formulation
- Variations to the standard color can occur because of:
  - Different production sites
  - Different OEM paint and/or add-on suppliers
  - Different application set-ups
  - Color difference between paint batches
2. Use of the BYK-mac within Car Refinishes

Car Color Information Collection

- Color variations are collected at car dealers, ports of entry, OEM sites and PDI
- BYK-Mac made measurement more prominent than the collection of car parts (digitization)

Formula Development

New OEM car colors and identified variants are formulated in several MM products

- Effect pigment identification by microscope
- Measurement of color/texture with BYK-mac
  - Specific sample clamps for panels & paper documentation
  - Both color and texture measurement are an average of 4 rotations (including outlier detection)
2. Use of the BYK-mac within Car Refinishes

Formula Development
- Color matching based on optical model and optimization using all reflection measurements of the BYK-mac
- Instrumental measurements become more and more leading over visual judgment

3. Reasons to set up a global monitoring system
- Akzo Nobel has a global presence with different manufacturing sites, research centers and CCIC teams

BYK-Mac is used in more than 20 countries
3. Reasons to set up a global monitoring system

- Needless returning a device to BYK-Gardner results in additional costs (service and logistics) and downtime of the device
- Monitoring reduces the risk of “wrong” decisions in processes like Quality Control or upload of incorrect measurements
- Monitoring secures the quality of the measurements that are stored in color databases
- Acts as diagnostic tool and enables traceability of instruments and calibration data
- Monitoring tool can be combined with functionality to update firmware and specific firmware settings like outlier detection and pressure sensor sensitivity

4. Explanation of the monitoring system

Suppose what would happen if ANCR would not have a monitoring system in place.

Measurement and Calibration Procedure without any monitoring

- Only in case of break down or completely wrong values
4. Explanation of the monitoring system

What was needed to start a monitoring system

• A central database to store reference values and results of instrument checks
• A dedicated and user-friendly software application
• Close cooperation with BYK-Gardner to set up and get agreement on procedures
• Several tile sets to check the spectrophotometer and camera part of the BYK-mac
• ANCR tile sets had to be traceable to BYK-Gardner and PTB
• Several managers involved in the color processes had to believe that monitoring is in their benefit

The system at a glance – “Master unit”

The “Master unit” consists of three close tolerance BYK-mac devices. Also a specific tool was created to measure and enable outlier detection and averaging.
4. Explanation of the monitoring system

The system at a glance – IIA tile sets

Master IIA tile sets are certified by BYK-Gardner once a year and these are used to check the BYK-mac master unit. Regional IIA centers have derived IIA tile sets that are measured with the BYK-mac Master unit frequently and recertified by ANCR.

The system at a glance – the procedure

Measurement and Calibration Procedure Byk MAC
For internal use at ANCR

Responsibility Byk  Responsibility ANCR

Determine Cyan+ effect check reference

Perform Routine check Cyan + Effect

B&W Calibration

Determine Cyan+ effect check reference

Perform Routine check Cyan + Effect

IAA Check

Check instrument & documentation

Ship Instrument to Byk Gardner

Contact Byk Gardner

Ship Instrument to ANCR

Create division and updated database

Factory II A Check

Dimension reference values for specific tile

Factory Calibration and fine tuning

Repair Instrument

Responsibility Byk

Responsibility ANCR

Rarely

Occasionally

Daily

Perform Routine check Cyan + Effect

Instrument ready for use

Measure

Car Refinishes | How to manage more than 100 BYK-mac units in your company
4. Explanation of the monitoring system

The system at a glance – the routine check

Check is performed by instrument owner

Identification of tile set and instrument

Tolerances derived from measurements done with several instruments

The system at a glance – IIA Check Color & Texture

Check is performed by expert users in regional IIA centers
4. Explanation of the monitoring system

The system at a glance – Reports and history

Results are stored in central database and from this history of an instrument or tile set can be retrieved.

Highlights of the monitoring system

- Core of the monitor system is an in-house developed software tool.
- Procedures to certify IIA tile sets were developed in close cooperation with BYK-Gardner.
- All tile sets are directly traceable to BYK-Gardner and indirectly to PTB.
- Akzo Nobel Car Refinishes created it’s own Master BYK-mac unit.
- Tool can be easily used within other Business Units.
- Tool is also used for firmware updates and adjustment of specific settings (thresholds for outliers).
5. Color tolerances versus color in practice

The introduction of the BYK-mac gave a boost to the quality control of “color” in the automotive. Many car manufacturers are switching from visual to instrumental and/or are introducing sparkle and graininess into their approval process.

Automotive industry is now setting tolerances for texture, but these are not always in line with the color/texture variations are coming from the production lines. So should we not take into account application and conditions like temperature, humidity into account?

Example 1: blue metallic color

Reflection curves [400 – 700 nm] and L*a*b* values for the 6 BYK-mac geometries

<table>
<thead>
<tr>
<th>Geometry</th>
<th>L</th>
<th>a</th>
<th>b</th>
<th>C</th>
<th>H</th>
<th>DC</th>
<th>G15</th>
<th>G25</th>
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<th>G75</th>
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Indication of the color for the different measurement geometries
## 5. Color tolerances versus color in practice

### Different color/texture variations detected by CCIC

<table>
<thead>
<tr>
<th>Sample/Name</th>
<th>Geometry</th>
<th>L</th>
<th>a</th>
<th>b</th>
<th>C</th>
<th>H</th>
<th>Dc</th>
<th>G125</th>
<th>G145</th>
<th>G175</th>
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<td>15</td>
<td>5.4</td>
<td>-3.7</td>
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<td>1.0</td>
<td>1.0</td>
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<td>-2.6</td>
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<td>-1.7</td>
<td>-1.7</td>
<td>-1.7</td>
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<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
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<td>3.3</td>
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<td>-3.5</td>
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<td>-1.7</td>
<td>-3.0</td>
<td>0.1</td>
<td>3.6</td>
<td>3.6</td>
<td>3.6</td>
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</table>

| variant 2   | 15       | 2.1 | 3.6 | -4.1| 0.6 | -5.1| 7.4  | 3.2  | -1.0 | -1.0 |
|             | 25       | 1.7 | 2.3 | -3.8| 0.4 | -0.8| 6.2  | 3.2  | -1.0 | -1.0 |
|             | 45       | 0.3 | 2.2 | -3.2| -0.3| 3.2 | 1.1  | 1.1  | 1.1  | 1.1  |
|             | 75       | 0.1 | 0.9 | 0.3 | 0.7 | 4.4 | 3.5  | 3.5  | 3.5  | 3.5  |
|             | 110      | -3.1| 4.8 | 3.4 | -4.6| 0.7 | 6.3  | 6.3  | 6.3  | 6.3  |

| variant 3   | 15       | 5.7 | -5.2| -6.2| 1.6 | -5.1| 15.4 | 8.3  | -5.5 | 13.8 |
|             | 25       | 5.7 | -5.2| -6.2| 1.6 | -5.1| 15.4 | 8.3  | -5.5 | 13.8 |
|             | 45       | -3.6| 0.4 | 0.2 | 0.0 | -3.6| 4.6  | 4.6  | 4.6  | 4.6  |
|             | 75       | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.2  | 6.2  | 6.2  | 6.2  |
|             | 110      | -3.0| 2.3 | 1.5 | -2.7| 0.2 | 4.6  | 4.6  | 4.6  | 4.6  |

### Presence in the market

- Standard = 25%
- Variant 1 = 23%
- Variant 2 = 17%
- Variant 3 = 22%
- Other Variants = 13%

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### Example 2: light blue color

<table>
<thead>
<tr>
<th>Geometry</th>
<th>L</th>
<th>a</th>
<th>b</th>
<th>C</th>
<th>H</th>
<th>Dc</th>
<th>G125</th>
<th>G145</th>
<th>G175</th>
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<tr>
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<td>104.9</td>
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<td>-20.5</td>
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</tbody>
</table>

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### Table for Example 2: light blue color

<table>
<thead>
<tr>
<th>Sample/Name</th>
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<th>L</th>
<th>a</th>
<th>b</th>
<th>C</th>
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<th>Dc</th>
<th>G125</th>
<th>G145</th>
<th>G175</th>
</tr>
</thead>
<tbody>
<tr>
<td>variant 1</td>
<td>15</td>
<td>9.5</td>
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<td>0.3</td>
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Questions?