



# **The use of Solar Reflective Colorants and Formulating Colors based on TSR**

Webinar Functional coatings with reflective properties and cool roof for energy savings and emission reduction

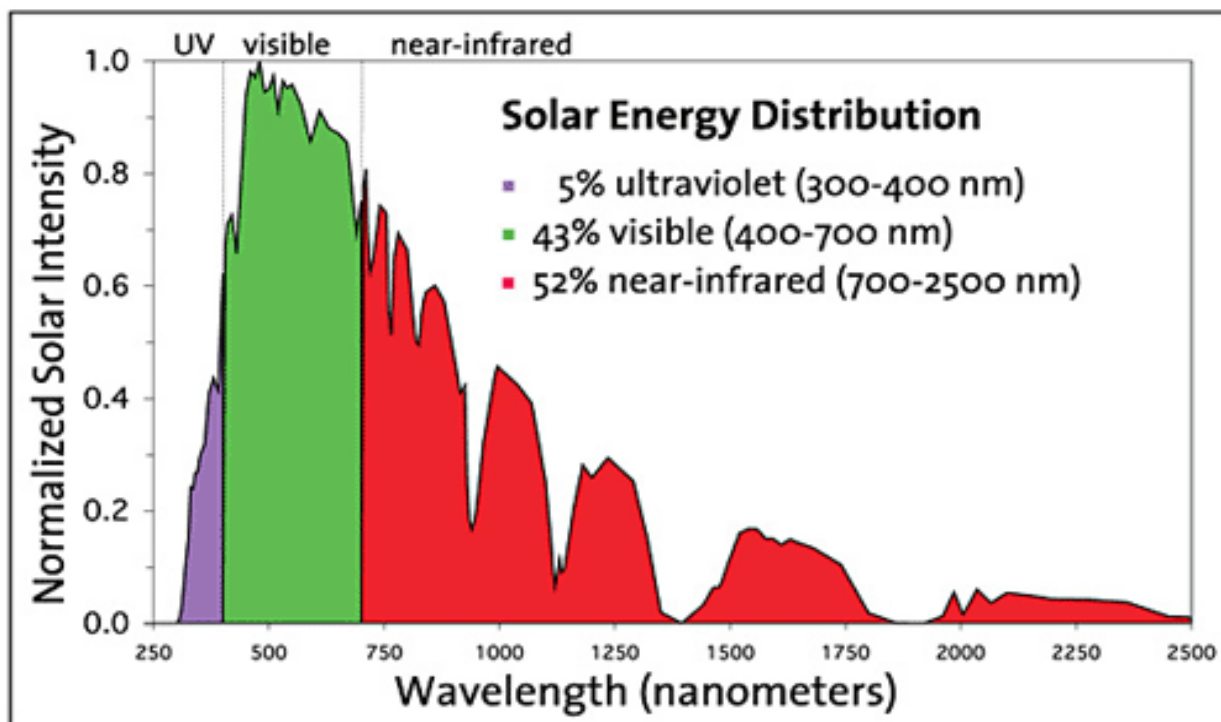
March 11, 2021

Gerard van Zijl



- ▶ Formulation of colors while bearing in mind:
  - ▶ Reduction of thermal stress in coating systems like ETICS
  - ▶ to keep coated surfaces cooler
  - ▶ Maintain full formulating flexibility
- ▶ How?
- ▶ Choosing the right pigments and taking care of coating system built up.
- ▶ On top of that special matching software helps optimizing the heat reflection.



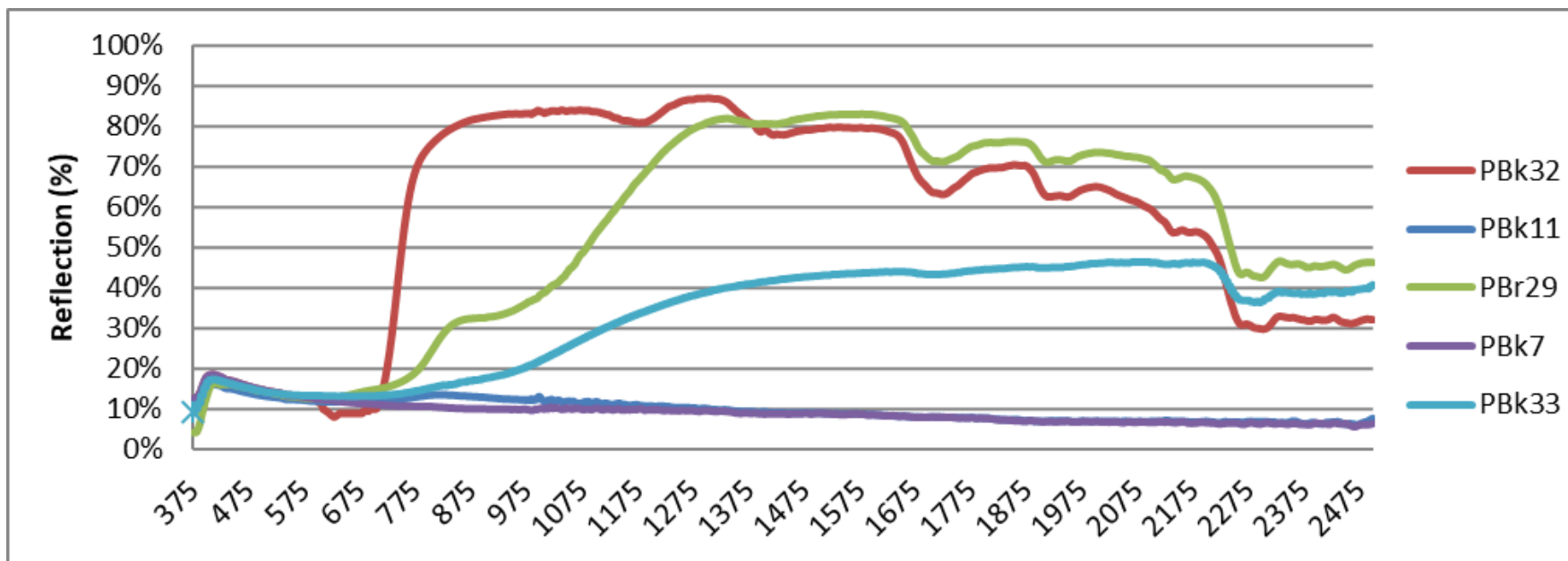


NIR (700 to 2500 nm) dominates the overall irradiated solar energy by more than 50 % (exact data depends on spectrum and range boundaries).

$$\% \text{ TSR} = \left( \int (\% R * I d\lambda) / \int I d\lambda \right) * 100$$

where:  $R$  = reflectance percentage  
 $I$  = Solar Irradiance  
 $d\lambda$  = wavelength interval of integration (300 to 2500nm)

- ▶ Typical white coatings: TSR  $\geq 75\%$  -> absorbs 25% of incident solar energy
- ▶ Black coating based on carbon black pigmentation: TSR = 4% -> absorbs 96% of incident solar energy



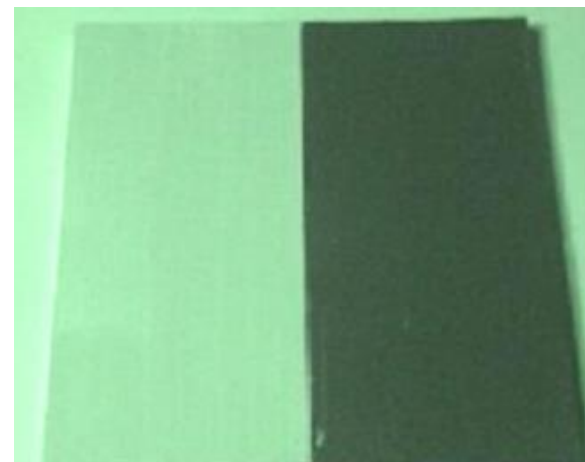
Normal Lighting



PBr29

PBk7

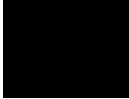








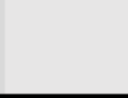

NIR Lighting



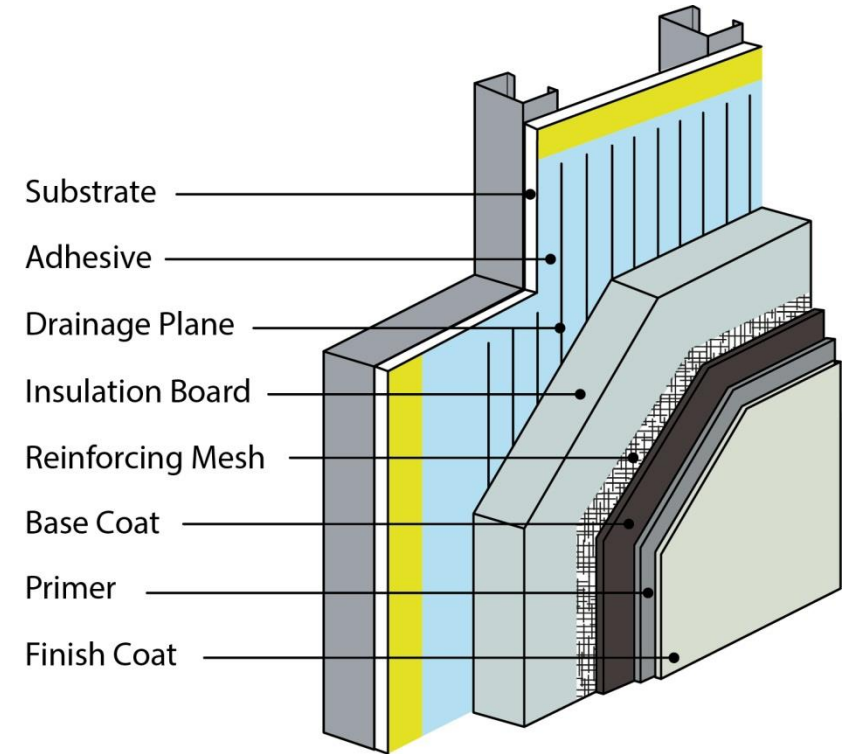
PBr29

PBk7

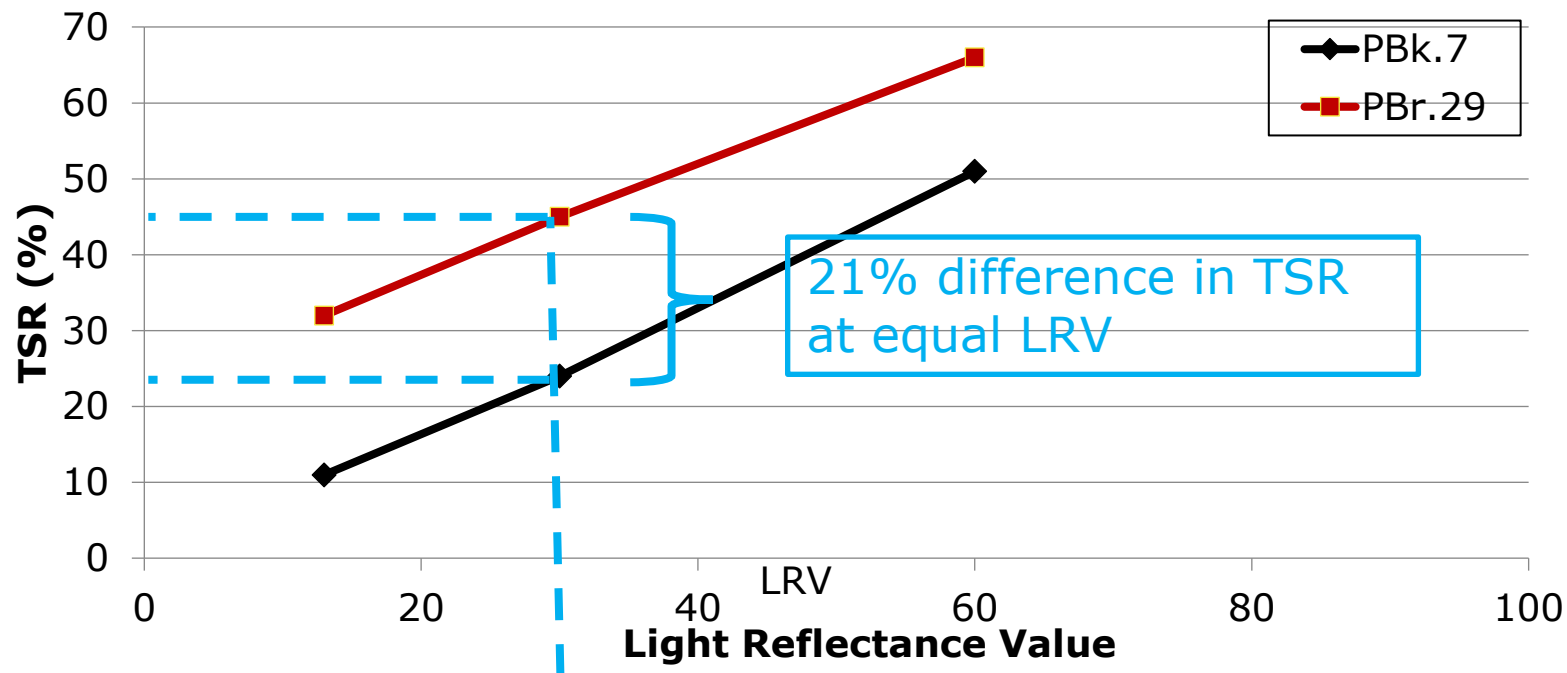
- LRV is a measurement that tells you how much visible light a color reflects.

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
										

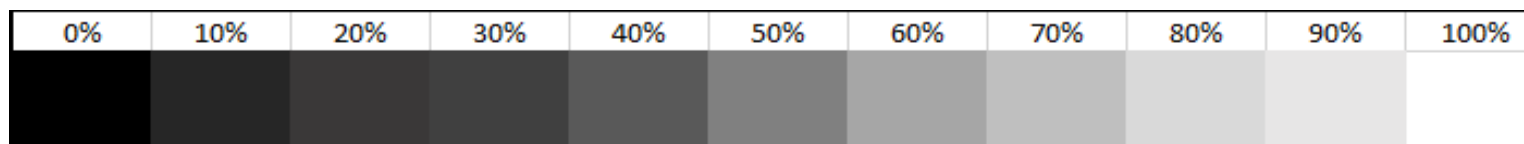
- Architects, builders, or homeowners may not want to limit themselves to white or pastel colors to decorate a building.
- In ETICS however dark colors with a LRV <20 are not recommended due to increased stress levels with temperature fluctuations.



sectional view of ETICS



Darker color possible at identical TSR or higher TSR for the same color



- 4 colors were selected to tint the render and topcoat.



- The selected colors all have a LRV below 20
- The TSR value was measured for the selected 4 colors
  - Topcoat 1 layer
  - Topcoat 2 layers
  - Topcoat on top of the white render
  - Topcoat on top of the colored render



**RAL 3000  
Topcoat**

**RAL 6002  
Topcoat**

**RAL 8024  
Topcoat  
Carbon Black**

**RAL 8024  
Topcoat  
IR Black**

**RAL 9004  
Topcoat  
Carbon Black**

**RAL 9004  
Topcoat  
IR Black**

LRV Value

13

10

13

13

4

4

TSR 100 um over White

59

36

18

37

5

26

TSR 2 x 100 um over White

55

31

15

35

5

26

TSR White Render + Topcoat

50

32

15

32

5

25

TSR Colored Render + Topcoat

50

26

TSR Colored Render (Carbon Black) + Topcoat

13

4

TSR Colored Render (NIR Black) + Topcoat

31

23

TSR Colored Render (Carbon Black) + Topcoat

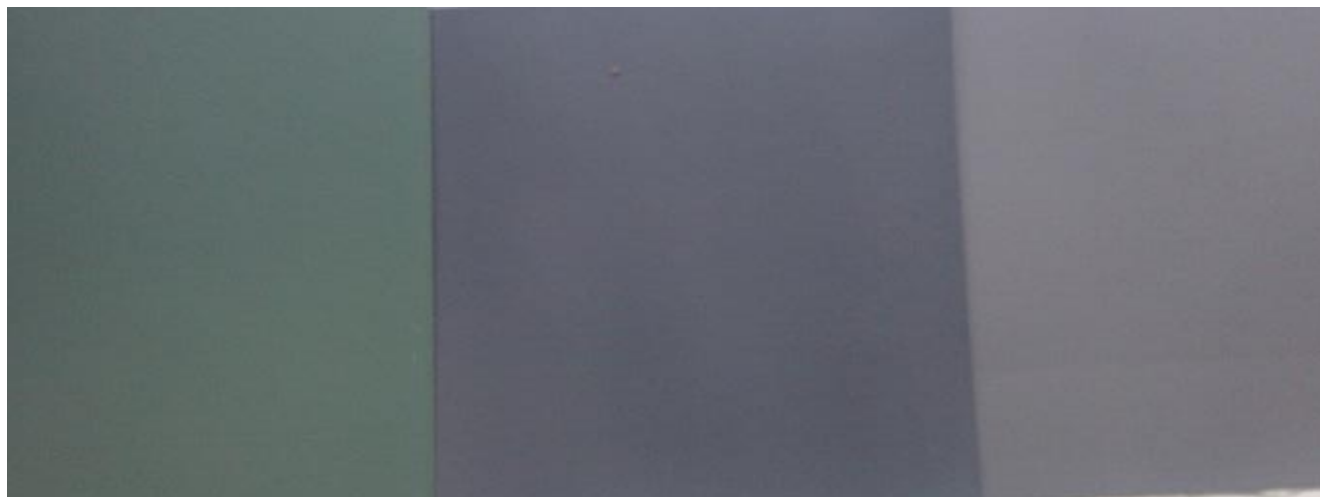
19

12





Fulltone



White reduction

PBk32

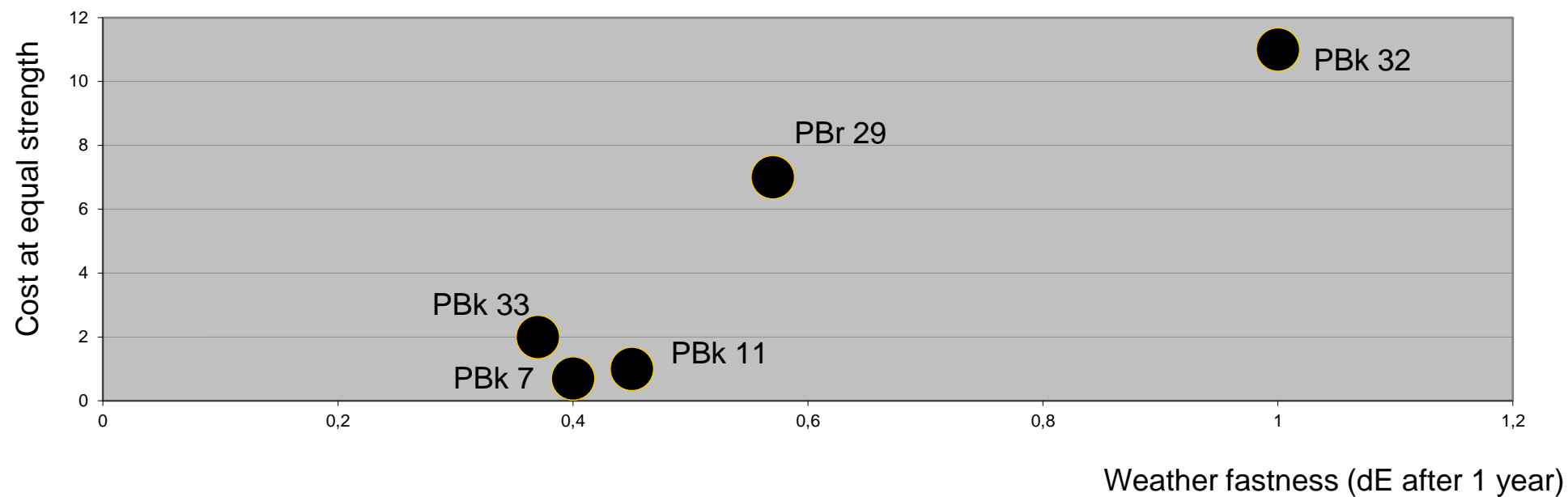
PBr29

PG17



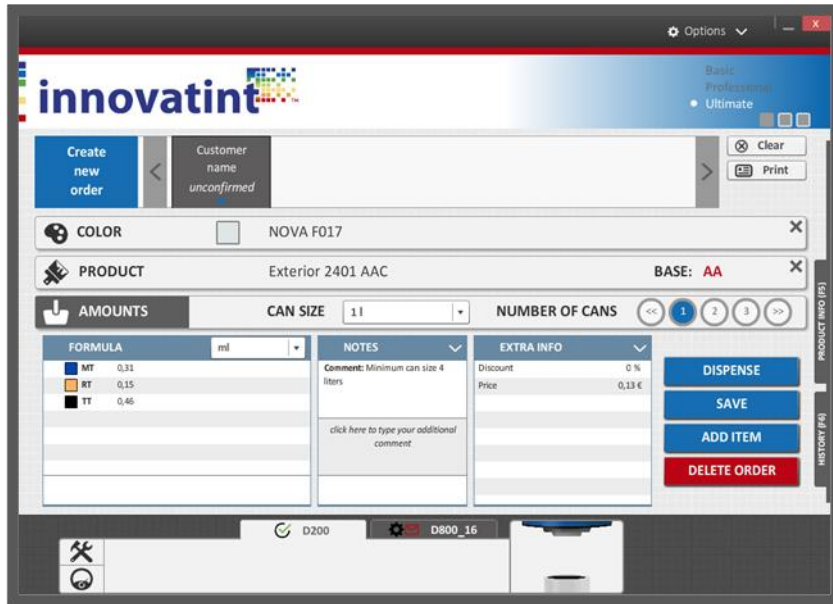
## Black pigments

comparison of weather fastness and cost  
reduced shades (color depth 1/3)



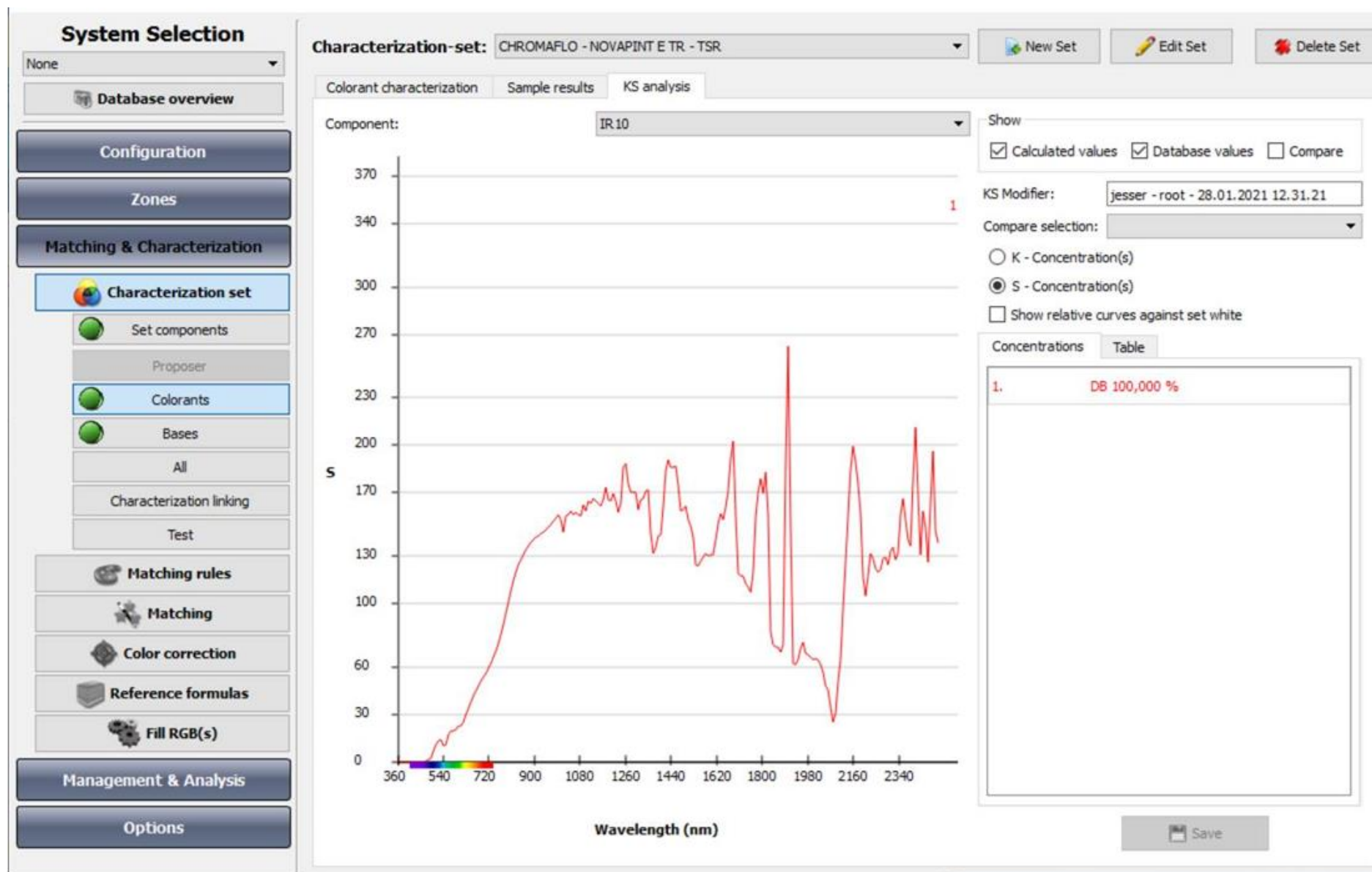
Cost comparison based on NCS 7000-N and NCS 4000-N

- ▶ Innovatint color matching and POS-dispensing software



- ▶ Tool developed to include TSR-value when matching colors

- ▶ Formulating colors:
  - ▶ Coventional:
    - ▶ using Spectrophotometer (range 400-700nm) for characterization of bases and colorants
    - ▶ Setting matching rules like delta E
  - ▶ TSR-included:
    - ▶ Using Spectrophotometer (range 400-700nm) for characterization of bases and colorants
    - ▶ Setting matching rules
    - ▶ Characterization of visible and NIR spectrum of colorants and bases.



Solar reflective colorant

**System Selection**

None

Database overview

Configuration

Zones

Matching & Characterization

Characterization set

Set components

Proposer

Colorants

Bases

All

Characterization linking

Test

Matching rules

Matching

Color correction

Reference formulas

Fill RGB(s)

Management & Analysis

Options

**Characterization-set:** CHROMAFLO - NOVAPINT E TR - TSR

New Set Edit Set Delete Set

Colorant characterization Sample results KS analysis

Component: BX11

Wavelength (nm)

430  
380  
340  
300  
250  
210  
170  
120  
80  
40  
0

S

360 540 720 900 1080 1260 1440 1620 1800 1980 2160 2340

Show

☒ Calculated values ☒ Database values ☐ Compare

KS Modifier: jesser - root - 28.01.2021 10.55.40

Compare selection:

☐ K - Concentration(s)

☒ S - Concentration(s)

☐ Show relative curves against set white

Concentrations Table

1.	DB 100,000 %
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Save

Conventional colorant

**System Selection**

None

Database overview

Configuration

Zones

Matching & Characterization

Characterization set

Matching rules

**Matching**

Color correction

Reference formulas

Fill RGB(s)

Management & Analysis

Options

Components Preferences Live view / results (1) Live view / results (2) Live view / results (3) Statistics

**Product:** SIO  
**Zone:** Default zone  
**Can size:** 1 kg  
**Unit:** g

Show settings

Matched colors:

☐ ASF 1400

**Recommended** **Cheapest** **Most accurate** **Least metamer**

Matching TR

IR 10 56.953  
YX11 3.214

IR 10 56.953  
YX11 3.214

CX10 57.685  
RX10 0.222  
YX12 3.656

CX10 53.115  
D 119 4.032  
GX11 4.429

TSR 31,01  
Cost 0,25 €  
dE (D65) 4,49

TSR 31,01  
Cost 0,25 €  
dE (D65) 4,49

TSR 19,08  
Cost 0,34 €  
dE (D65) 1,55

TSR 19,50  
Cost 0,44 €  
dE (D65) 2,34

Accept formula Reject formula Add to dispense queue Save as LAB history

**Recommended** **Cheapest** **Most accurate** **Least metamer**

1 2 3 4

Matching TR

IR 10 56.953  
YX11 3.214

BX11 0.341  
IR 10 56.414  
YX11 3.308

GX12 0.37  
IR 10 56.478  
YX11 3.274

CX10  
YX10

TSR 31,01  
Cost 0,25 €  
dE (D65) 4,49

TSR 31,07  
Cost 0,25 €  
dE (D65) 4,51

TSR 31,03  
Cost 0,26 €  
dE (D65) 4,52

TSR  
Cost  
dE (D65)

1 / 1 (100 %)

Save all as



- ▶ A coating film can be visually hiding, but this does not mean that it is NIR hiding. A white substrate is recommended for optimal TSR performance.
- ▶ The decision if a color can be used for ETICS systems both LRV and TSR should be used.
- ▶ In Multilayer Systems one should be careful with the pigment choice for the top layer and all layers below.
- ▶ A possibility is created to include TSR during color matching.







# THANK YOU!



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