

# Innovative colorants for cool facades

Gerard van Zijl

Chromaflo Technologies Europe BV, Sittard (NL)

Choosing construction materials to save money and carbon - BSRIA

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*Where Art Meets Technology*



## Large, Independent, Global

A leader in innovation, product diversity and technical knowledge

### Products



Colorants



Tinting Systems



Color Selection



Specialty Chemical Products & Solutions

### Industries



Architectural Coatings



Industrial Coatings



Thermoset Plastics



Integrated Tinting Solutions

### Company Overview

380mio Dollar turnover with 650 employees

NANOPIGMY project seeks to produce cost-efficient multi-functional ceramic pigments with more functionalities than color to give to the automobile and construction materials (plastic, paint and concrete) the required functionalities through the use of these nanotechnology-based pigments, thus avoiding changes in manufacturing processes.



***This project has received funding from the European Community's Seventh Framework Programme (FP7-NMP-2011-SME-5) under grant agreement no 280393.***

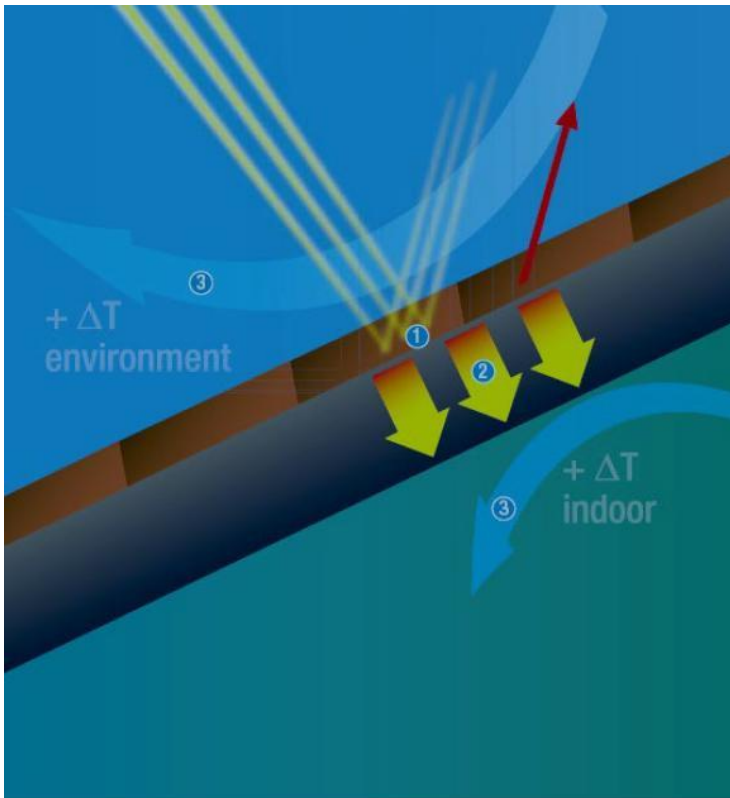
# Multi functional pigments



- Primary functionality of a pigment is providing colour
- Other functionalities could be:
  - corrosion protection,
  - self cleaning properties
  - energy efficiency
- Regarding energy efficiency we studied the so-called “Solar Reflective properties of various pigments.







- The sun's electro-magnetic radiation is transferred into heat (1)  
→ temperature rises on both sides of the hot surface
- Heat conductivity (2)
- Air convection (3) and
- Heat radiation

The aim of solar-reflective coatings is to maximize the solar reflectivity of the coated surface.

# Solar-Reflective Coatings - Why



- Keep surfaces cooler by reflecting solar radiation
- Reduce energy costs (lower demand for air conditioning)
- Protect the environment & limit Urban Heat Island Effect
- Thermal stress is reduced in construction materials e.g. External Insulation Finishing System (EIFS)



**Architectural & Decorative**

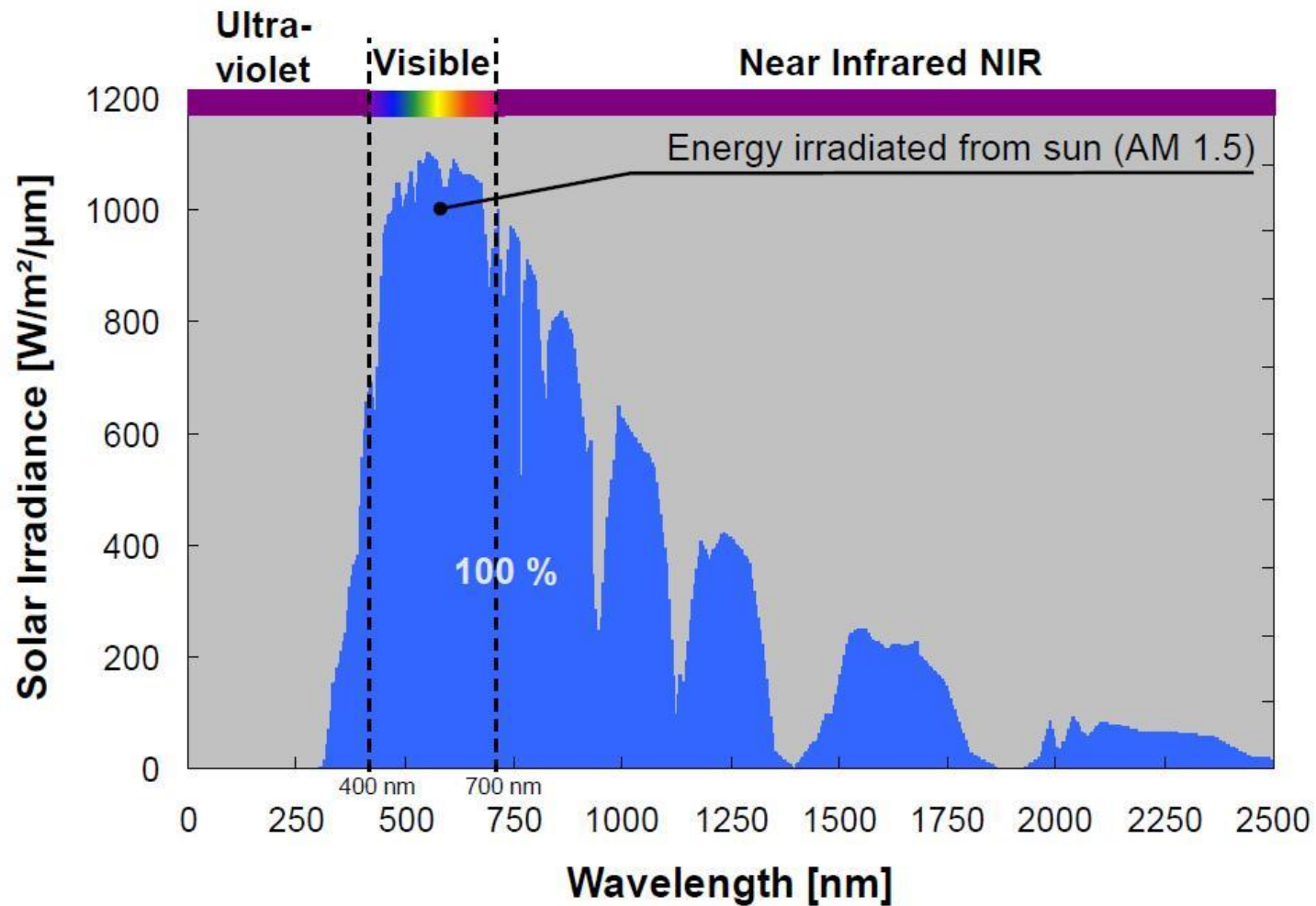


**Automotive & Transportation**



**Industrial & Marine**

# Solar light Reflection



# Quantifying Solar Reflectance



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

where: R = reflectance percentage  
I = Solar Irradiance  
dλ = wavelength interval of integration (300 to 2500nm)

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



# Novapint D-803 SR Colorant



- Novapint D-803 is a water-based colorant containing a functional NIR reflective pigment PBr.29 (BASF) developed for facade applications
  - TSR value is higher than carbon black PBk.7
  - Black intensity is lower than carbon black PBk.7



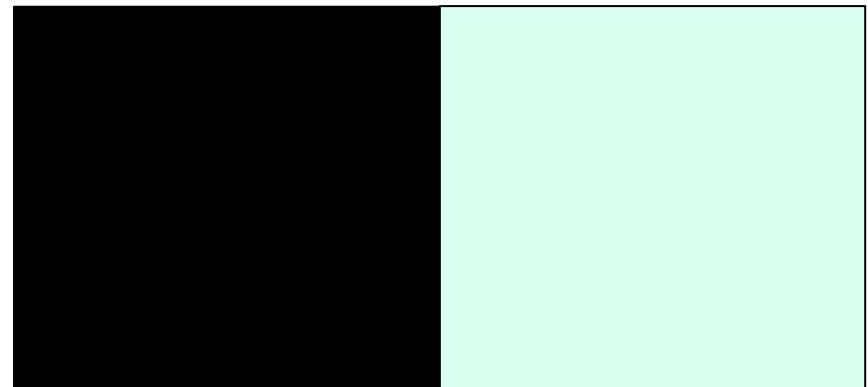
Visible Range



PBk7

PBr29

NIR Range

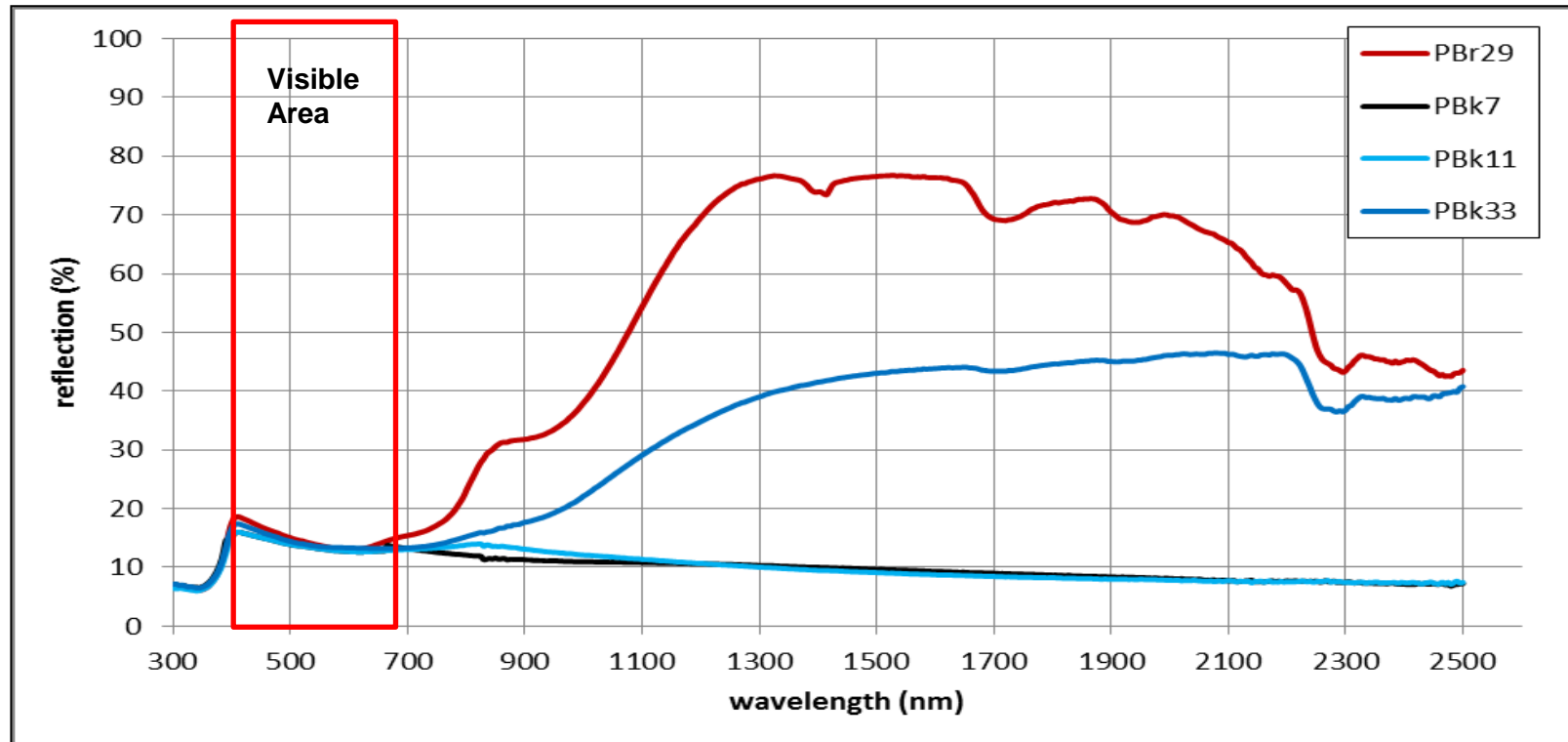


PBk7

PBr29

# Reflection Curves Black Colorants

(Semi-gloss coating, 160  $\mu\text{m}$ , adjusted L value, 1/3 reduction)



- A much higher solar reflectance in the NIR-region is achieved by the Novapint D-803 NIR colorant (PBr.29).

# TSR Values of Black Colorants

(Semi-gloss coating, 160 µm, adjusted L value, 1/3 reduction)

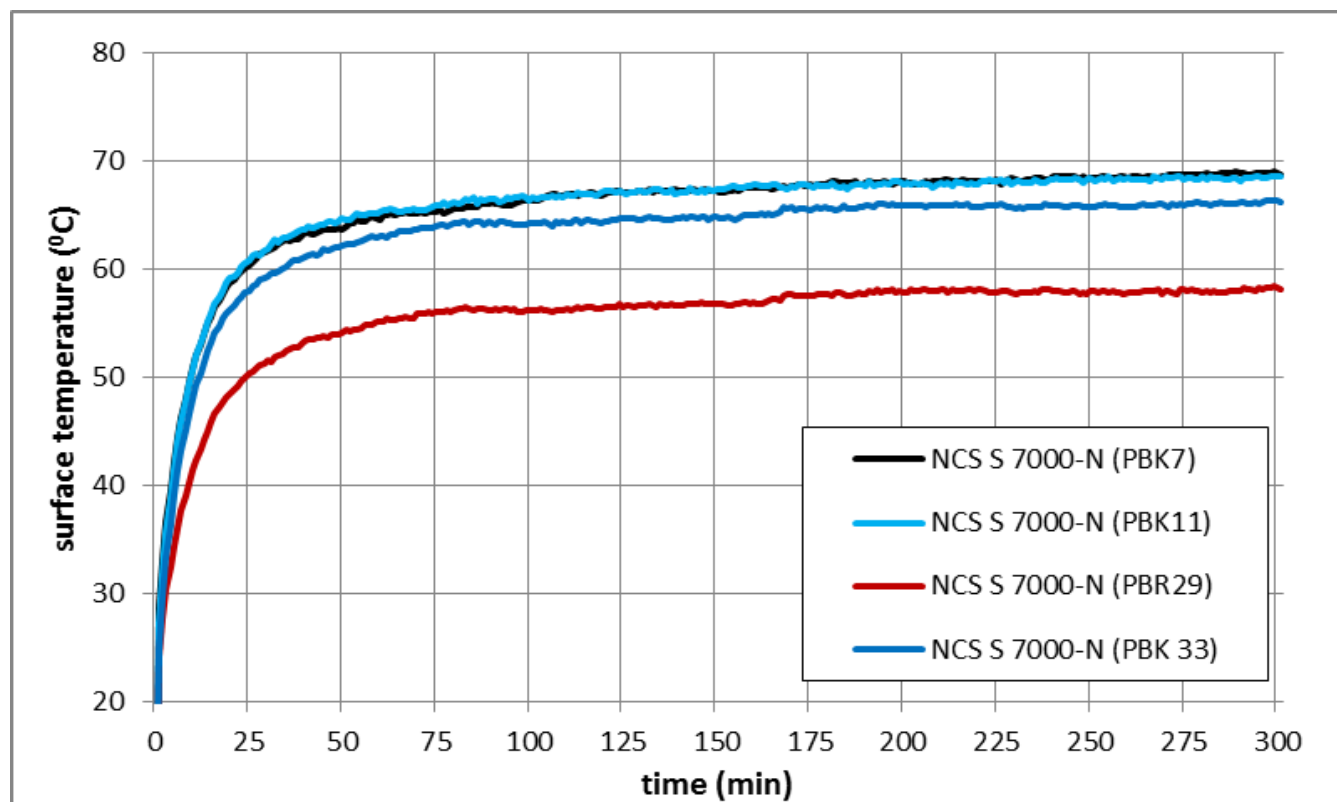


Color name	Novapint D	C.I.	TSR (%)
Black	D-500	PBk7	12
Oxide Black	D-800	PBk33	21
Oxide Black	D-802	PBk11	13
NIR Black	D-803	PBr29	33

- A much higher TSR value is achieved by the Novapint D-803 NIR colorant (PBr.29)

# Heat Build-Up of Black Colorants

(Clear Coating, Shade NCS S 7000-N, Halogen lamp)



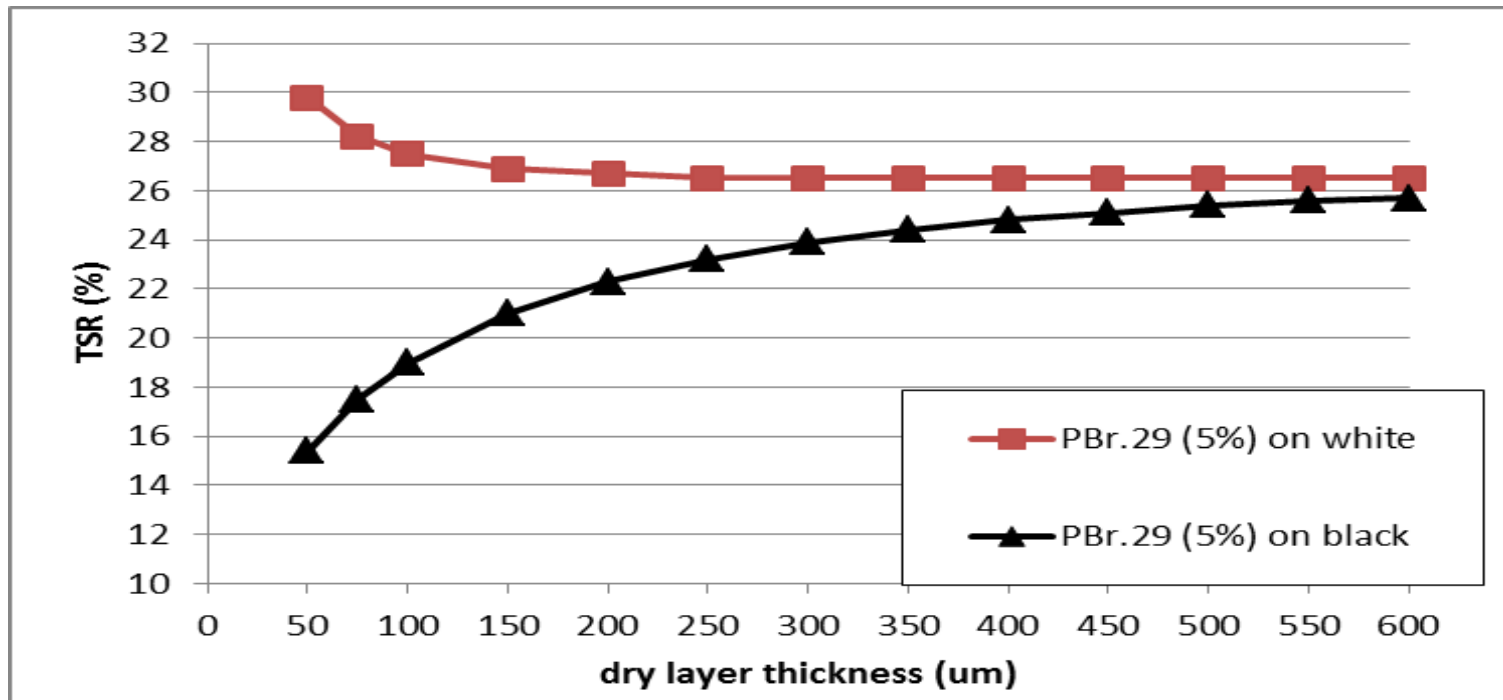
NCS S 7000-N



- Novapint D-803 NIR colorant (PBr.29) has a much lower surface temperature -11°C in comparison to a similar coating containing PBk.7 and PBk.11

# Substrate Influence

(clear coat)

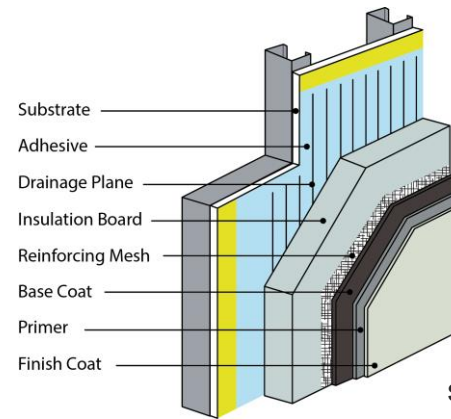


- A coating film can be visually opaque (or hiding), this does not mean that it is NIR opaque as well.
- The substrate and layer thickness have a big influence on the TSR value for a NIR colorant (PBr.29).



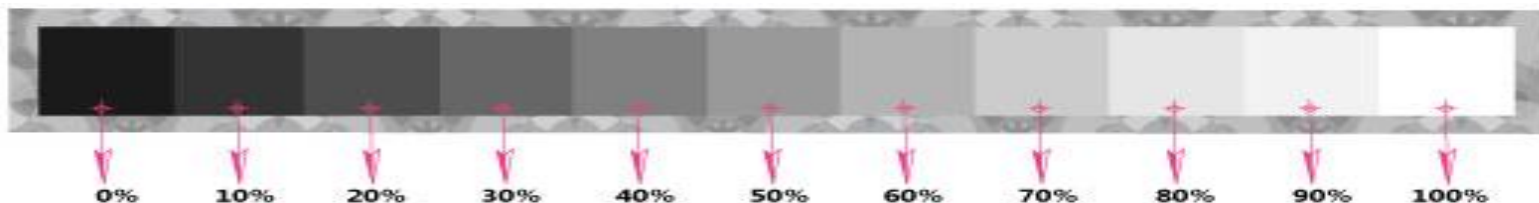
# TSR vs. LRV

- Architects, builders, or homeowners may not want to limit themselves to white or pastel colours to decorate a building.

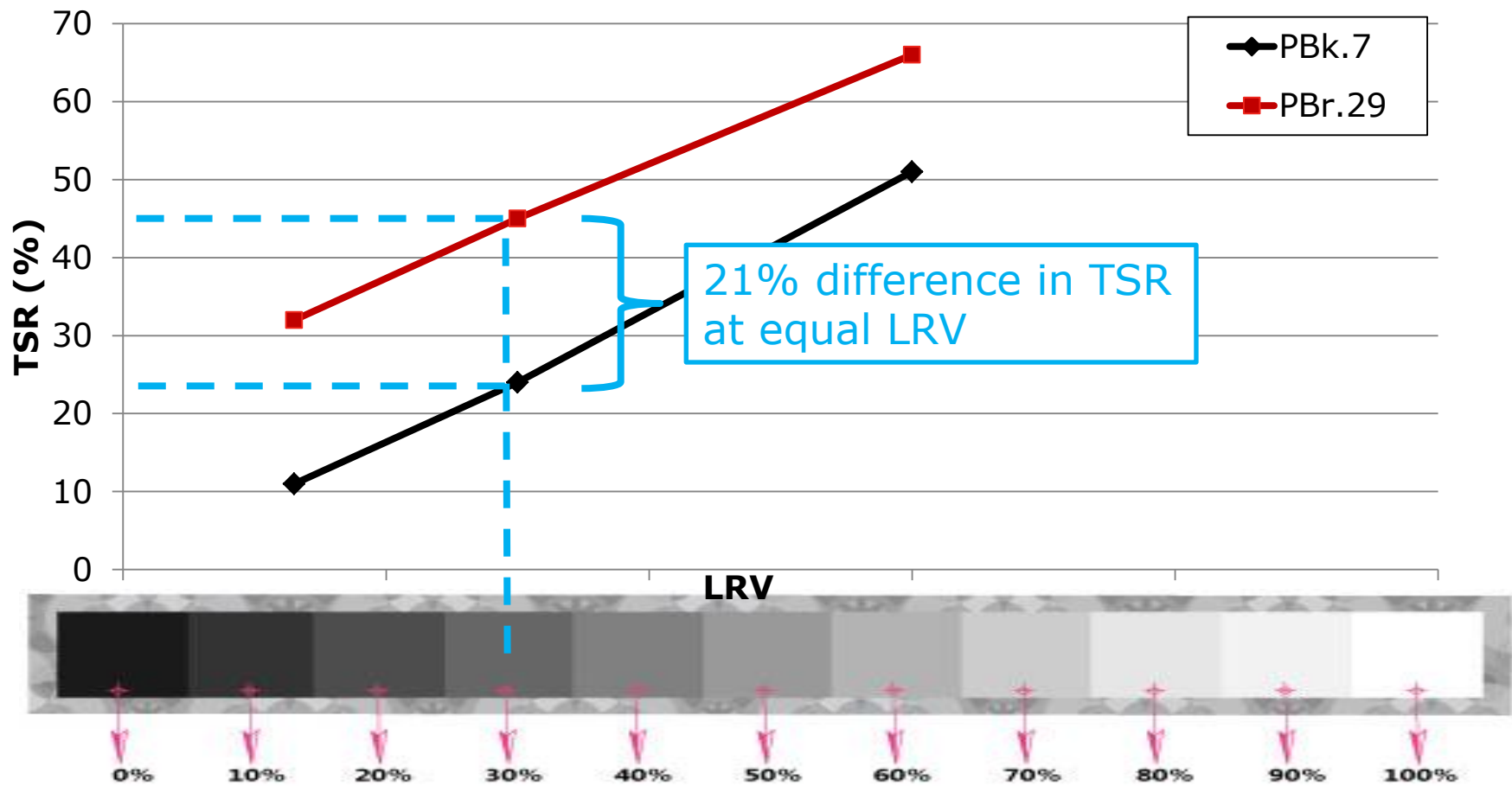


sectional view of EIFS

- EIFS manufacturers specify the selection of a finish coat with a Light Reflectance Value (LRV) of at least 20. Dark colours with a LRV <20 are not recommended.
- LRV is a measurement that tells you how much visible light a color reflects.



# TSR vs. LRV



- Two colours can have identical LRVs but different TSR values and heat build-up, depending on whether or not the pigmentation reflects in the NIR range.

## Nanopigmy results

- For Nanopigmy the Ultramarine Blue pigment was modified in order to develop a multi-functional pigment.
- Goal: NIR-Reflectance >10% gain compared to unmodified Ultramarine Blue
- This goal was achieved on lab-scale with a monolayer coating of various metals.
- TSR was increased from 52% to 60%
- No further results before up-scaling this pigment.

# Conclusions



- With a proper pigment selection it is possible to increase the NIR-Reflection of a particular colour.
- A higher TSR of a colour results in a lower temperature of the coated material. This enables a wider colour selection.
- With an increased TSR it is expected that operating costs and carbon emissions are reduced.
- LRV should not remain the sole factor when deciding which colours can be used for EIF systems. TSR is a more practical measurement. More colours become available and/or energy can be saved with optimized pigmentation
- When measuring TSR the whole system must be included. Not only the top layer.

Thank You for Your Attention



**Gerard van Zijl**  
Product Manager Industrial Coatings

E-mail: [gvanzijl@chromaflo.com](mailto:gvanzijl@chromaflo.com)  
Mobile: +31 6 462 161 35

**Chromaflo Technologies Europe BV**  
P.O. BOX 809, 6130 AV Sittard  
Nusterweg 98, 6136 KV Sittard  
The Netherlands

Phone: +31 46 457 01 70  
Fax: +31 46 457 01 50  
[www.chromaflo.com](http://www.chromaflo.com)