Efka® PX 4780 / 4787
Innovative, reactive high performance dispersing agents for solvent-based systems
Ludwigshafen, 27. March 2020
Agenda

1. Introduction
2. Performance Highlights
3. Dual Anchoring Mechanism
4. Co-Reactive Functionalities
5. Summary
Our comprehensive portfolio enables solutions for various industries

BASF is the premiere provider of **Performance & Formulation Additives** for the paints and coatings industry.
## Strong brands to empower your business

<table>
<thead>
<tr>
<th>Water-based brands</th>
<th>Application</th>
<th>Solvent-based* brands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispex® / Dispex® Ultra</td>
<td>DISPERSING AGENTS</td>
<td>Efka®</td>
</tr>
<tr>
<td>Foamaster® / FoamStar®</td>
<td>DEFOAMERS</td>
<td>Efka®</td>
</tr>
<tr>
<td>Rheovis® (organic) / Attagel® (clays)</td>
<td>RHEOLOGY MODIFIERS</td>
<td>Efka®</td>
</tr>
<tr>
<td>Hydropalat®</td>
<td>WETTING AGENTS</td>
<td>Efka®</td>
</tr>
<tr>
<td>Loxanol®</td>
<td>FILM-FORMING AGENTS</td>
<td>Efka®</td>
</tr>
<tr>
<td>Tinuvin® / Lignostab®</td>
<td>LIGHT STABILIZIERS</td>
<td>Tinuvin® / Chimassorb®</td>
</tr>
<tr>
<td>Irganox®</td>
<td>ANTIOXIDANTS</td>
<td>Irganox® / Irgafos® / Irgastab®</td>
</tr>
</tbody>
</table>

*Efka® includes also High Solids and 100% Solid Systems
Development targets

Develop a dispersing agent that:
- Provides excellent dispersing properties
- Reduces negative impact on physical properties

New pigment affinity chemistry
- Improved rheological behavior

Equip dispersant with functional groups to become crosslinkable
- Focus on NCO- and melamine-crosslinking systems
- Investigate effects on physical properties of coating

Target applications:
- Automotive / OEM
- Industrial
Efka® PX 4780 / 4787
Innovative reactive, high performance dispersing agents for solvent-based systems

Performance highlights:
- Exponentially low pigment paste viscosities at lower addition levels
- Relatively consistent and stable viscosities over wide addition range
- Cross-linkable with -NCO and melamine-based resin matrices for optimal durability
- Exceptional jetness for carbon black pigments
- Excellent gloss development
- Highest available transparency in CAB-containing systems

Application:
Efka® PX 4780 / 4787 are high molecular weight dispersing agents designed to disperse and stabilize organic pigments and carbon-blacks. Use of Efka® PX 4780 / 4787 results in significantly lower pigment paste viscosities without having to use high level of dispersants. Efka® PX 4780 / 4787 are suitable for industrial and automotive coatings, especially where resin-matrix reactive dispersant are desired.

Characteristic Values:

<table>
<thead>
<tr>
<th></th>
<th>Efka® PX 4780</th>
<th>Efka® PX 4787</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Brownish liquid</td>
<td>Brownish liquid</td>
</tr>
<tr>
<td>Solvent</td>
<td>Solvent-free</td>
<td>Butyl acetate</td>
</tr>
<tr>
<td>Active ingredients</td>
<td>~ 100%</td>
<td>~ 70%</td>
</tr>
<tr>
<td>Amine value</td>
<td>~ 20 mg KOH/g</td>
<td>~ 15 mg KOH/g</td>
</tr>
</tbody>
</table>
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Efka® PX 4780 / Efka® PX 4787 – Carbon Black Viscosity Curve

Very efficient dispersants vs competitive benchmarks

Efka® PX 4787 tested in lab with Carbon black.

Efka® PX 4787 provides efficient viscosity suppression at lower DOP than competitive products.

Monarch 1300: Comparative Visc vs DOP at 0.016 sec⁻¹ (Low Shear); 16% PP; 12 Hr Scandex
Jetness development of different carbon black in sb 2pack PUR

Determining factors

- SB resin free pigment concentrates (RFPC)
- Carbon black: Emperor 1600
- Solvent: methoxy propyl acetate
- DoP: 90%
- Pigment load: 12-15%
- 5h Skandex, 2mm glass beads,
- SB 2pack PUR: Joncryl 507 + Basonat HI 2000 NG
Efka® PX 4780 shows the lowest mill-base viscosity and allows higher pigment loads.
Jetness development of PC in SB 2 pack PUR with Emperor® 1600

Efka® PX 4780 shows high jetness and blueish undertone.
**Efka® PX 4780 / 4787**

Significant improvement of flow and excellent viscosity reduction

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**flow blade**: put 3 g into cavity and place metal blade vertical and measure the flow after a certain period of time.

### High viscosity black UV-system

<table>
<thead>
<tr>
<th>UV black-1 blank</th>
<th>UV black-5 Efka® PX 4780</th>
<th>UV black-9 Efka® PX 4700</th>
<th>UV black-2 Efka® PX 4701</th>
</tr>
</thead>
</table>

**Flow of UV-system**

<table>
<thead>
<tr>
<th>Blank (w.o. additive)</th>
<th>No flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efka® PX 4780 (100% active)</td>
<td>5.25 cm after 10 min</td>
</tr>
<tr>
<td>Efka® PX 4700 (70% active in solvent)</td>
<td>1.75 cm after 10 min</td>
</tr>
<tr>
<td>Efka® PX 4701 (100% active)</td>
<td>1.75 cm after 10 min</td>
</tr>
</tbody>
</table>
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Advanced polymeric dispersing agents with core-shell structure

pigment specific!

resin & solvent specific!
BASF has developed novel pigment dispersants with a Dual Anchoring Mechanism

Dual Anchoring Mechanism is able to adapt to different types of pigment surfaces, leading overall to stronger anchoring of the dispersant.
Efka® PX 4780 / 4787 –
Dual Anchoring Mechanism achieves best pigment adsorption

Dual Anchoring Mechanism improves adsorption of dispersants on pigments significantly, resulting in improved stability and low pigment dispersion viscosities.

Efka® PX 4787 shows close to ideal adsorption behavior

Analytical ultra-centrifuge: gives direct information of dispersant adsorption on pigment

1. Homogeneous distribution without centrifugal field
2. High-resolution separation and in-situ detection with centrifugal field
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Efka® PX 4780 / 4787 – Cross-linkable dispersants lead to improved coating properties

Conventional dispersing agent with NO crosslink function
> Weaken network

Advanced co-reactive dispersing agent with certain crosslink ability
> Enhanced network density
# Improved MEK rub resistance with Efka® PX 4780 in a SB MF/PES system

<table>
<thead>
<tr>
<th>Dispersant</th>
<th>DoP [%]</th>
<th>MEK rubs</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>w/o additive</td>
<td></td>
<td>&gt;200</td>
<td>Slight abrasion</td>
</tr>
<tr>
<td>Benchmark 2 (non reactive)</td>
<td>25</td>
<td>66</td>
<td>Coating swells</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>27</td>
<td>Coating swells</td>
</tr>
<tr>
<td>Efka PX 4780 (crosslinkable)</td>
<td>25</td>
<td>&gt;200</td>
<td>Slight abrasion</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>&gt;200</td>
<td>Slight abrasion</td>
</tr>
</tbody>
</table>

**Pigment:** Heliogen blue L6600
Efka® PX 4780 / Efka® PX 4787
Provides best pendulum hardness

The co-reactive nature of Efka® PX 4787 positively impacts hardness and chemical resistance.
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Efka® PX 4780 (100%) and Efka® PX 4787 (70% in BuAc)
- New dispersant technology for solvent borne industrial and automotive applications
- Dual-anchoring mechanism for optimized pigment affinity
- Provide unprecedented viscosity reduction (rheology control)
- Excellent dispersing properties with carbon-blacks and organic pigments
- Co-reacts with NCO- and melamine-crosslinking formulations
- Enhanced formulation flexibility

Outlook
- Concept transfer to other application areas and waterborne applications
Contacts

Dr. Sascha Oestreich
Head of Technical Sales Formulation Additives
Phone: +49 211 7940-9028
Mobile: +49 173 5396101
sascha.oestreich@basf.com

Lars Hoffmann
Technical Sales Formulation Additives
Phone: +49 621 60-92208
Mobile: +49 172 7470244
lars.hoffmann@basf.com

Andrea Schamp
Marketing Formulation Additives Europe
Phone: +49 211 7940-2605
Mobile: +49 173 5936561
andrea.schamp@basf.com

internet: http://www.basf.com/additives
email: formulation-additives-europe@basf.com
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