POWDER COATING SUMMIT
SEPTEMBER 8-9, 2022

Hard Minerals Enhance Powder Coating Performance

Overview

- Wester Mineralien: Mastering hard particles
- Why hard mineral particles in powder coatings?

- Study: Processing & properties of powder coatings with hard mineral additives
- Results of study

Introducing us: Wester Mineralien GmbH

1909 1st Generation

Founding of *Westerwerke* by Jean Wester. Production of refractory products.

1961 2nd Generation

Founding of *Wester Tonbergbau* in Alfter-Witterschlick (clay mine) by Hanns Wester.

1975 3rd Generation

Foundation of *Wester Mineralien GmbH* by Harald Wester & Arndt Wester. Trade of refractory products from clay with the addition of corundum. Processing & recycling of corundum for different abrasive industries.

1980

Closure of the clay mine. Specialization in production & trade of minerals at Alfter-Witterschlick site.

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Since 2005

Production/refinement: high-quality, chemically coated white fused alumina for the laminate & furniture industry. Quality management: All products analyzed in our own laboratories.

2015 4th Generation

Nicola Wester & Max Wester become shareholders of *Wester Mineralien GmbH*.

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Introducing us: Wester Mineralien GmbH

Since 2015

Establishment of in-house R&D department in cooperation with sales team & laboratory team.

Quality increase through product development. Research on minerals in different coating systems & other applications.

Introducing us: Wester Mineralien GmbH

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Production/refinement of WFA powders

Decades of experience with corundum

Introducing us: Wester Mineralien GmbH

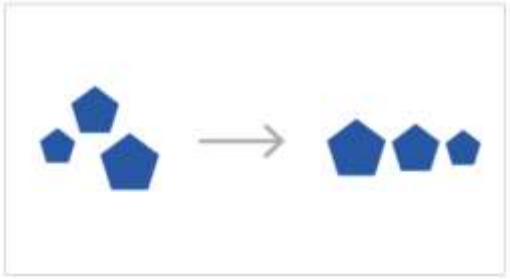
Production/refinement of WFA powders

GRIND/SHAPE

DE-DUST

SIEVE

MACRO GRAINS



AIR CLASSIFY

MICRO GRAIN

COAT

DRY

Introducing us: Wester Mineralien GmbH

Experts in different materials

Production/refinement

Contract processing

Trading

Introducing us: Wester Mineralien GmbH

27 high-performance systems

60 employees

10,000 tons per year /
50 tons per day

Grain sizes 1- to 3-digit µm

Well equipped laboratories

Inorganic minerals and organic coatings?

Do minerals go well with organic coatings?

Inorganic minerals and organic coatings?

Do minerals go well with organic coatings?

Yes!

White fused alumina (WFA) = State-of-the-art in clear melamine coats for abrasion & scratch resistance

Transparency of finishes not affected due to properties of chemically treated WFA

Inorganic minerals and organic coatings?

Do minerals go well with organic coatings?

Yes!

Motivation

Abrasion & scratch resistance in coatings of all kinds for long lasting surfaces

Idea

Transfer know-how to powder coatings

Inorganic minerals and organic coatings

- Why Powder coatings?

Inorganic minerals and organic coatings

Why Powder coatings?

Economic & ecologic advantages compared to other coatings

→ Strong demand: Expanding share of industrial coatings market

Inorganic minerals and organic coatings

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Improvement of formulations

→ Increasing requirements to performance & life span

Inorganic minerals and organic coatings

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Mineral powders integrable into existing process

→ Same state of aggregation (bulk goods)

Inorganic minerals and organic coatings

Challenges

Protection of the processing machines

Application

Functionality of final surface layer

Optic of final surface layer

→ Depending on field of use: Aesthetic expectations of customers

→ Goal: Perfect balance between appearance & functionality

Inorganic minerals and powder coatings – Developer‘s approach

Positive effects of hard minerals in powder coatings: Data needed!

Study

Cooperation project with experts of Powder Coating Group (ChemQuest)

Gray standard durable powder coating, based on polyester-HAA (Hydroxy-Alkyl Amide) chemistry

Inorganic minerals and powder coatings – Study

Different fillers compared to unmodified control formulation

→ Nepheline Syenite (d_{50} = 7,5 µm)
→ WFA F 500 (d_{50} = 12,8 µm)
→ WFA F 800 (d_{50} = 6,5 µm)
→ SiC F 500 (d_{50} = 12,8 µm)

Each tested 5 Vol% & 10 Vol%

Inorganic minerals and powder coatings – Study

Processability

Application performance

Appearance (color, gloss & surface profile)

Mechanical properties

Abrasion resistance

Inorganic minerals and powder coatings – Study

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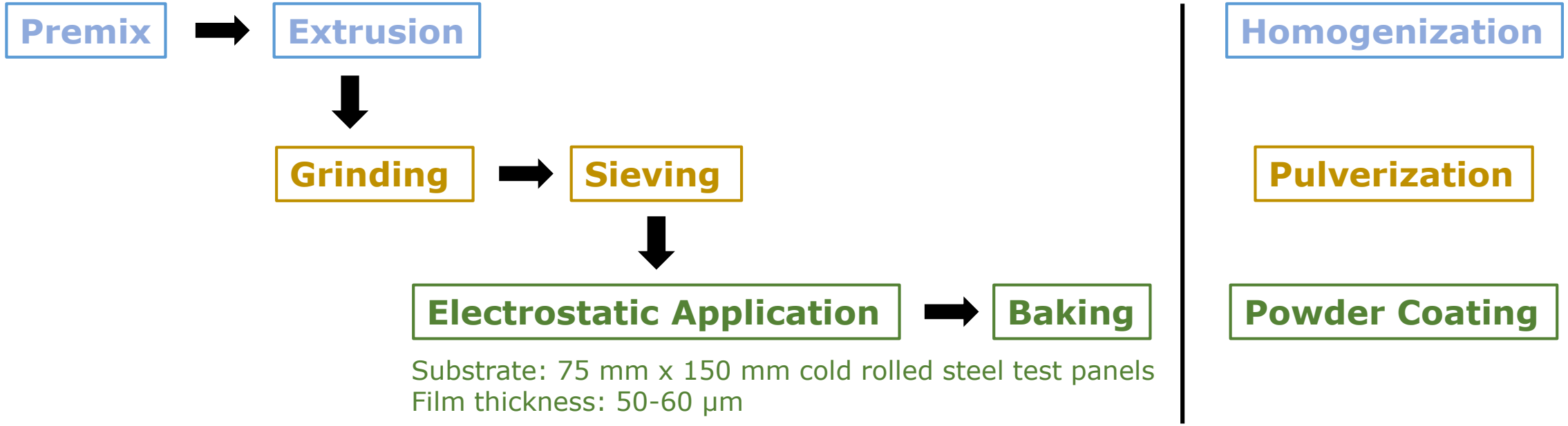
Conventional process & application



→ No issues caused by fillers

Inorganic minerals and powder coatings – Study

Analysis of appearance: Gloss

Formula	Modification (Vol %)	Gloss (60°)
1	None	95,1
2	5% Nepheline Syenite	69,5
3	10% Nepheline Syenite	55,3
4	5% WFA F 500	69,6
5	10% WFA F 500	48,5
6	5% WFA F 800	72,4
7	10% WFA F 800	57,8
8	5% SiC F 500	67,1
9	10% SiC F 500	47,3

Average of multiple measurements in various locations across the surface at 60° angle

Reduced with addition of ALL fillers

Reduction similar: WFA F 500/SiC F 500 (12,8 µm) & Nepheline Syenite (7,5 µm)

WFA F 800 (6,5 µm) reduces gloss slightly less

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Inorganic minerals and powder coatings – Study

Analysis of appearance: Color

Formula	Modification (Vol %)	L*
1	None	61,75
2	5% Nepheline Syenite	61,08
3	10% Nepheline Syenite	60,42
4	5% WFA F 500	59,78
5	10% WFA F 500	58,81
6	5% WFA F 800	59,32
7	10% WFA F 800	58,62
8	5% SiC F 500	58,29
9	10% SiC F 500	56,83

ALL samples mainly darker (lower "L")

Higher concentration of filler = Greater shift

SiC F 500: Significant shift

WFA F 500 & WFA F 800: Moderate shift

Inorganic minerals and powder coatings – Study

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Inorganic minerals and powder coatings – Study

Analysis of appearance: Surface profile

Formula	Modification (Vol %)	PCI Smoothness
1	None	4
2	5% Nepheline Syenite	4
3	10% Nepheline Syenite	4
4	5% WFA F 500	4
5	10% WFA F 500	3
6	5% WFA F 800	4
7	10% WFA F 800	4
8	5% SiC F 500	4
9	10% SiC F 500	3

PCI smoothness standards: Subjective visual scale

1 = most texture to 10 = smoothest

5% of ALL fillers: NO EFFECT on smoothness

10% of either WFA F 500 or SiC F 500: Slight increase in texture

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Inorganic minerals and powder coatings – Study

Analysis of mechanical properties: Melt viscosity

Formula	Modification (Vol %)	Pellet Flow (mm)
1	None	75
2	5% Nepheline Syenite	70
3	10% Nepheline Syenite	62
4	5% WFA F 500	70
5	10% WFA F 500	65
6	5% WFA F 800	70
7	10% WFA F 800	67
8	5% SiC F 500	70
9	10% SiC F 500	63

Shorter pellet flow = Higher melt viscosity

Melt viscosity increased with addition of ALL fillers

No difference between WFA/SIC & Nepheline Syenite

Inorganic minerals and powder coatings – Study

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Formula	Modification (Vol %)	Pellet Flow (mm)
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Inorganic minerals and powder coatings – Study

Analysis of mechanical properties: Impact resistance

		Impact (in-lbs)	
Formula	Modification (Vol %)	Direct	Reverse
1	None	20	20
2	5% Nepheline Syenite	20	20
3	10% Nepheline Syenite	20	20
4	5% WFA F 500	20	20
5	10% WFA F 500	20	20
6	5% WFA F 800	20	20
7	10% WFA F 800	20	20
8	5% SiC F 500	20	20
9	10% SiC F 500	40	40

Gardner impact tester - Impact resistance in inch-pounds of force

Rapid deformation

Direct impact (film surface) & reverse impact (uncoated side behind the film)

Impact resistance generally unaffected by addition of ALL fillers

Inorganic minerals and powder coatings – Study

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Impact resistance generally unaffected by addition of ALL fillers

Inorganic minerals and powder coatings – Study

Analysis of abrasion resistance

		500 Cycles	1000 Cycles
Sample	Modification (Vol%)	Coating Loss (g)	Coating Loss (g)
1	None	0,011	0,026
2	5% Nepheline Syenite	0,007	0,017
3	10% Nepheline Syenite	0,008	0,018
4	5% WFA F 500	0,005	0,010
5	10% WFA F 500	0,003	0,008
6	5% WFA F 800	0,007	0,015
7	10% WFA F 800	0,005	0,011
8	5% SiC F 500	0,002	0,005
9	10% SiC F 500	0,002	0,004

Taber Abrasion Test Method

Addition of ALL fillers: Significant improvement in abrasion resistance

WFA F 800 (6,5 µm) & Nepheline Syenite (7,5 µm) provide improvements

Best performance with addition of SiC F 500 followed closely by WFA F 500 (12,8 µm)

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6	5% WFA F 800	0,007	0,015
7	10% WFA F 800	0,005	0,011
8	5% SiC F 500	0,002	0,005
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Inorganic minerals and powder coatings – Study

Analysis of abrasion resistance

		1000 Cycles
Sample	Modification (Vol%)	Coating Loss %
1	None	-100
2	5% Nepheline Syenite	-65
3	10% Nepheline Syenite	-69
4	5% WFA F 500	-38
5	10% WFA F 500	-31
6	5% WFA F 800	-58
7	10% WFA F 800	-42
8	5% SiC F 500	-19
9	10% SiC F 500	-15

Taber Abrasion Test Method

Addition of ALL fillers: Significant improvement in abrasion resistance

WFA F 800 (6,5 µm) & Nepheline Syenite (7,5 µm) provide improvements

Best performance with addition of SiC F 500 followed closely by WFA F 500 (12,8 µm)

Results of study

- Worries about processibility could be taken away
- Successful transfer from experienced fields to powder coatings
- Small compromises in optical properties

Results of study

- Overall results of study extremely satisfactory:

Abrasion resistance up to **6,5x** compared to coating w/o filler

Abrasion resistance up to **4,5x*** compared to coating with Nepheline Syenite

→ Economically & ecologically rational

*correlates with price difference

Results of study

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Published in Journals in the US & Great Britain

Thank you Kevin Biller & crew!

Picture source: http://askjoepowder.com/

Thank you for your attention!

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Questions?

www.wester-mineralien.de