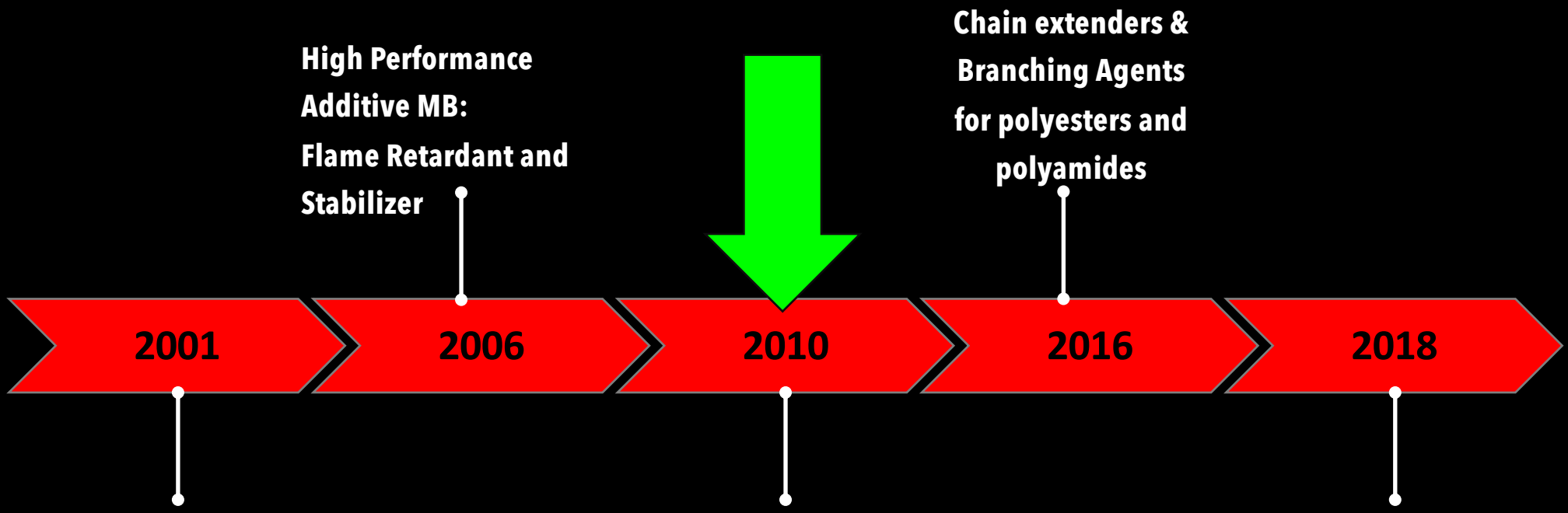

SILMA
a small addition makes a big difference
WEBINAR
IMPROVE
SCRATCH & ABRASION
RESISTANCE
IN POLYMERS
Dr. Camillo Cardelli

INDEX

SILMA VIDEO

MILESTONES


2001
2006
2010
2016
2018
Silma is founded. producer of special MB and additives
High Performance Additive MB: Flame Retardant and Stabilizer
Development of Polysiloxane Additives
Chain extenders & Branching Agents for polyesters and polyamides
Development of silane additives

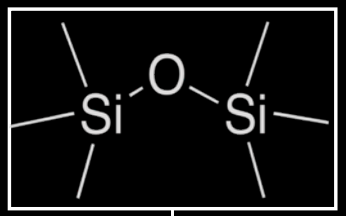
SILMA POLYSILOXANE

SINCE 2010

- Silma Is Investing To Produce Polysiloxane Additives since 2010 in liquid, powder and pellets form
- 2018 Silane Processing Plant Started
- Development of unique reactive processing (not just absorption on porous granules)

CHEMICAL PROPERTIES

POLYSILOXANES



- VERY STRONG CHEMICAL BOND
  - EXCELLENT CHEMICAL AND THERMAL RESISTANCE
- VERY FLEXIBLE CHAIN
  - EXCELLENT FLEXIBILITY DOWN TO -80°C
- NO COMPATIBLITY WITH POLYMERS
  - PHASE SEPARATION AND MIGRATION
- VARIOUS MW AVAILABLE FOR LUBRICATION AND VISCOSITY REDUCTION
- VERY LOW SURFACE TENSION
  - EXTREMELY HIGH HYDROPHOBICITY
- NON POLAR STRUCTURE AND LOW CHAIN-CHAIN INTERACTION
  - LOW FRICTION COEFFICIENT
- ONLY SI, O, C WITH LOW FLAMMABILITY
  - GOOD BEHAVIOUR IN FIRE AND NON-TOXIC FUMES

- Not toxic, environmental friendly, not water soluble

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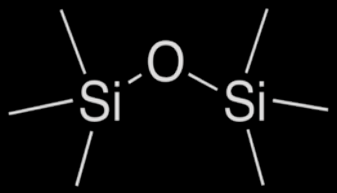
CHEMICAL PROPERTIES

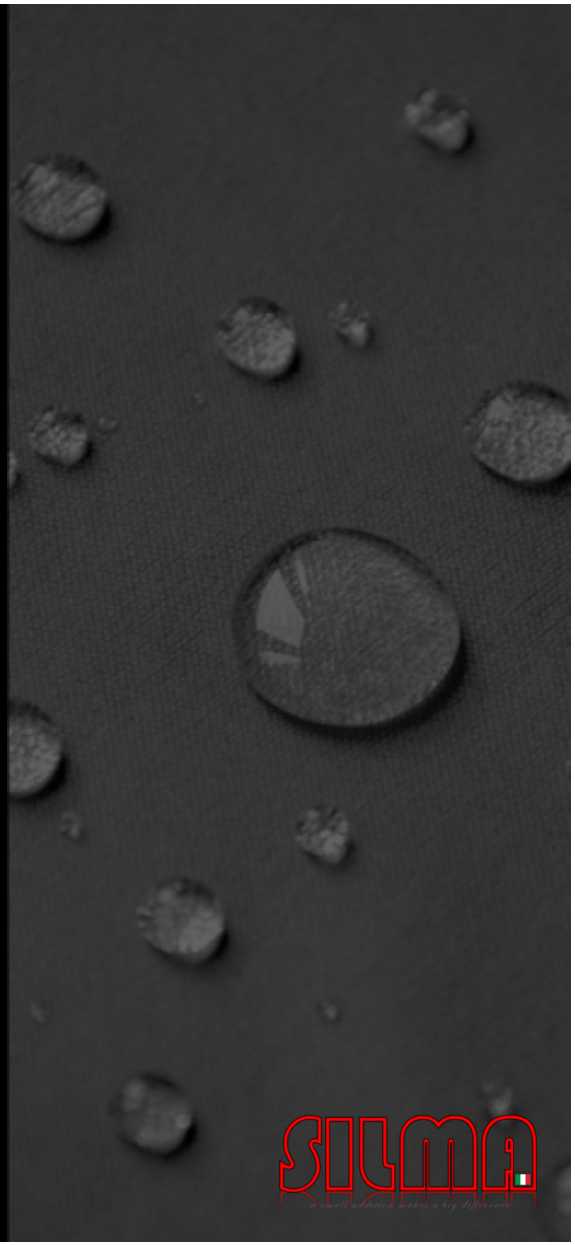
FUNCTIONAL GROUPS ON POLYSILOXANE CHAIN



TYPE	REACTIVITY WITH
ALKYL	NOT REACTIVE, HYDROPHOBIC
HYDROXYL	POLYESTERS, POLYURETHANES
ALKOXY	MINERALS, SILANES
CARBOXYL	MINERALS, POLYAMIDES, POLYESTERS
AMINO	POLYAMIDES, POLYESTERS, ANHYDRIDES
HYDRIDE	PLATINUM CURING
VINYL	RADICAL AND PLATINUM CURING
EPOXY	POLYAMIDES, POLYESTERS
ACRYLIC	RADICAL CURING (PEROXIDES, RADIATION)

Variables:

- *Number of functional groups*
- *Position of functional groups*



SILMA's PORTFOLIO

AT THE GLANCE

SILMA's PORTFOLIO

AT THE GLANCE

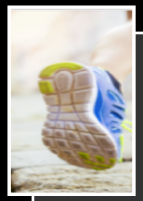
Silmaprocess AM1142A

TPEE and TPE

IPN

Silmaprocess AP1910 IPN

PP and TPV compounds



Silmaprocess AV1910

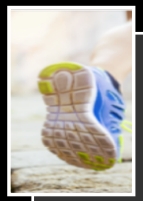
XL-EVA for shoes

Silmaprocess AA1910 IPN

Wear resistant PA6/PA66

Silmaprocess AZ1142A

ABS, PC/ABS, PBT, PET

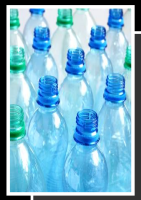


Silmaprocess AZ1142A

TPU compounds

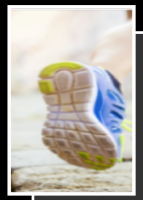
Silmaprocess AA1142A

Low friction PA6/PA66



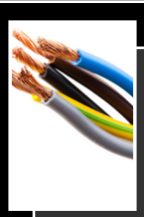
Silmalink AM1536

Branching agent – PA/PET



Silmaprocess AY1142A

TPE (styrenics)



Silmaprocess AL1142A

HFFR PE/PP/EVA/TPV

Silmaprocess AP1142A PLUS

Mineral/GF filled PP

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SCRATCH RESISTANCE

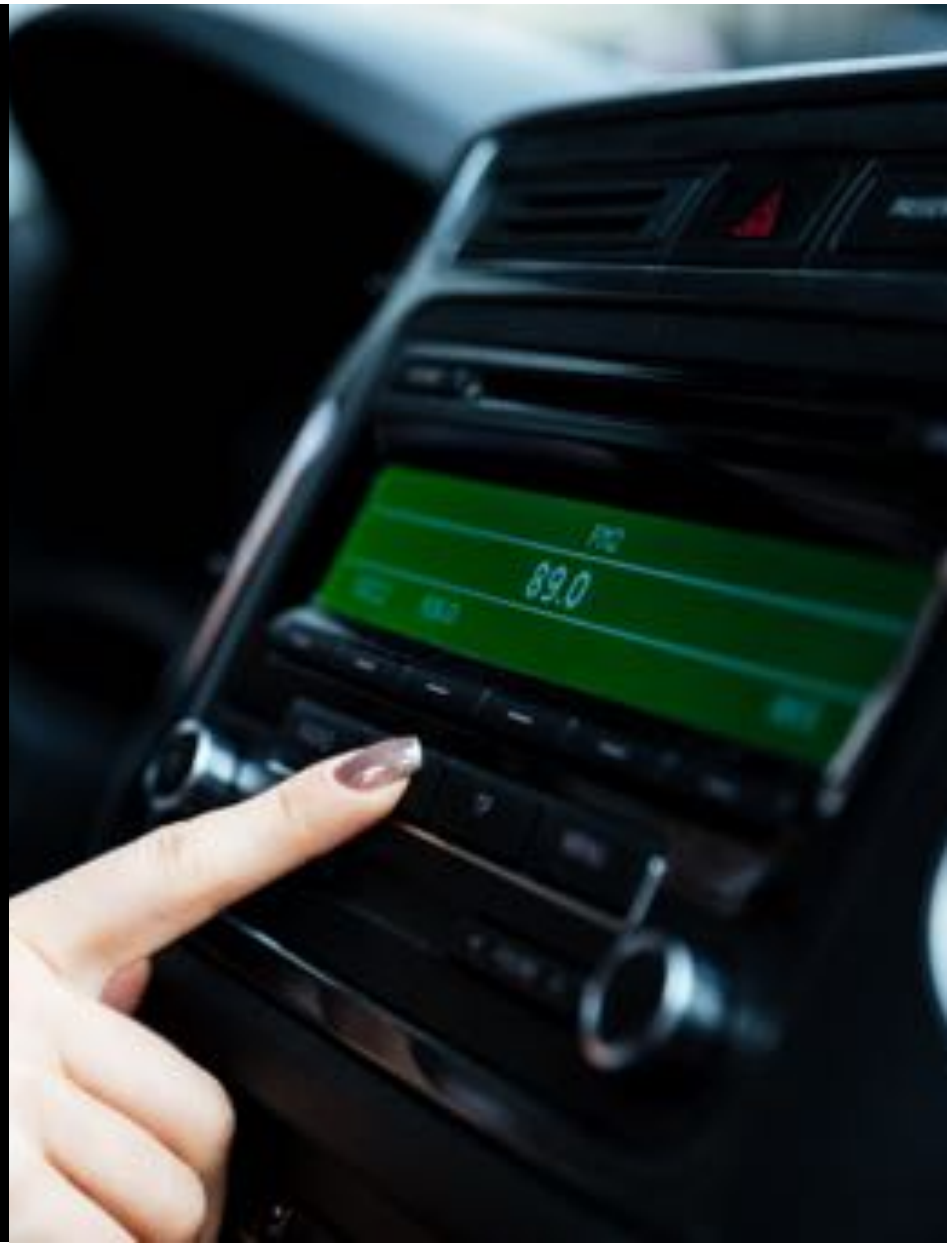
IN POLYMERS

MAIN APPLICATIONS

- PP TALC COMPOUNDS (TALC FILLED)
- POLYAMIDE COMPOUNDS
- THERMOPLASTIC ELASTOMER COMPOUNDS

MAIN INDUSTRIES

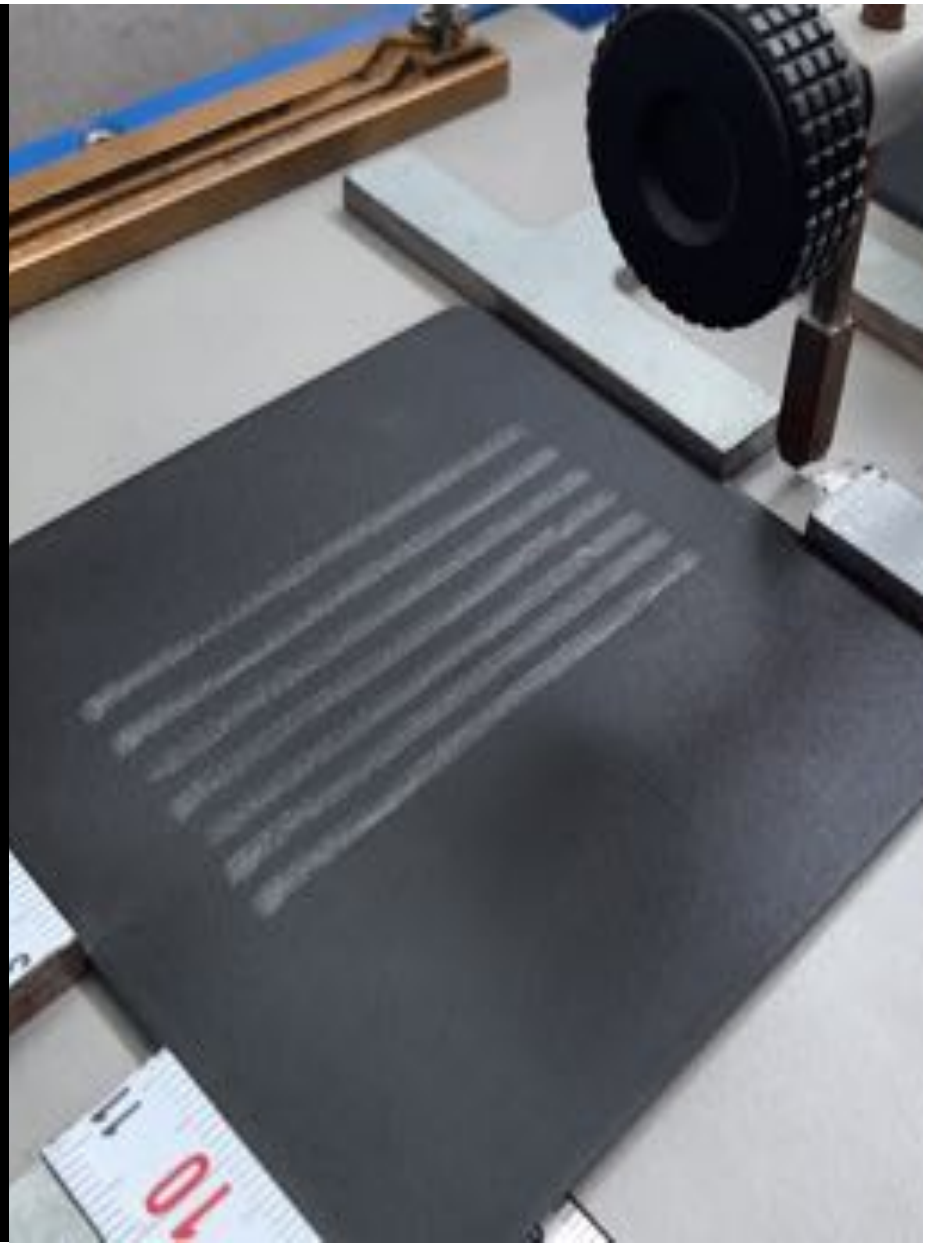
- AUTOMOTIVE
- ELECTRIC & ELECTRONICS

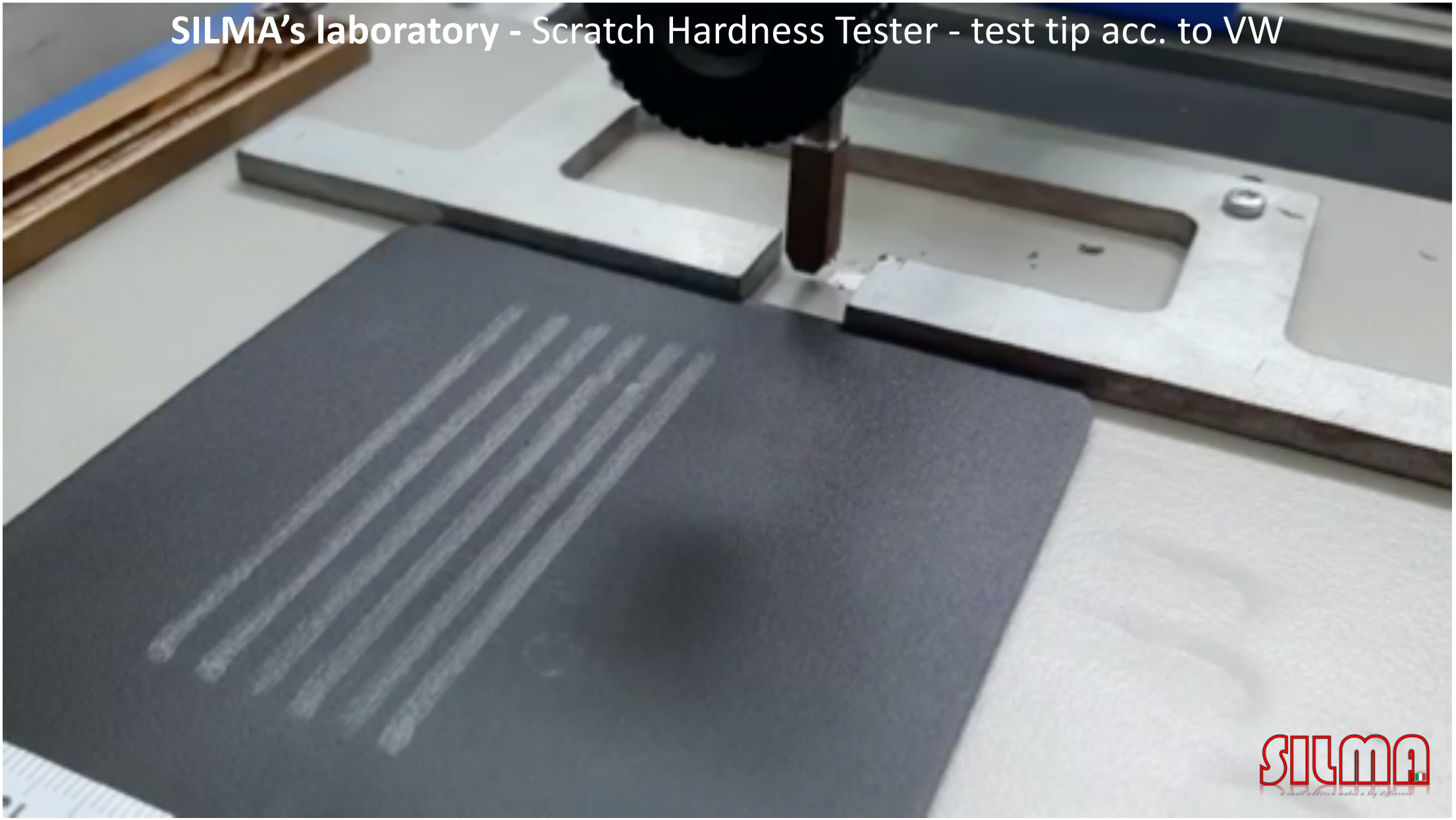


CASE STUDY

Silmaprocess AP1142A PLUS

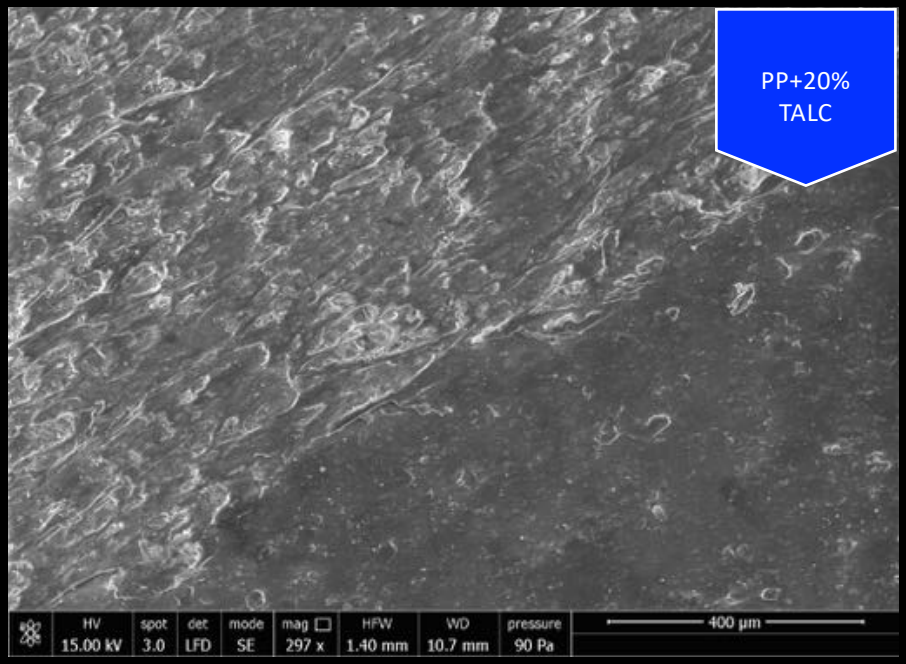
in compound PP + 30% TALC

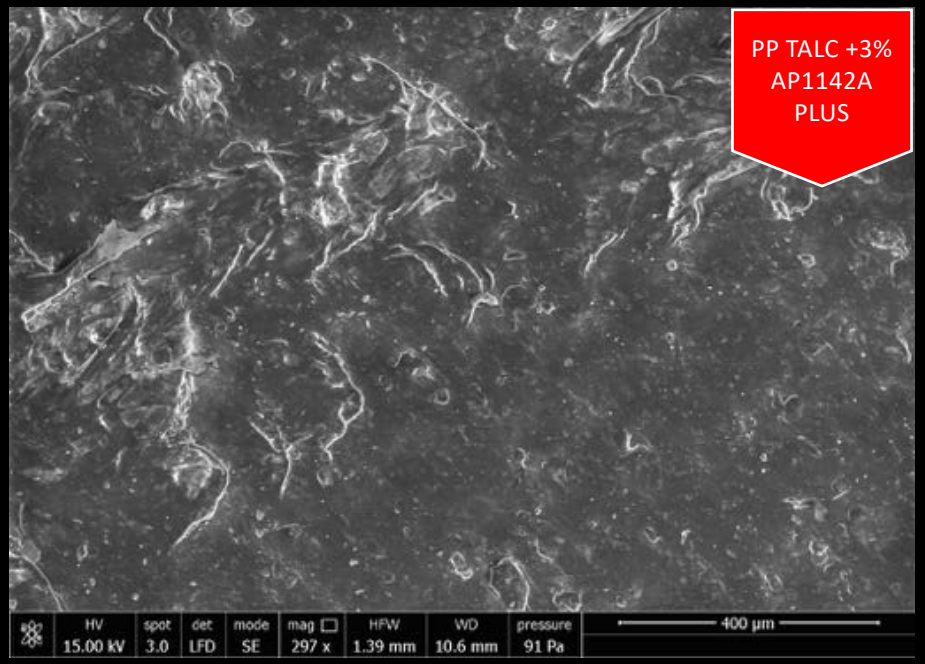



SILMA’s laboratory - Scratch Hardness Tester - test tip acc. to VW
SILMA

CASE STUDY

SURFACE ANALYSIS OF THE SCRATCH AT SEM





SECONDARY ELECTRONS 30-40 nm DEEPTH

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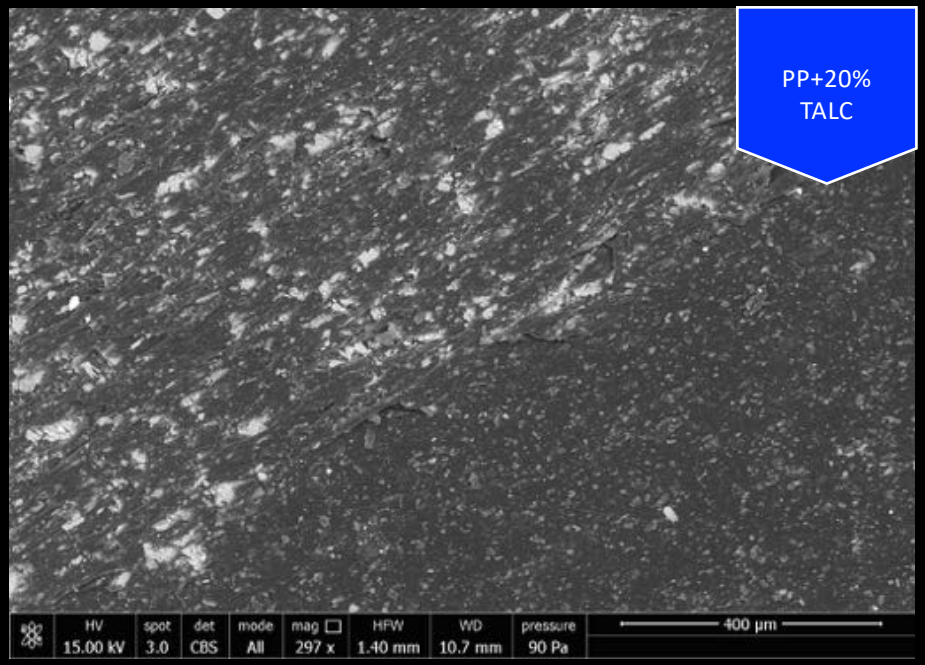
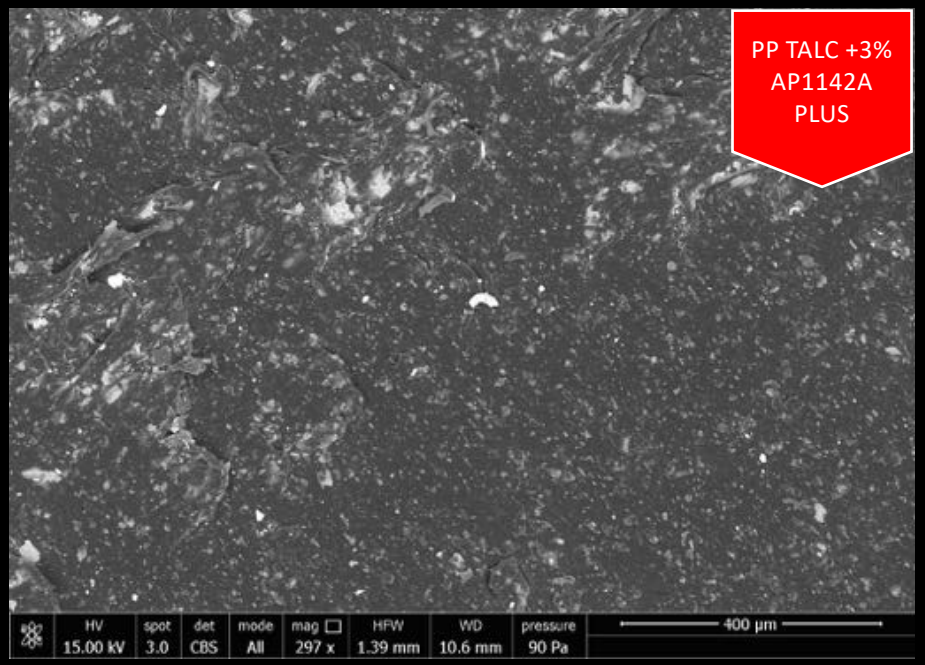
CASE STUDY

SURFACE ANALYSIS OF THE SCRATCH AT SEM





BACK SCATTERING ELECTRONS - 2-4 µm depth - SENSITIVE TO ATOMIC NUMBER

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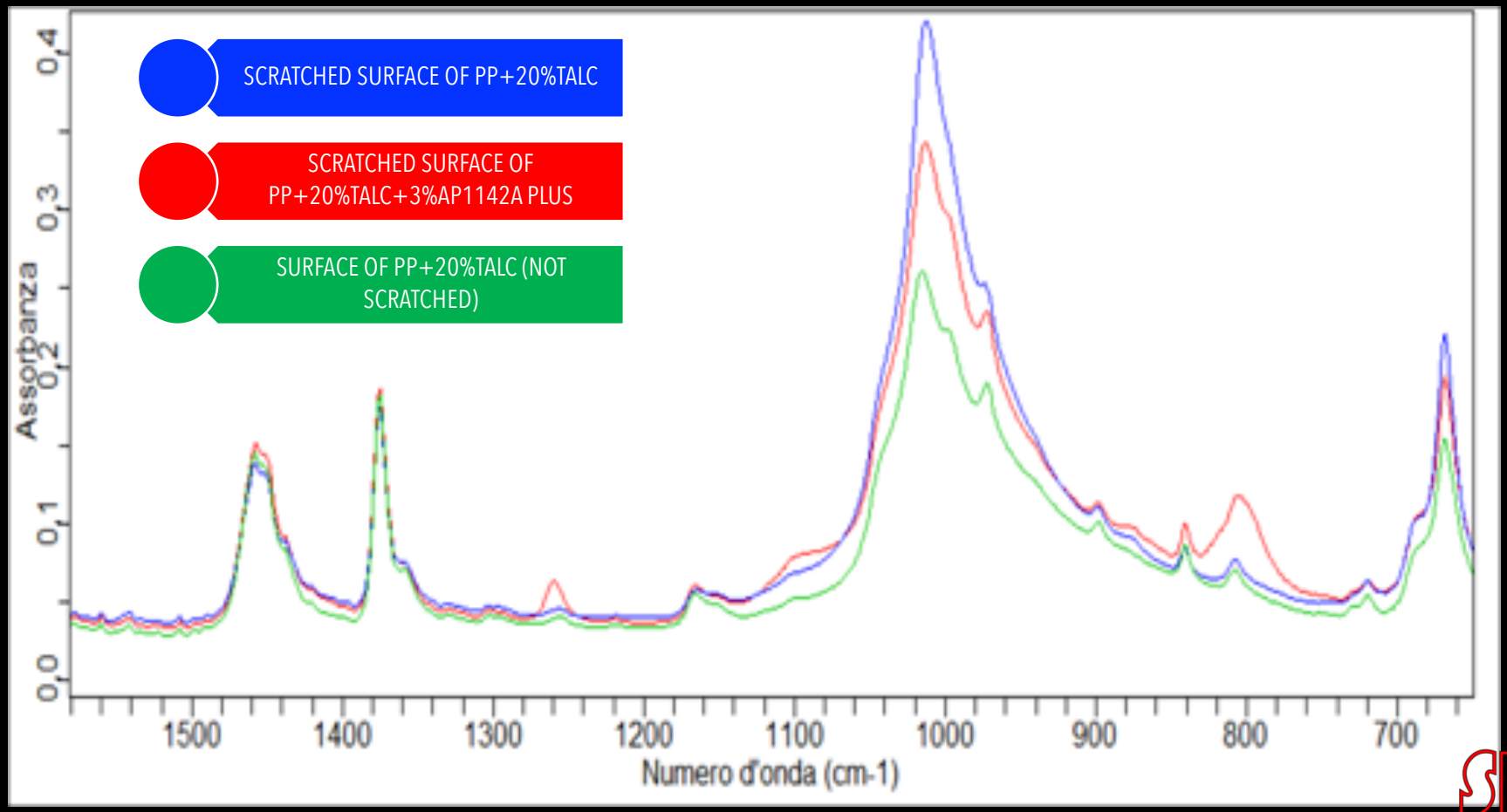
CASE STUDY

SURFACE ANALYSIS OF THE ATR (*attenuated total reflection*)



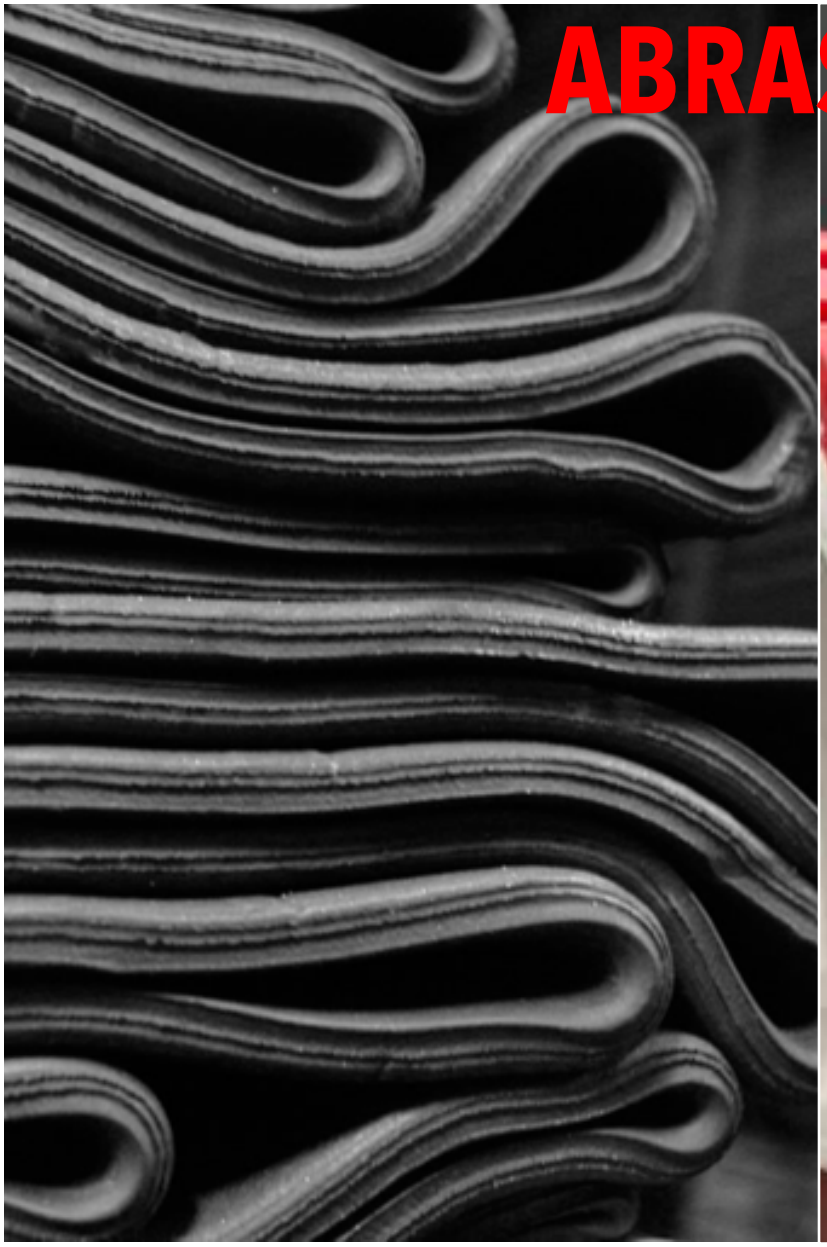
ABRASION RESISTANCE

IN POLYMERS

- Strategy: migration of PDMS additives
- Durability: permanent surface properties
- Conflict of Interest: Gripping vs Abrasion in sole
- Adhesion of Paints & Glue
- Cost/Performance

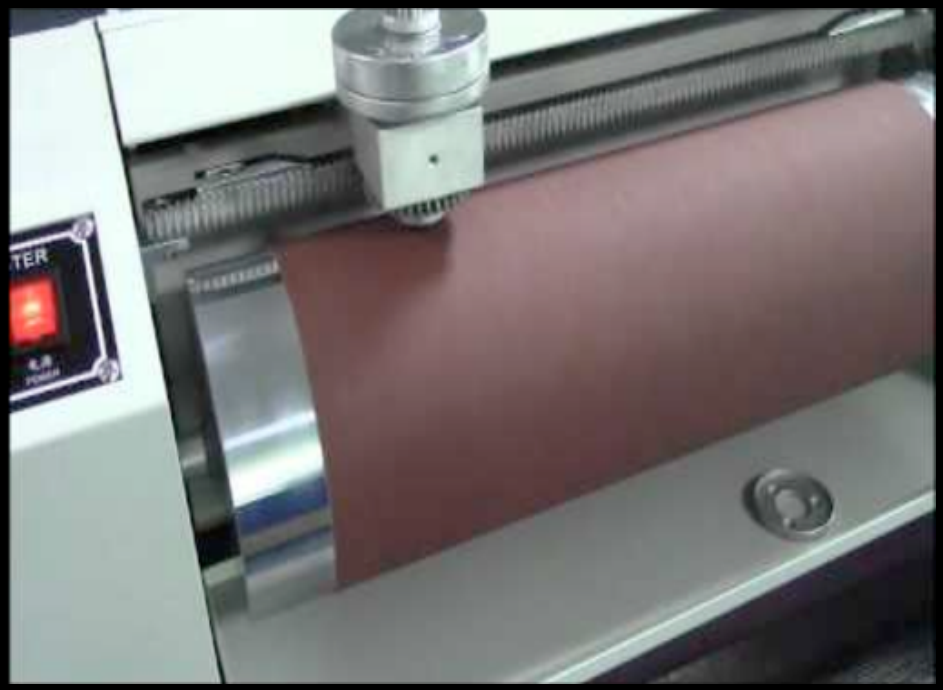
ABRASION RESISTANCE

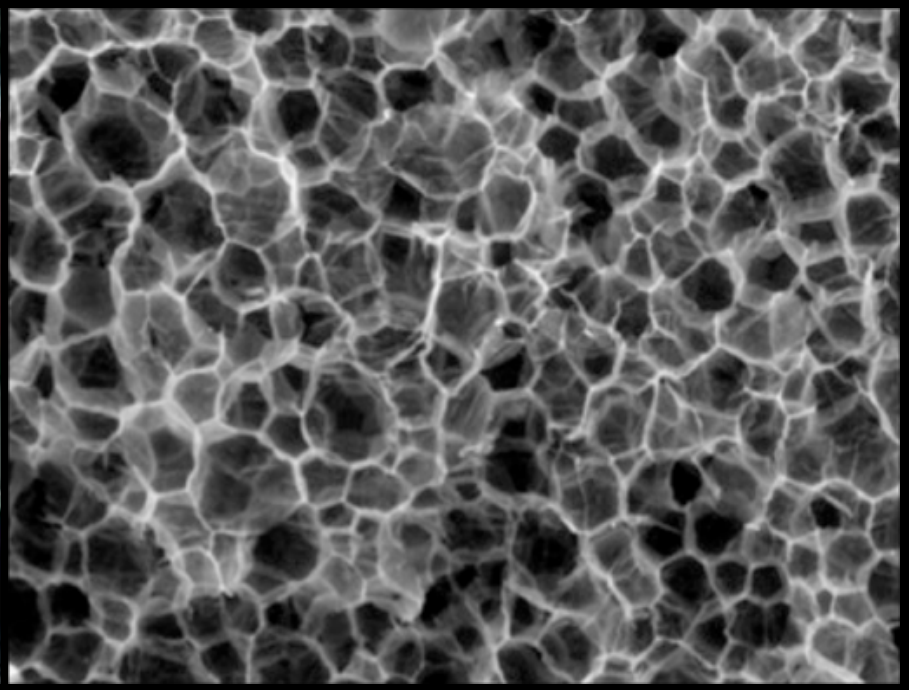
MAIN APPLICATIONS



CASE STUDY

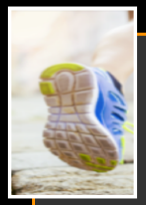
Abrasion resistance in rubber compounds





CASE STUDY

SILMAPROCESS AY1142A in styrenics TPE compound



SILMAPROCESS AY1142A

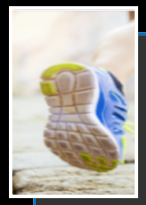
TPE styrenics compound

SEBS BASED COMPOUND FOR SOLES	TPE 70 ShA
No modification, d=1.020 g/cm³	300 mm³
+ 1% SILMAPROCESS AY1142A	270 mm³
+ 3% SILMAPROCESS AY1142A	220 mm³
+ 5% SILMAPROCESS AY1142A	160 mm³

DIN Abrasion Resistance Test Machine

CASE STUDY

SILMAPROCESS AV1910 in foamed XL-EVA



SILMAPROCESS AV1910

Foamed XL-EVA

Foamed XL-EVA for soles	XL-EVA 45 ShA
Competitor **not reactive** PDMS MB	167 mm^3
Silmaprocess AV1910	91 mm^3

DIN Abrasion Resistance Test Machine

POLYSILOXANES

PERMANENT SURFACE PROPERTIES

Highly migrating, low molecular weight basic PDMS give only TEMPORARY benefits to surfaces

Strategies for not reactive polymers:

- ✓ **High / Extra High Molecular weight PDMS**
- ✓ **2D or 3D structure polysiloxanes chains**

Functional PDMS additives for reactive polymers:

- ✓ **EVA compounds for shoes crosslinked by peroxide**
- ✓ **EPDM compounds for conveyor belts crosslinked by peroxide or by sulphur**
- ✓ **PE/EVA/POE for cables crosslinked by silanes, peroxide or electron beam**
- ✓ **Polyurethanes (PU and TPU)**

- ✓ Fast migration during processing (excellent surface properties)
- ✓ Chemically or physically blocked final morphology (long duration of performances over the time)

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SUMMARY

SCRATCH & ABRASION RESISTANCE

1. In pellets form, free-flowing, >12 months shelf life, RoHS and REACH compliant, non-toxic
2. The optimal molecular weight and the molecular structure (linear or branched) of polysiloxanes to perfectly control the rheology and the mobility of silicon chains
3. The right functional groups into polysiloxane backbone to control the reaction / interaction with polymers and minerals of plastic and rubber compounds
4. Selection of the best thermoplastic polymer in terms of molecular weight and crystallinity in order to have stable, not sticky pellets, easy and fast dispersion, and proper melting and crystallisation.
5. IPN technology for creation of new thermoplastic PDMS-hybrids materials
6. Very low dosage for great results thanks to high specific efficiency.

⇒ *SILMAPROCESS: ONLY BENEFITS, NO DRAWBACK*

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THANK YOU

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DIGITAL CHANNELS

STAY CONNECTED WITH US