Calcined Neuburg Siliceous Earth as anti-blocking agent in PET films

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Status Quo

- In the manufacture of PET films, the use of an anti-blocking additive is absolutely essential.
- The anti-blocking agent is intended to strongly reduce the coefficient of friction, while as little as possible affecting the optical properties of the film .
- Synthetic silicas impart favorable optical properties, but due to their high surface area often affect the efficiency of other additives like stabilizers, slip additives etc.
- Calcined Neuburg Siliceous Earth, with natural silica as the major constituent, lends itself, based on its mineralogical composition and morphology, to the application as anti-blocking additive.

Objective

The objective of the present study was to demonstrate the possibilities of using Neuburg Siliceous Earth as an anti-blocking agent in PET films.

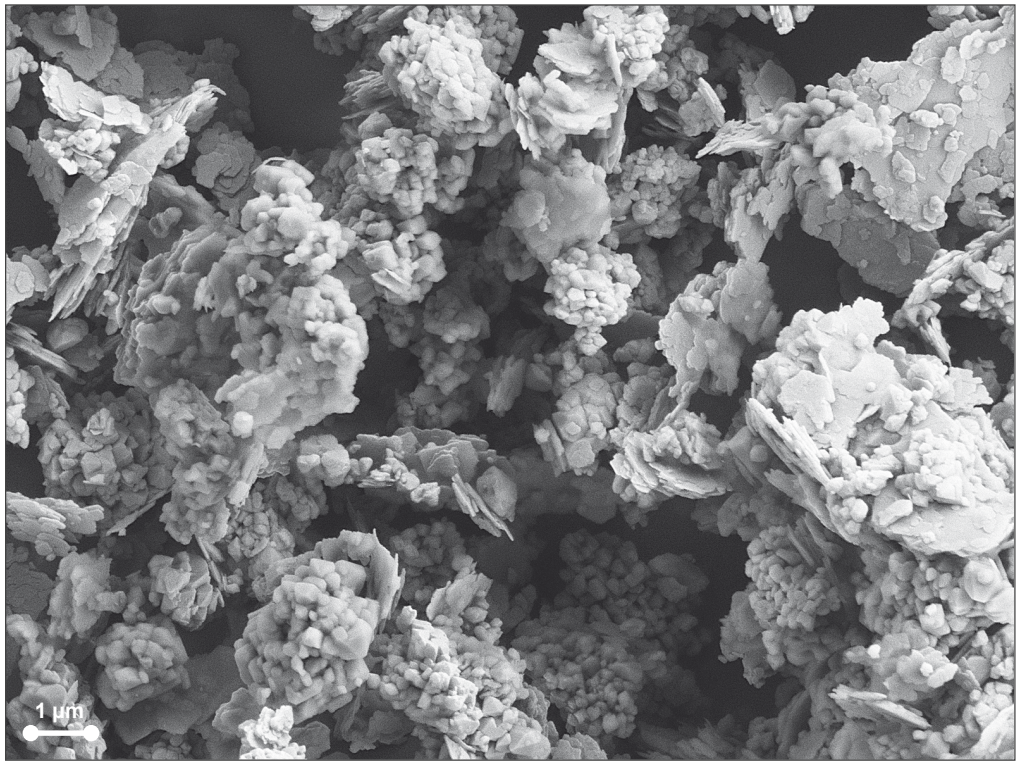
The tests comprised tribological (coefficient of friction) and the optical properties in comparison with commercial synthetic silicas.

Mineral Additives Characteristics

	Particle size d_{50} [µm]	Specific surface area BET [m²/g]
Fumed silica	0.04 *	200
Precipitated silica 1 (silicagel type)	3.2	500
Precipitated silica 2	5	---
Silfit Z 91	2	7.5

* primary particle size
characteristics according to manufacturer

Structure

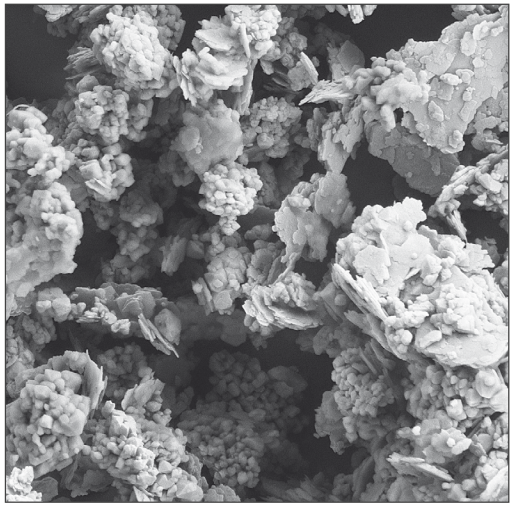


A natural combination of corpuscular Neuburg silica and lamellar kaolinite: a loose mixture impossible to separate by physical methods.

The silica portion exhibits a round grain shape and consists of aggregated primary particles of about 200 nm diameter.

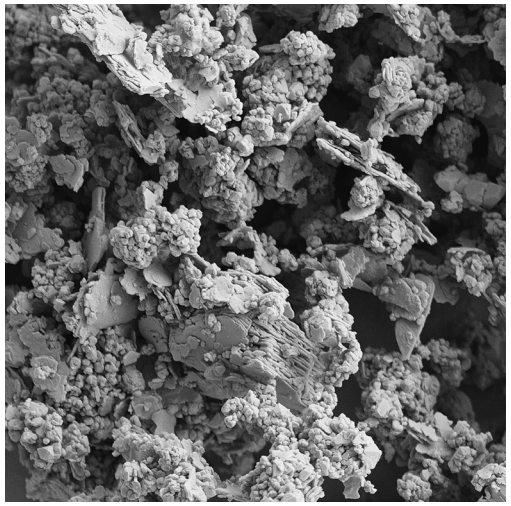
Calcined Neuburg Siliceous Earth

A downstream thermal process leads to the calcined products Silfit and Aktifit, based on SILLITIN Z 86.



Neuburg Siliceous Earth

Calcination Process



Calcined Neuburg Siliceous Earth

Additional application benefits, as well as the removing of crystal water included in the kaolinite. The silica part remains inert.

Compounding

Masterbatch	90 % PET, standard grade with IV 0.82 10 % Silfit Z 91)*)* For the synthetic silicas only a lower dosage was possible (between 5 and 8 %).
Final compound	PET, standard grade with IV 0.61 Masterbatch The dosage of masterbatch was adjusted to realize 0.05 and 0.1 % content of mineral additive in the film.
Content of mineral additve in the film	0.05 % = 500 ppm 0.1 % = 1000 ppm

Film Preparation

Compounding Cast film	Twin screw extruder ZSK 25 Extrusion at 265°C Cast film thickness approx. 150 µm
Stretching	Laboratory stretching machine Karo IV Biaxial simultaneous stretching Temperature 90°C Preheating time 50 s Stretching speed 100%/s Stretching ratio 3.5 x 3.5 Without annealing End film thickness approx. 15 µm

Coefficient of Friction COF
Film / Metal, static

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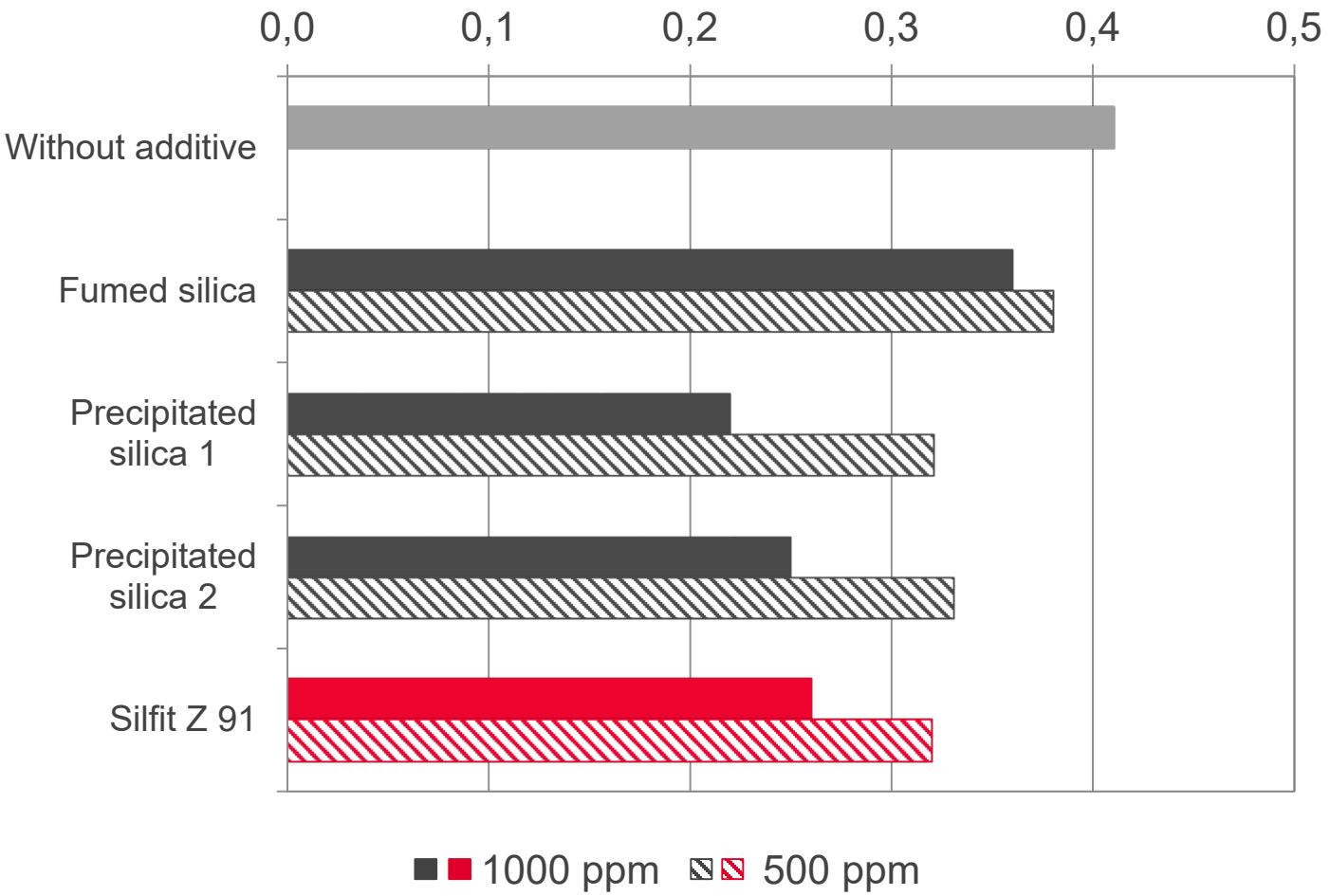
DIN EN ISO 8295, 100 mm/min



Coefficient of Friction COF
Film / Metal, dynamic

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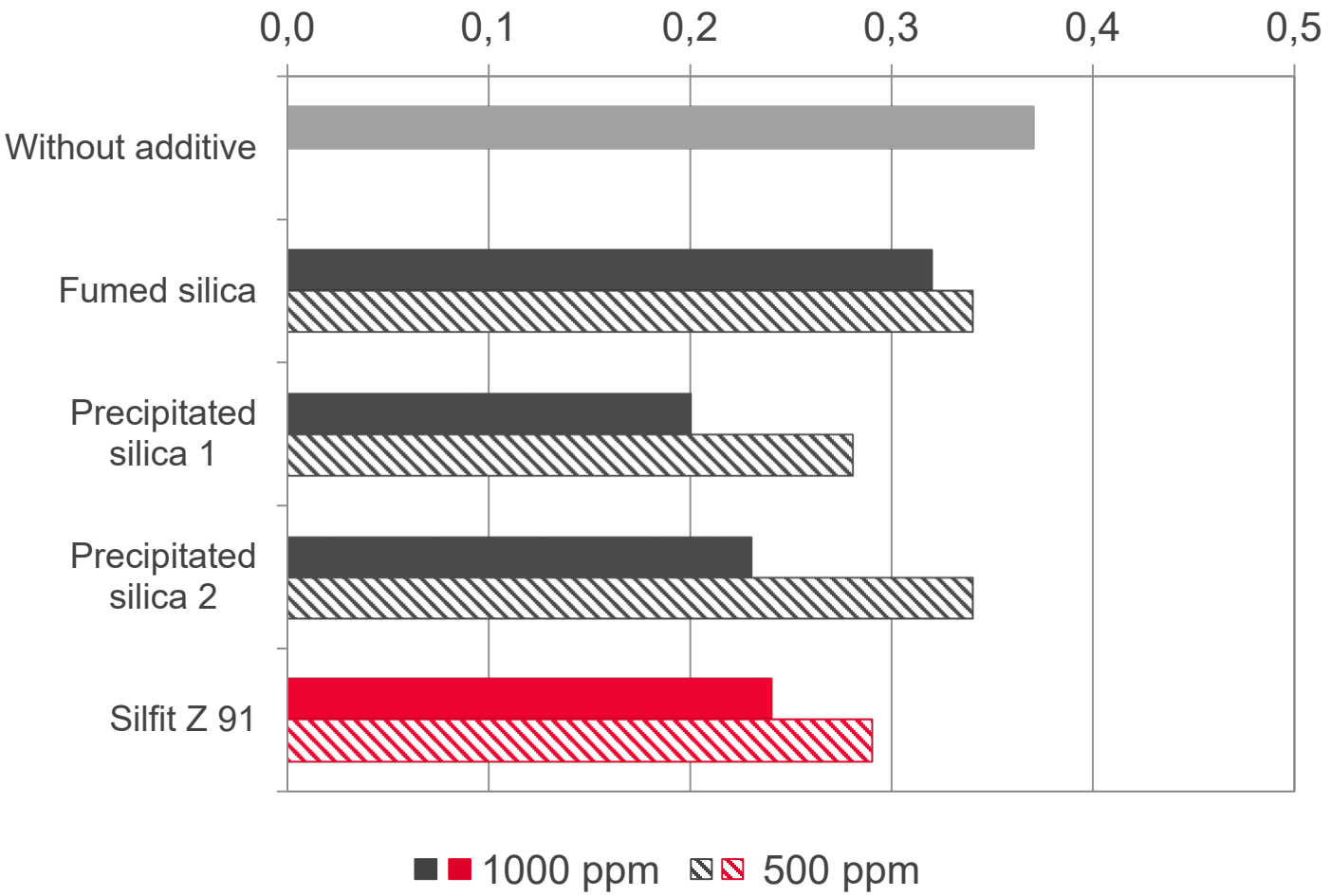
DIN EN ISO 8295, 100 mm/min



Coefficient of Friction COF
Film / Film, static

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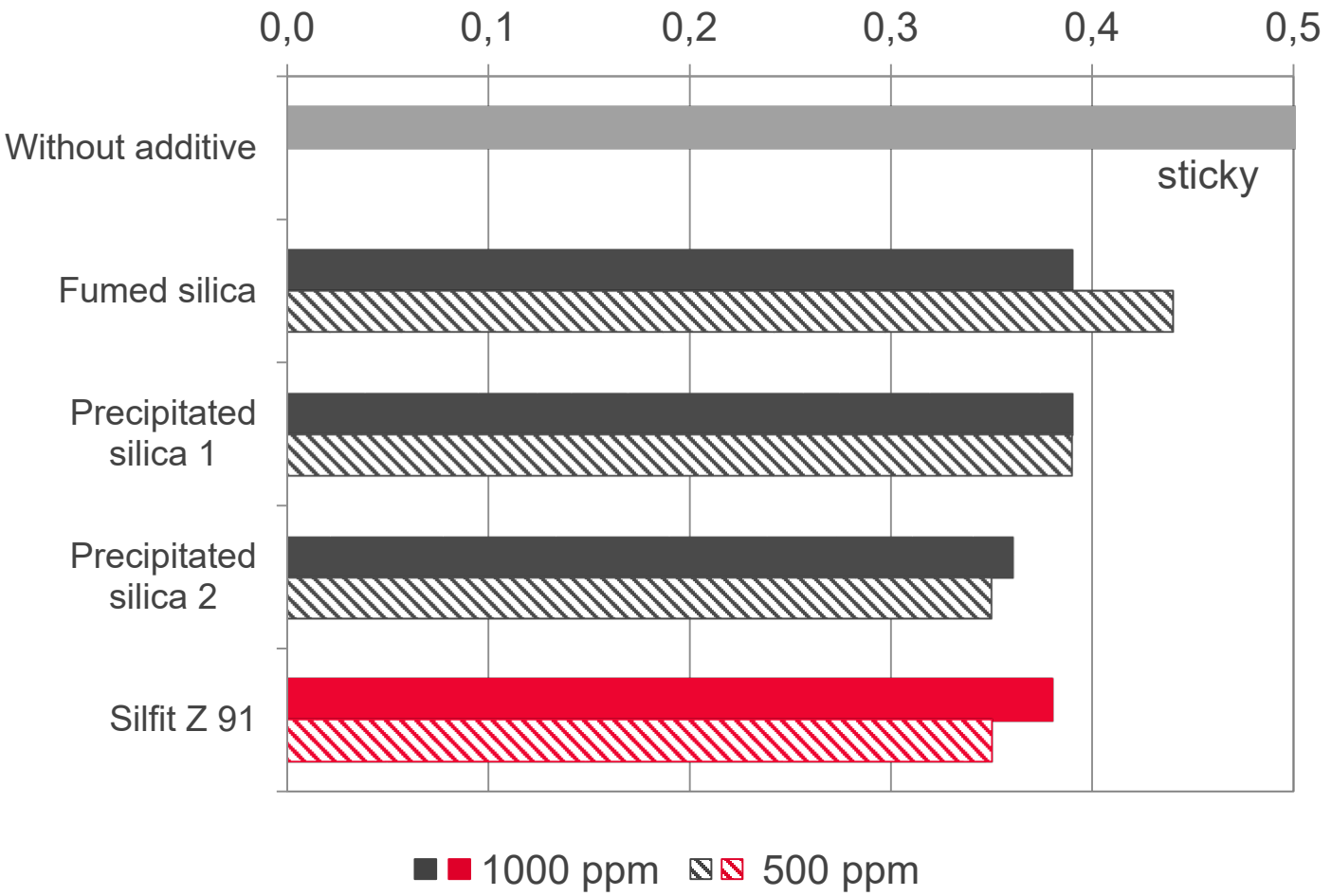
DIN EN ISO 8295, 100 mm/min



Coefficient of Friction COF
Film / Film, dynamic

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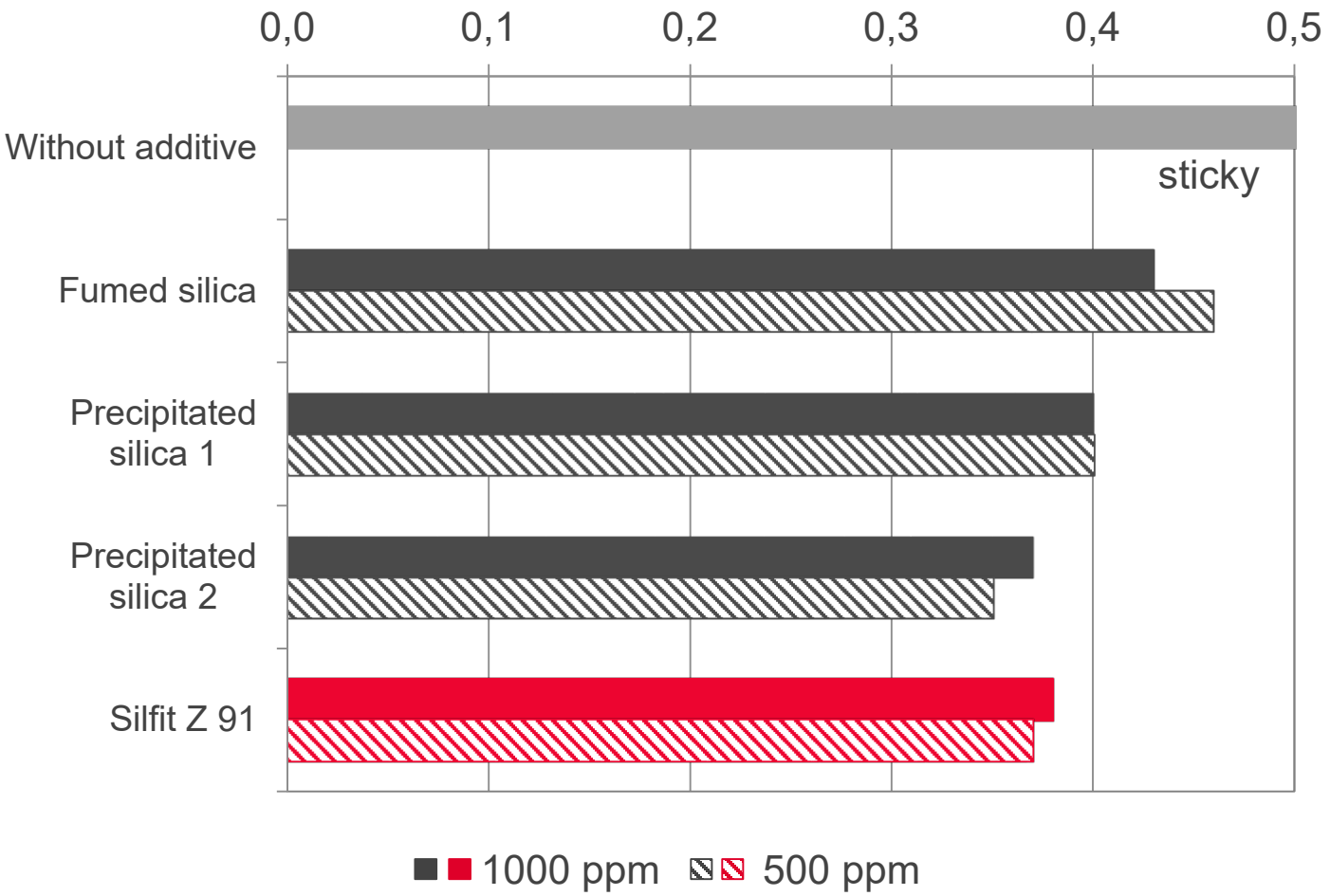
DIN EN ISO 8295, 100 mm/min



Gloss 45°

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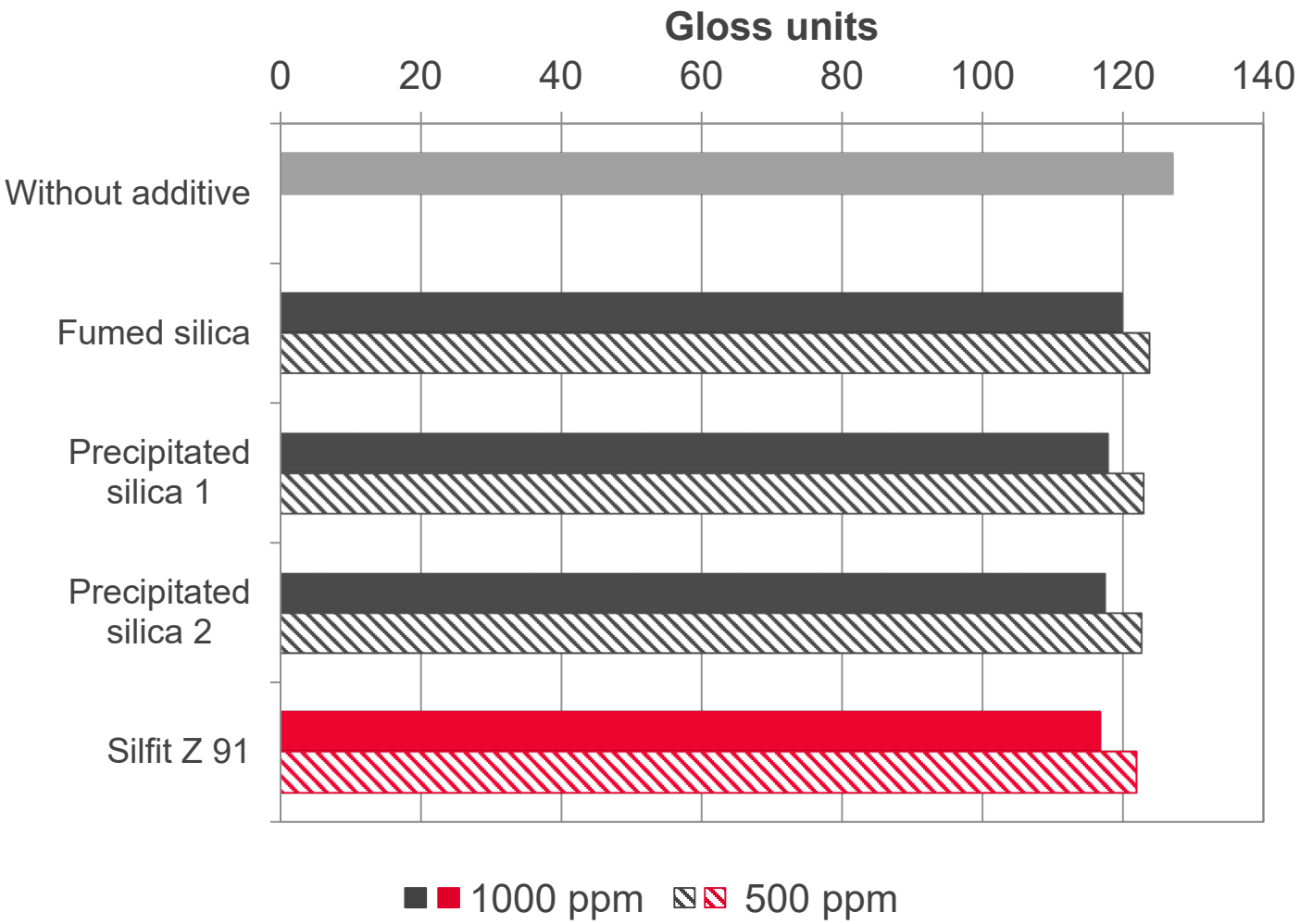
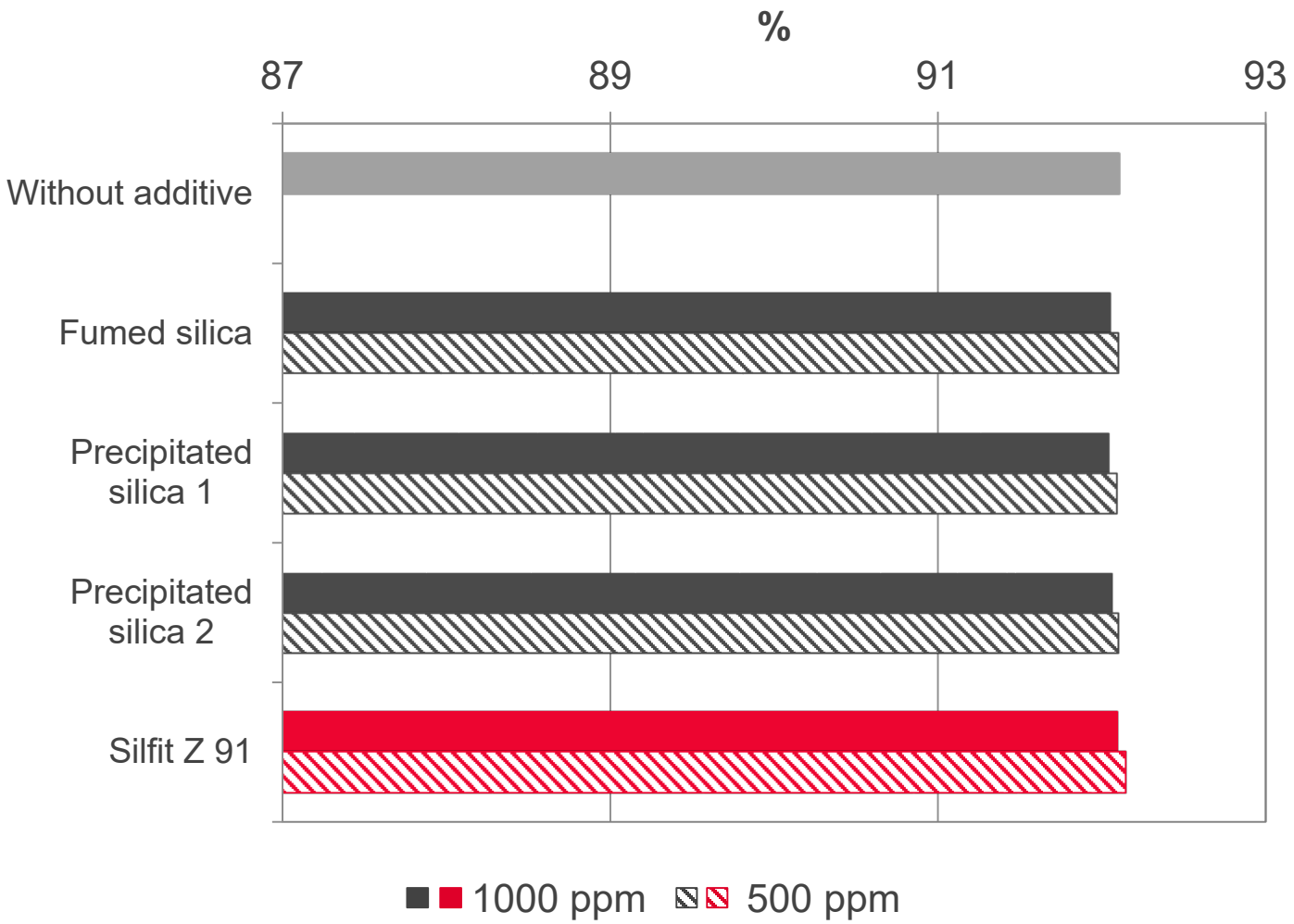
ASTM 2457



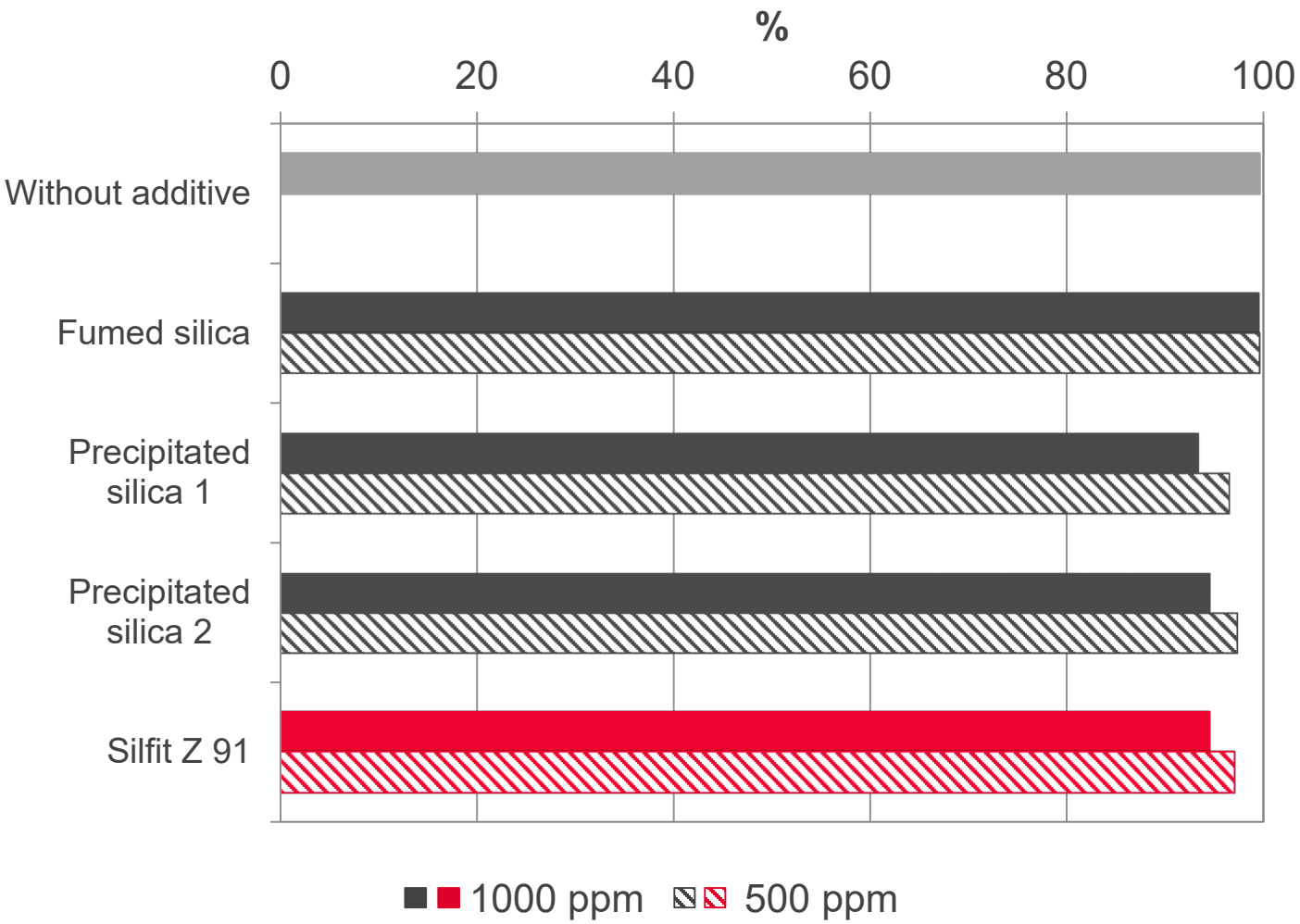
Transmittance

ASTM 1003



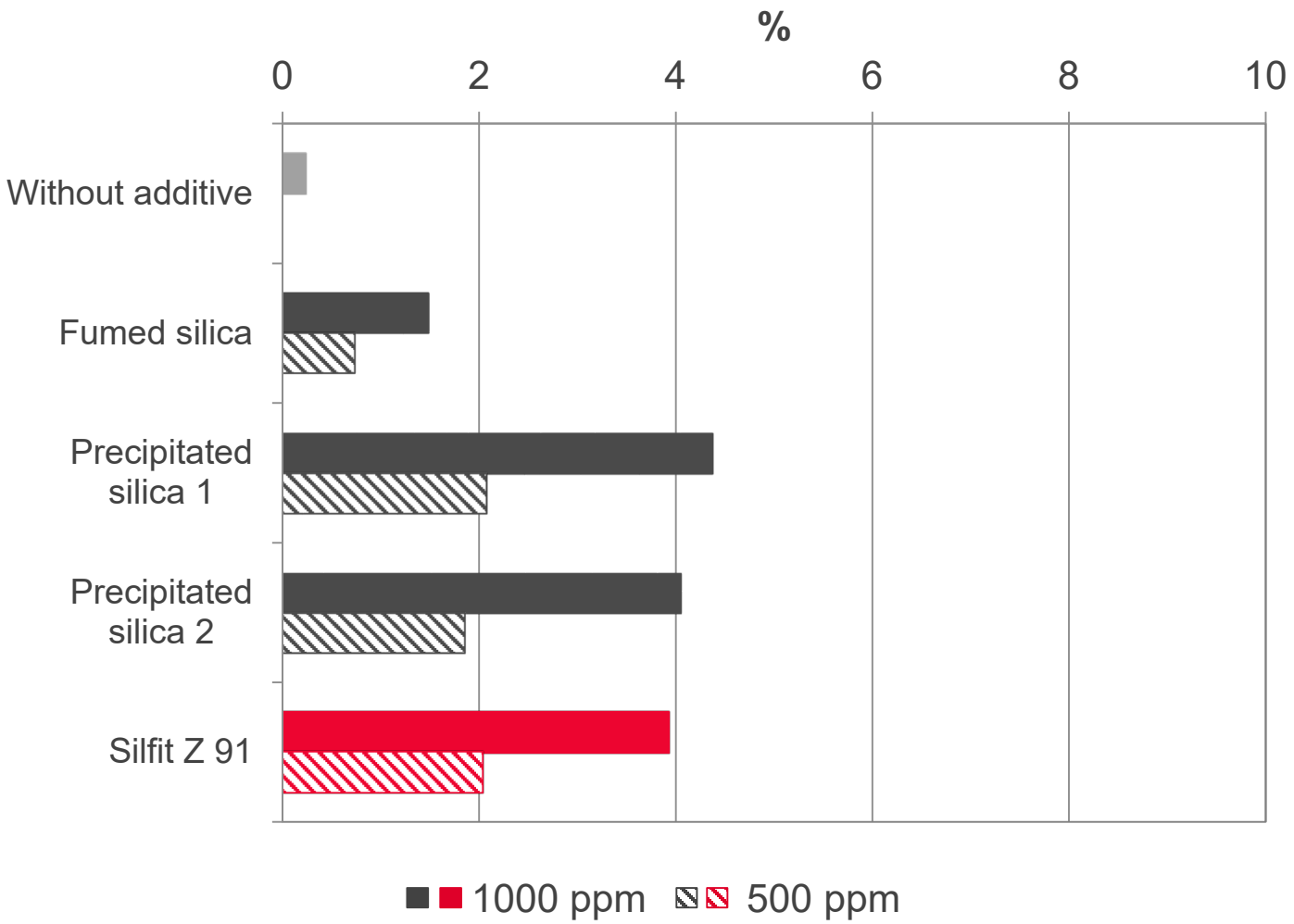
Clarity

ASTM 1003



Haze

ASTM 1003



Summary

Compared to anti-blocking agents based on synthetic silica, Silfit Z 91 shows the following effects in PET films:

- Property profile similar to precipitated silicas: low coefficient of friction combined with good optical properties
- Easy handling:
  low dust exposure, high bulk density, easy dispersible
- Due to the low specific surface area, interactions with other additives can be nearly excluded.
- Significant cost advantage.

Conclusion

Silfit Z 91 is well suited as a cost-effective anti-blocking agent for PET films.

In summary, Silfit Z 91 offers even in low dosage a good anti-blocking efficiency combined with only little affecting the optical properties.

Supplement:

Aktifit VM, a Calcined Neuburg Siliceous Earth grade surface treated with a special vinyl functional group, is expected to achieve the same properties in the film. An additional advantage of Aktifit VM, however, is the very low moisture content of the filler without moisture absorption in humid climatic conditions.

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