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MICRONISED SODIUM SULFATE FOR PAPER, BOARD & POLYMER–PAPER COMPOSITE APPLICATIONS

(D100 < 30 µm – Functional & Cost-Optimising Filler)

1. Introduction

Micronised Sodium Sulfate is an inorganic, chemically inert filler increasingly used in **polymer-coated paper, barrier-coated paperboard, and polymer–paper composite sheets** where controlled optical properties, surface quality, and cost efficiency are required.

Unlike conventional mineral fillers such as calcium carbonate or talc, Sodium Sulfate offers a **closer refractive index match with polyolefin-based coatings**, reduced abrasiveness, and excellent compatibility with extrusion and coating processes when supplied in a **properly micronised form**.

For paper and board applications, **particle-size control is critical**. Commercially successful applications typically require **D100 < 30 µm**, with a narrow distribution to avoid coating defects, pinholes, and surface roughness.

2. Role of Micronised Sodium Sulfate in Paper & Board Systems

Micronised Sodium Sulfate functions primarily as a **functional filler and extender** in polymer layers rather than as a barrier material itself. Its role is to **optimize formulation performance, processing stability, and cost**, while maintaining acceptable optical and mechanical properties.

Key functional characteristics:

- Chemically neutral and non-reactive
- Low abrasiveness compared to carbonate fillers
- Good dispersion in polyolefin and copolymer systems
- Stable at typical polymer coating temperatures

3. Application-Specific Uses

3.1 Polymer-Coated Paper

(PE, LDPE, LLDPE, PP, EVA, EAA coatings)

Commercial functions

- Functional filler in polymer coating layer
- Reduction of polymer consumption per m^2
- Control of surface gloss and smoothness

- Improved anti-blocking behaviour in stacked rolls

Why Sodium Sulfate is selected

- Refractive index close to polyolefins → minimal haze increase
- Does not significantly whiten or dull coated paper
- Fine particle size prevents coating streaks and die build-up
- Suitable for extrusion coating and dispersion coating systems

Typical end products

- Packaging base paper
- Release paper
- Industrial wrapping paper
- Laminated technical papers

3.2 Barrier-Coated Paperboard

(Multilayer PE / PP / EVOH / acrylic barrier systems)

Commercial functions

- Extender in non-critical barrier layers
- Rheology modifier for uniform coat weight
- Reduction of pinholes and coating defects
- Improved dimensional stability at high line speeds

Advantages in barrier board systems

- Enables lower polymer loading without compromising coat integrity
- Maintains smooth surface for downstream printing
- Compatible with curtain coating and extrusion coating
- Does not interfere with oxygen or moisture barrier polymers when properly dispersed

Typical applications

- Liquid packaging board (outer layers)
- Dry food cartons

- Cupstock board (non-food-contact layers)
- Frozen food packaging board

Note: Micronised Sodium Sulfate is not a barrier material; it is used to optimize polymer barrier layers.

3.3 Polymer–Paper Composite Sheets

(Paper laminated or compounded with thermoplastics)

Commercial functions

- Functional filler in polymer matrix of composite
- Improvement of stiffness and dimensional stability
- Cost optimization in polymer-rich laminates
- Surface appearance control (reduced sink marks and flow lines)

Why used instead of $CaCO_3$ in some composites

- Lower abrasiveness → reduced equipment wear
- Better optical compatibility with PP and PE
- Lower interaction risk with paper sizing chemicals
- Suitable where opacity increase is not desired

Typical end products

- Decorative laminated boards
- Furniture backing sheets
- Interior building panels
- Industrial paper–plastic composite sheets

4. Importance of Micronisation (D100 < 30 µm)

For paper and board applications, **coarse Sodium Sulfate is not acceptable**. Oversized particles lead to:

- Coating streaks and surface defects
- Pinholes in barrier layers

- Poor dispersion and agglomeration
- Increased wear on coating equipment

A **D100 < 30 µm**, preferably with a tight distribution, ensures:

- Uniform coating appearance
- Stable extrusion and coating flow
- Reduced defect rates at industrial line speeds

5. Standard Specification – Micronised Sodium Sulfate

(Paper, Board & Composite Grade)

Chemical & Physical Properties

Parameter	**Typical Specification**
Chemical name	Sodium Sulfate
CAS No.	7757-82-6
Appearance	White, free-flowing powder
Chemical purity	≥ 99.0 %
Moisture content	≤ 0.5 %
pH (5% aqueous)	6.5 – 8.5
Bulk density	0.9 – 1.2 g/cm^3 (typical)
Oil absorption	Low

Particle Size Distribution (Critical)

Parameter	**Specification**
D10	≤ 5 µm
D50	8 – 15 µm
D90	≤ 25 µm
D100	**< 30 µm**

(Laser diffraction, dry or wet method)

6. Processing & Handling Notes

- Suitable for **extrusion coating**, **curtain coating**, and **compound-based lamination**
- Recommended to pre-dry if moisture-sensitive polymers are used
- Compatible with PE, PP, EVA, EAA, EMA, and similar systems
- Proper dispersion is essential to achieve consistent surface quality

7. Regulatory & Compliance Considerations

- Sodium Sulfate is listed for **indirect food-contact applications** under FDA and EU regulations
- For food-contact packaging, material must originate from an **approved manufacturing source** and comply with:
    - FDA CFR 21 (indirect food contact)
    - EU Regulation 1935/2004
    - EU Regulation 10/2011 (where applicable)
- Industrial-grade material may be used for **non-food-contact layers** only

8. Summary

Micronised Sodium Sulfate with **D100 < 30 µm** is a proven, commercially viable filler for **polymer-coated paper, barrier-coated paperboard, and polymer–paper composite sheets**. When properly micronised and formulated, it delivers a balance of **performance, process stability, and cost efficiency**, while minimizing optical and surface-quality trade-offs common with traditional mineral fillers.

COMPARISON OF FUNCTIONAL FILLERS FOR PAPER, BOARD & POLYMER–PAPER COMPOSITE APPLICATIONS

Parameter	Micronised Sodium Sulfate	Calcium Carbonate ($CaCO_3$)	Talc	Barium Sulfate ($BaSO_4$)
Chemical nature	Neutral inorganic salt	Alkaline carbonate	Magnesium silicate	Heavy inorganic sulfate
Typical particle size used	D100 < 30 µm	D97–D99 < 30 µm	D95–D99 < 20–30 µm	D97 < 10–30 µm
Density (g/cm^3)	~2.6	~2.7	~2.7–2.8	~4.5
Refractive index	~1.47	~1.59	~1.59	~1.64
Optical effect in PE/PP	Low haze increase	High whitening / opacity	Moderate whitening	Strong whitening
Abrasiveness	Low	Medium	Medium	High
Effect on coating equipment	Minimal wear	Moderate die/roll wear	Moderate wear	High wear
Dispersion in polyolefins	Good	Moderate	Good (platelet alignment)	Moderate
Effect on surface smoothness	Smooth, uniform	Can increase roughness	Can improve slip	Smooth but heavy
Barrier layer compatibility	Good (non-reactive)	Can interact with acids	Generally compatible	Compatible
Moisture sensitivity	Water-soluble	Insoluble	Insoluble	Insoluble

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Primary functional role	Functional filler / extender	Opacity & stiffness	Slip, barrier tuning	Density & opacity
Cost impact	Moderate cost reduction	High cost reduction	Moderate	High cost
Suitability for food-contact layers*	Yes (approved source)	Yes (approved grades)	Yes (approved grades)	Yes (approved grades)
Typical loading levels	Low–medium	Medium–high	Low–medium	Low

* Subject to regulatory compliance and approved manufacturing source.

When Micronised Sodium Sulfate is Preferred

- Optical neutrality is important (semi-transparent or low-haze coatings)
- Abrasiveness must be minimized
- Polymer-coated paper appearance must remain smooth
- Barrier coatings need uniformity without opacity increase
- Cost reduction is needed **without sacrificing surface quality**

Key Differentiation Summary

Micronised Sodium Sulfate occupies a **unique middle position**:

- Less abrasive than $CaCO_3$ and $BaSO_4$
- More optically compatible with polyolefins
- Lower whitening effect than traditional mineral fillers
- Ideal for **polymer-coated paper and composite structures**, not bulk paper loading

This makes it particularly suitable for **polymer-rich paper, board, and composite systems** where surface quality, coating stability, and cost balance are critical.