

Synthetic Amorphous Silica (SAS) in Tyre Manufacturing: Essentiality, Safety, Performance and Sustainability

Executive Summary

Synthetic Amorphous Silica (SAS) is an essential functional material for the tyre industry, enabling the production of high-performing and sustainable tyres. SAS has a long-established history of safe use in tyres and supports sustainability efforts through the entire tyre lifespan. Its unique reinforcing properties enhance tyre durability, reduce rolling resistance, and improve wet grip, contributing to improved fuel efficiency, extended electric vehicle range, and reduced greenhouse gas emissions. These benefits are consistent with the objectives of the European Green Deal and the EU ambition to reduce transport-related greenhouse gas emissions by 90% by 2050.

This document outlines the technical benefits, safety considerations, sustainability aspects, and economic importance of SAS in tyre manufacturing, demonstrating its indispensable role in advancing the tyre industry and the broader European green mobility goals.

Introduction

SAS is a versatile material in tyre compounds, contributing to the production of high-performance tyres that offer enhanced safety, durability, and energy efficiency.

The tyre industry primarily uses precipitated silica, which is one of the four main types of SAS. In Europe, precipitated silica is widely used in tyres because it reduces rolling resistance and improves wet grip. The EU tyre sector purchases and uses one-third of all EU SAS production, with a plausible range of 25–40%. For the specific subcategory of precipitated silica, tyres are the dominant outlet, accounting for more than half of demand.

The EU tyre and the SAS manufacturing industries are both considered strategic pillars of the European economy.

The global sales of Tyres Europe's 14 corporate members represent 70% of total global sales and eight out of ten world leaders in the sector are Tyres Europe members. The EU tyre manufacturing industry is a vital component of European manufacturing. According to a 2024 study by Oxford Economics, the EU tyre industry contributed approximately 13.9 billion EUR (rounded) directly to Gross Domestic Product (GDP) in 2023, with a total economic impact of around 43.9 billion EUR (rounded) when indirect and induced effects are included. The sector directly employed more than 112,000 people (rounded) in 2023 and supported approximately

390,000 additional jobs (rounded) across supply chains and related industries through indirect and induced channels.¹

The EU SAS manufacturing industry accounts for 20% of global production and the industry is a strategic pillar of the European economy, securing over 10,000 jobs and supporting a value chain worth more than €300 billion annually.²

The use of SAS in rubber tyres: chemical and physical properties

SAS is an intentionally manufactured, highly pure form of amorphous silicon dioxide (SiO₂). It has been produced and marketed for almost a century and is commercially available in four principal types: pyrogenic (also called fumed) silica; precipitated silica; silica gel; colloidal silica. The tyre industry accounts for the majority of the demand for precipitated silica in Europe.

For tyre applications, SAS is used as a reinforcing filler in elastomer compounds. Its performance derives from a combination of high specific surface area, controlled morphology, surface silanol chemistry and compatibility with silane coupling systems, which together enable strong filler–polymer interaction and effective stress transfer within the rubber matrix.

To ensure workplace safety, SAS is supplied as low dust micropearls or granulates, which minimise operators' exposure during handling and processing. Furthermore, extensive epidemiological studies confirm that SAS has a low toxicity profile.³

In the finished tyre, SAS is embedded within the cured rubber matrix, where it performs a structural reinforcement function and remains chemically and physically integrated into the material system during intended use.

Benefits of using SAS in tyres

Tyre development is commonly described through the framework of the “Magic Triangle” which refers to the three interrelated parameters of tyre performance: rolling resistance, wet grip, and abrasion resistance. Improvements in one of these parameters have traditionally been achieved at the expense of one or both others. SAS is unique in its ability to simultaneously improve certain key parameters of the “Magic Triangle” without negatively affecting the others, thereby delivering a more favourable overall performance profile.

¹ <https://www.oxfordeconomics.com/resource/the-economic-impact-of-the-eu-tyre-manufacturing-industry/>

² Socio-economic Analysis of the Impacts of the Potential Re-Classification of Synthetic Amorphous Silica (SAS) as STOT RE 1, 2023 (https://www.asasp.eu/wp-content/uploads/2024/07/SAS_CLP_SEA.pdf)

³ Evangelia E. Antoniou et al., Nine human epidemiological studies on synthetic amorphous silica and respiratory health. Toxicology Letters, 2024 (<https://doi.org/10.1016/j.toxlet.2023.08.005>)

- **Fuel efficiency and electric vehicle range extension:** Rolling resistance is a significant contributor to overall vehicle energy consumption. By lowering hysteresis losses in the tread compound, silica-based systems can reduce fuel consumption in internal combustion engine vehicles and improve the operating range of battery electric vehicles. The magnitude of the benefit depends on vehicle type, driving conditions and tyre design, but the direction of effect is well established: lower rolling resistance improves use-phase efficiency.
- **Wet grip and braking safety:** The integration of SAS into modern tyre compounds can improve traction on wet surfaces by supporting favourable viscoelastic behaviour at the tyre–road interface. This contributes to shorter braking distances and better handling stability under wet conditions, which is a core safety parameter in tyre design and a key counterbalance to efforts aimed solely at reducing rolling resistance.
- **Durability and wear performance:** As a reinforcing filler, SAS contributes to the mechanical robustness of the rubber matrix and supports tread wear performance under demanding service conditions. This is important not only for product longevity, but also for maintaining a balanced performance profile over the lifetime of the tyre.

The sustainability relevance of SAS in tyres is linked primarily to use-phase performance. Major tyre manufacturers and industry research report that SAS-containing tyres contribute to global climate goals by reducing CO₂ emissions by up to 8%. Furthermore, increased abrasion resistance extends the lifespan of the tyre, lowers replacement frequency, and reduces the emission of tyre wear microparticles, thereby supporting broader sustainability objectives. Additionally, ongoing research aims to recover SAS from end-of-life tyres to further minimise waste.

Impact of recent EU regulatory developments

Hazard-based classifications can trigger downstream consequences in product legislation that go beyond workplace risk-management considerations.

For the tyre industry, the Ecodesign for Sustainable Products Regulation (ESPR) will introduce product requirements, including specific provisions on ‘Substances of Concern’ (SoC).

Currently, SAS is proposed for a harmonised classification as Specific Target Organ Toxicity - Repeated Exposure, Category 1, with the respiratory tract as target organ (STOT RE 1). As such, if the proposal moves forward, SAS will automatically be designated as SoC under the ESPR. Downstream impacts will include information disclosure obligations and possible implications for product design. In this context, a potential classification of SAS would have significance extending well beyond occupational handling scenarios.

While the classification would not constitute a restriction on use, this will increase the pressure to phase out SAS at the design stage, not merely to manage exposure.

For the tyre industry, the principal regulatory risk would not arise from demonstrated exposure during use, but from the way in which hazard classification can influence design acceptability and product-policy screening criteria. The classification could create disproportionate pressure to replace a technically important material even in the absence of a functionally equivalent alternative capable of delivering the same balance of performance, safety, and sustainability outcomes.

Conclusion

Synthetic Amorphous Silica is an important material in modern tyre design, delivering a combination of performance, safety and sustainability benefits that are difficult to achieve simultaneously. SAS has a long record of safe use in tyre applications and contributes to lower rolling resistance, improved wet grip, and maintained durability, supporting reduced fuel consumption, extended electric vehicle range and longer tyre service life. These benefits are relevant both to vehicle safety and environmental performance over the tyre life cycle, including lower use-phase emissions and more efficient use of resources.

Any regulatory measure affecting SAS should therefore be grounded in a robust evaluation and consideration of its properties, an assessment of exposure conditions within long-standing industrial uses, and an evaluation of socio-economic implications for downstream industries. Regulatory action that does not adequately account for these dimensions could generate unintended consequences for the resilience of the European industrial value chain, including for the tyre industry.

About Tyres Europe

Tyres Europe represents 14 corporate members whose global sales account for 70% of the worldwide tyre market. Collectively, these manufacturers maintain a robust presence in the European Union (EU) and candidate countries, operating over 80 production facilities and more than 20 R&D centres. In total, the tyre sector supports nearly 500,000 jobs across the EU.

About ASASP

The Association of Synthetic Amorphous Silica Producers is a sector group of the European Chemical Industry Council (Cefic) and represents the major producers of synthetic amorphous silica (SAS) in Europe. ASASP aims to provide a platform for an open and constructive dialogue throughout the value chain, between manufacturers, downstream users and key regulators at European level. ASASP works closely with leading scientists and academics to continually support research related to synthetic amorphous silica, its uses, health and safety.