

# Silica microspheres: safe alternative to talc

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Once a popular ingredient in cosmetics, talcums and baby powders, talc has come under question for its potential toxicity. Talc is a soft, smooth and natural mineral that is crushed and refined into a fine powder for use in cosmetic formulations.

Having similar properties to silica but much cheaper in cost, talc is a main ingredient in liquid and powder makeup such as blush, eyeliner, eye shadow and foundation. It provides lubrication and improves product texture and feel.

When mined from the earth, talc deposits often are located in close proximity to asbestos, a cancer-causing agent. Therefore, digging for talc too deep or near an overlapping asbestos deposit will capture this contaminant. As a result, mined talc can contain asbestos, creating a risk for cancer.

## Talc powder and ovarian cancer

Over the years, studies have indicated an observed statistical link between talc containing asbestos and ovarian cancer, but most note that additional scientific research is needed to understand this association. Despite this ambiguous scientific connection between talc, asbestos and ovarian cancer, consumer concerns and legal implications have been quite strong.<sup>1</sup>

By April 2020, thousands of lawsuits were filed against Johnson & Johnson alleging a connection between its talc products and diagnoses of cancer. That year, the company announced it would no longer sell its talc-based baby powder product in the United States or Canada, and in August 2022, Johnson & Johnson said it would remove all talc-based powder products from the global market in 2023.<sup>1</sup>

By July 2022, Johnson & Johnson was facing



nearly 38,000 cases regarding its talc products and asbestos and had paid approximately \$4 billion in legal settlements and costs. Nine months later in April 2023, as part of bankruptcy proceedings, the company offered \$8.9 billion to settle outstanding cases, but plaintiffs rejected the offer.<sup>2</sup>

Johnson & Johnson is not the only personal care products company dealing with talc litigation. Many other manufacturers, distributors, brands and retailers of talcum powder have been named in lawsuits and successfully sued.<sup>4</sup>

## Beauty brands moving away from talc

While the European Union has banned the use of talc in cosmetic products, no regulations ban talc for cosmetics in the United States. However,

MoCRA (Modernization of Cosmetics Regulation Act of 2022) requires the FDA to issue regulations for standard testing methods to detect and identify asbestos in talc-containing cosmetics by the end of 2023.<sup>3</sup>

That means another process step for manufacturers using talc ingredients and the chance of product rejection.

Beauty brands such as Revlon, Chanel and L'Oréal are quietly moving away from using talc in some product formulations as consumer disapproval elevates.<sup>4</sup> Their lead likely will prompt other smaller brands to follow suit.

The movement away from talc in cosmetic products, as well as shortage of inventory as suppliers start to close down, will escalate the need to find a replacement for talc.

## Safer than talc

Fine silica microspheres offer a safe and viable alternative to talc in the formulation of skincare and cosmetic products such as liquid and loose powders. Natural and environmentally friendly, these fine particles are composed of silicon dioxide, a sustainable material free from petroleum and plastic.

The silica microspheres are hard and do not deform, yet they are soft to the touch and their spherical shape improves rolling for better slip, feel and spreadability.

## Superior characteristics for better cosmetics

Possessing characteristics often superior to talc, fine silica microspheres are safe additives

Feeling	Sensory Comparison			
	No Additive	Talc	Fine Silica Microspheres	Fine Silica Microspheres + Camellia
Coverage	●	●●	●●●●	●●
Spreadability	●	●●	●●●●	●●
Adhesion	●	●●	●●●●	●●
Texture	●	●●	●●●●	●●
Colour	●	●●	●●●●	●●

● Average ● Good ●●●● Best

**Figure 1:** Sensory comparison study demonstrates the benefits of replacing talc with fine silica microspheres in cosmetics and skincare formulations

that enhance the properties of cosmetic and personal care products with functionality, as listed below.

- Oil, sweat and odour absorption
  - Enhanced UV protection
  - Reduced greasiness and stickiness
  - Mattifying effect to minimize pores
  - Moisturizing
  - Soft focus, blurring
- In a sensory comparison study conducted by ACT Solutions, fine silica microspheres displayed greater performance over talc in several important categories including texture and spreadability.

#### Different grades for specific formulations

To meet the needs of specific formulations, fine silica microspheres are available in various grades and particle sizes. Selection is important as each property offers a different trait. For example, a particle with higher porosity offers better light-scattering properties for a soft focus.

Table 1 illustrates grades and sizes from 3 – 20 µm, pore diameters up to 13 nm, and moisture and oil absorption capacity from 40 – 150 mL/100 g.

H-Series is a synthetic spherical silica having low cohesiveness and high fluidity with two types of oil absorption, one having over twice the absorption capacity as the first. The type with high oil absorption is very bulky and disperses easily.

H-121 offers the most functionality for O/W (oil-in-water) emulsions by reducing

**TABLE 1: FINE SILICA MICROSPHERES DISPLAY A RANGE OF CHARACTERISTICS TO MEET SPECIFIC FORMULATION NEEDS**

Sensory Comparison						
Grade		Mean Particle Size (µm)	Specific Surface Area (m <sup>2</sup> /g)	Pore Volume (mL/g)	Pore Diameter (nm)	Oil Absorption (mL/100g)
H-Series Normal Type	H-31	3	800	1	5	150
	H-51	5	600	1	5	150
	H-121	12	800	1	5	150
	H-201	20	800	1	5	150
	H-52	5	700	2	10	300
	H-122	12	700	2	10	300
	H-33	3	700	2	11	400
	H-53	5	700	2	11	400
L-Series	L-31	3	300	1	13	150
	L-51	5	300	1	13	150
NP-Series	NP-30	4	40	0.05	–	30
	NP-100	10	50	0.1	–	35
	NP-200	20	100	0.1	–	40

greasiness, sliminess and stickiness while providing a mattifying and blurring effect. For W/O (water-in-oil) emulsions, H-33 provides the best performance in reducing sliminess and greasiness while increasing absorption and SPF (sun protection factor).

Other grades also serve this emulsion,

depending on the desired properties. For instance, H-51 provides a mattifying and blurring effect while minimizing pores.

Anhydrous formulations not defined by W/O or O/W are best served by grades H-33, H-121, H-51 and H-52, which offer different properties for formulations. H-33 leaves the skin feeling

**TABLE 2: TEST FORMULATIONS DEMONSTRATE THE REPLACEMENT OF TALC WITH FINE SILICA MICROSPHERES ALONE AND COMBINED WITH STARCH.**

Liquid Highlighter ACTS 22751				
Phase	INCI Name	With Talc WT (%)	With Fine Silica Microspheres WT (%)	With Fine Silica Microspheres + Cornstarch WT (%)
A	Water	62	62	62
	Ammonium Styrene/MA Copolymer Ethanol Amide	2	2	2
B	Polysorbate 80	2	2	2
	Bismuth Oxichloride (CI 77513), Iron Oxides (CI 77492), Isododecane, Copernica Cerifera (Carnauba) Wax, Butyrospermum Parkii (Shea) Butter	12.5	12.5	12.5
C	Bismuth Oxichloride (CI 77513), Titanium Dioxide (CI 77891), Isododecane, Copernica Cerifera (Carnauba) Wax, Butyrospermum Parkii (Shea) Butter	0.5	0.5	0.5
	Mica, Titanium Dioxide (CI 77891), Iron Oxides (CI 77491)	1	1	1
	Mica, Titanium Dioxide (CI 77891), Iron Oxides (CI 77491)	1	1	1
	Synthetic Fluorophlogopite, Titanium Dioxide (CI 77891), Tin Oxide	0.75	0.75	0.75
	Mica, Lauroyl Lysine	0.5	0.5	0.5
	Synthetic Fluorophlogopite, Titanium Dioxide (CI 77891), Iron Oxide (CI 77491), Tin Oxide	0.5	0.5	0.5
	Propanediol	5	5	5
	Acrylates Copolymer	0.5	0.5	0.5
D	Caprylic/Capric Triglyceride	10	10	10
	PPG-3 Benzyl Ether Myristate	5	5	5
	Cetearyl Alcohol, ceteth-20 Phosphate, Dicapryl Phosphate	3	3	3
	Cetearyl Alcohol	1	1	1
	Glycerol Stearate, Polyglyceryl-6 Palmitate/Succinate, Cetearyl Alcohol	1	1	1
E	Talc	2	0	0
	Silica	0	2	1
	Cornstarch	0	0	1

smooth, while H-121 also provides a mattifying effect, and H-51 reduces greasiness.

If SPF boost in sunscreen and other cosmetics is desired, H-33 and H-53 silica work in both O/W and W/O emulsions across different formulations.

L series is a synthetic spherical silica having low cohesiveness and high fluidity and a lower specific surface area than the H series. This product is suitable for chemical surface modification or coating. Despite the difference in surface area, the product provides the same oil absorption capacity as the H series.

The L series offers better slipperiness and spreadability over the H series. Because of the product porosity, it has a light-scattering effect for cosmetics and is used as a matting agent for coatings. The particle size distribution is narrow, so it is able to give a single asperity to a thin coating layer.

The NP series is a non-porous, heat-treated silica particle. This series has very high hardness, so it is often used as a filler for increasing resin hardness. The high refractiveness of the NP series offers good transparency when added to resins and films.

It also is used for anti-blocking in film applications. The NP series has high heat resistance and is very dimensionally stable at various temperature ranges.

#### Formulations without talc

Cosmetic companies can add fine silica to any phase of a product formulation as the microspheres provide the same effects when combined during the aqueous or oil phase or at the very end of the process.

Just adding 1% of the silica can increase benefits while ensuring the sustainability of company operations. Multiple grades can be added to a formulation to achieve different desired goals, but it is recommended not to exceed 4% total.

ACT Solutions developed test formulations that demonstrate the effects of replacing talc with fine silica microspheres. Table 2 shows how fine silica microspheres alone and with starch are formulated as an alternative to talc in liquid highlighter to enhance blending without drying the skin.

#### Range of cosmetic and skincare applications

In addition to replacing talc in personal care product formulations, fine silica microspheres offer an excellent alternative to microplastic ingredients like Nylon 12 and PMMA (porous/nonporous) in skincare and cosmetics.

They also boost SPF of formulations because they form a thick and uniform film on the skin due to their large particle size, which enhances the dispersion of the mineral actives throughout the film. In addition, silica gels are porous, so they excel at scattering light.

As UV light passes through the film of product on the skin, the porosity of the silica gels increases the pathlength and causes it to scatter in all directions. These two factors prevent UV light from reaching the skin and promote more UV light reflection from the skin, raising the SPF of the inorganic sunscreen.

TABLE 2: FINE SILICA MICROSPHERES BOOST PERFORMANCE OBJECTIVES IN MANY TYPES OF COSMETICS AND SKIN CARE FORMULATIONS

Target	Application	
	Aim	Effect
Skincare/ Foundation	Texture improvement	Slipperiness
		Smoothness
		Transparency
		Matte effect (foundation)
	Sweat & sebum absorption	Long-lasting effect
	Anti-oily feeling	
Lipstick	Coverage of wrinkles	Soft focus
	Defined features	Stereoscopic effect
	Sweat & sebum absorption	Long-lasting effect
	Rheology control	Solidifying
Mascara	Volume up	Blinking
Sunscreen	SPF boost & sweat absorption	SPF boost
		Long lasting effect
Body Wash	Texture improvement	Smoothness
		Long lasting effect
Deodorant	Sweat absorption	Long lasting effect
		Solidifying
Cream Cleanser	Texture improvement	Slipperiness
		Smoothness
Body Scrub	Texture improvement	Exfoliation

In addition, high-absorption fine silica spheres can be used as microencapsulation shells to trap oils and other active ingredients in the silica's microporous structure to form dry, waterless powders to provide cosmetic products with long-lasting fragrance.

Fine silica microspheres have wide-ranging use in the production of different skincare and cosmetic products, including the below. Table 3 outlines properties that fine silica microspheres enhance in different product formulations.

- Tinted moisturizer
- Serum
- Makeup foundation
- Liquid blush
- Lipstick
- Mascara
- Facial cleanser
- Sunscreen
- Body wash
- Deodorant
- Dry shampoo

#### Conclusion

Fine silica microspheres are a safe, natural and environmentally friendly alternative to talc in cosmetics and skincare formulations. While talc is inexpensive and can improve the texture and feel of cosmetics, it has been linked to potential carcinogenic exposure, which has increased consumer concerns and driven costly lawsuits.

Although talc has not been banned in the US, testing regulations have been introduced, leading many beauty brands, including Revlon,

Chanel and L'Oréal, to move away from talc-based formulations.

In addition, fine silica microspheres provide benefits such as oil, sweat and odour absorption; enhanced UV protection; reduced greasiness and stickiness; and a soft-focus, blurring effect. For these reasons, silica microspheres are an ideal ingredient for a wide range of products, from makeup foundation and lipstick to sunscreen and dry shampoo. **PC**

#### References

1. Slomovitz B, de Haydu C, Taub M et al. Asbestos and ovarian cancer: examining the historical evidence. *International Journal of Gynecologic Cancer*. 2021; 31:122-128. <https://ijgc.bmj.com/content/31/1/122>
2. Forbes Advisor. Talcum Powder Lawsuit Update September 2023. <https://www.forbes.com/advisor/legal/product-liability/talcum-powder-update/>
3. *Ibid.*
4. *Ibid.*
5. King & Spalding LLP. Nearly a Century in the Making: Congress Modernizes FDA's Regulation of Cosmetics. 9 January 2023. <https://www.kslaw.com/news-and-insights/nearly-a-century-in-the-making-congress-modernizes-fdas-regulation-of-cosmetics>
6. Papadimos R. More and More Beauty Brands Are Moving Away From Using Talc in Products. *Will + Good*. June 2020. <https://www.willandgood.com/talc-in-beauty-products/>