

SilaFresh™ Additive

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Extended Fragrance Release and Malodor Removal for Personal Care Products

About ABS Materials Inc.

www.absmaterials.com

ABS Materials is headquartered in Wooster, Ohio and serves diverse markets. The company's core competency is material science innovations centered around a patented suite of organosilica materials that volumetrically change upon absorption of organics. ABS Materials manufactures SilaFresh Additive, several granular medias, and commercial products.

What is the Innovation?

SilaFresh additive is a highly elastic and porous silica that can be loaded with large amounts of fragrances. Even when loaded with fragrances SilaFresh additive can adsorb malodors. The ability to release and adsorb at the same time is due the ability of the sorbent to change in size expanding to adsorb malodors and contracting while fragrances are released. SilaFresh additive is hydrophobic and does not absorb water or water vapor. Thus, the additive is not blinded in humid conditions or in the presence of sweat. Fragrance release is extended by hindered diffusion. No triggering mechanism is needed to deliver fragrance.

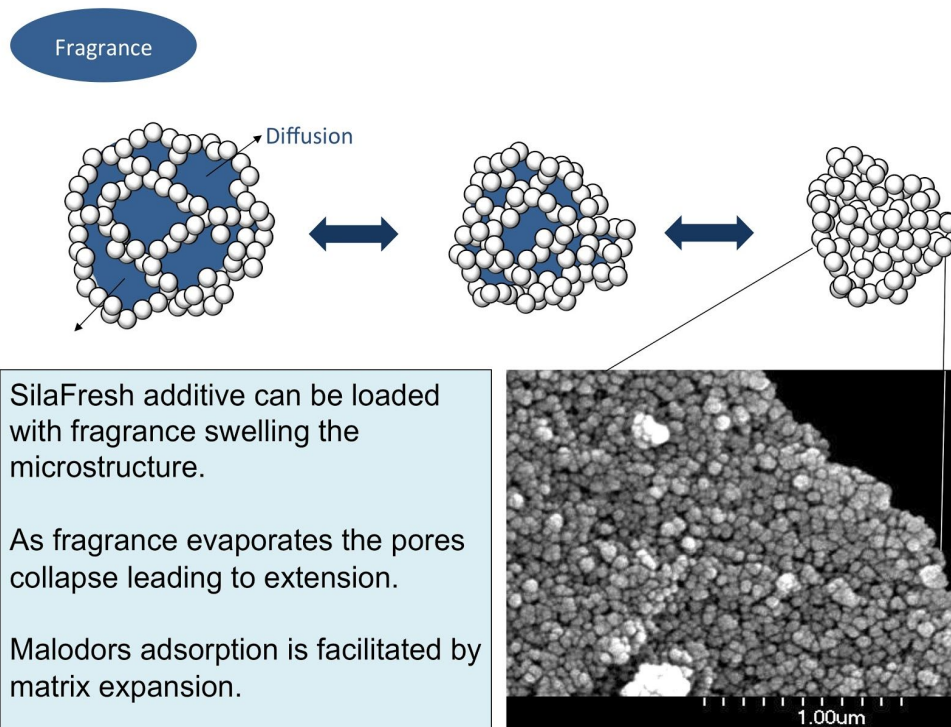


Figure 1: SilaFresh additive has expanding and contracting microcompartments to hold and deliver fragrances. Fragrance loaded media can still adsorb malodors.

Properties of SilaFresh Additive

Physical state	White porous solid
Particle size:	10-60 μm typical, or to customer specifications
Surface chemistry	Hydrophobic siloxane
Surface area	90 m^2/g
Pore volume	0.65 (mL/g) dry state
Density (empty):	0.2 g/mL (dry); \sim 1.0 g/mL (loaded)
Pore Size	<90% under 6 nm (when dry)
Swell capacity	5.5 mL/g (organic liquids)
Thermal Stability:	>250°C
INCI name:	Dimethicone/Phenyl Silsesquioxane/Phenyl Bis-Silsesquioxane Crosspolymer
CAS#:	1914981-02-4
Staining:	None
Shelf life:	>5 years
Fragrance Capacity:	70% fragrance by total mass when fully loaded

Malodor Adsorption Data

Static headspace gas chromatography mass spectrometry has been used to assess the removal of malodor vapors in sealed containers. Malodors were generated from the following samples:

- Desorption from dry filter paper into headspace. (Dry condition.)
- Partitioning from aqueous solution into headspace. (Wet condition.)

Malodor components tested were: 1-hexanol, indole, and p-cresol.

Mass SilaFesh additive used: 25 mg.

Concentration: Saturated vapor conditions.

Table 1: Vapor phase removal of malodors by SilaFresh additive as measured by headspace GC-MS

Condition	Percent Removal		
	hexanol	indole	p-cresol
Dry	97.7 \pm 1.5	95.4 \pm 1.5	95.5 \pm 4.5
Wet	87.7 \pm 1.3	79.7 \pm 4.0	68.8 \pm 2.4

Table 2: Freundlich isotherm parameters

Adsorbate	Condition	1/n	K (ug/mg)	Ce range (g/L)	R ²
1-hexanol	dry	0.66	152	4 x 10 ⁻⁶ - 5 x 10 ⁻³	0.92
	wet	1.59	78	1 x 10 ⁻¹ - 6 x 10 ⁻⁵	0.91
p-cresol	dry	0.99	1370	2 x 10 ⁻³ - 3 x 10 ⁻⁵	0.85
	wet	0.89	218	1 x 10 ⁻¹ - 4 x 10 ⁻³	0.99
indole	dry	1.09	1220	4 x 10 ⁻¹ - 1 x 10 ⁻⁴	0.65
	wet	0.59	149	2 x 10 ⁻¹ - 1 x 10 ⁻³	0.73

Table 3: Amount of water and 1-hexanol adsorbed by SilaFresh additive from gas phase, T=25°C

Sorbate	Mass adsorbed at $p=p_0$ (mg/g)
1-hexanol vapor	220
Water vapor	30

Malodor Adsorption by Fragrance Loaded SilaFresh Additive

A column was packed with 100 mg of SilaFresh additive loaded with with linalool, 0.35 g linalool per g of SilaFresh additive (26% fragrance by total mass). Flow was directed through the media at 50 bed volumes per minute. The flow was initially maintained as clean ambient air for 60 min. Malodor vapors at 80% of saturated vapor pressure were introduced into the stream. Both the amount of linalool and malodor entering and leaving the column were measured by gas chromatography mass spectrometry.

Table 4: Malodor vapor removed by linalool loaded SilaFresh additive.

Malodor vapor	Percent Removal	Linalool Desorption Rate
1-hexanol	>99.9%	increased
p-cresol	>99.9%	unchanged
indole	>99.9%	unchanged

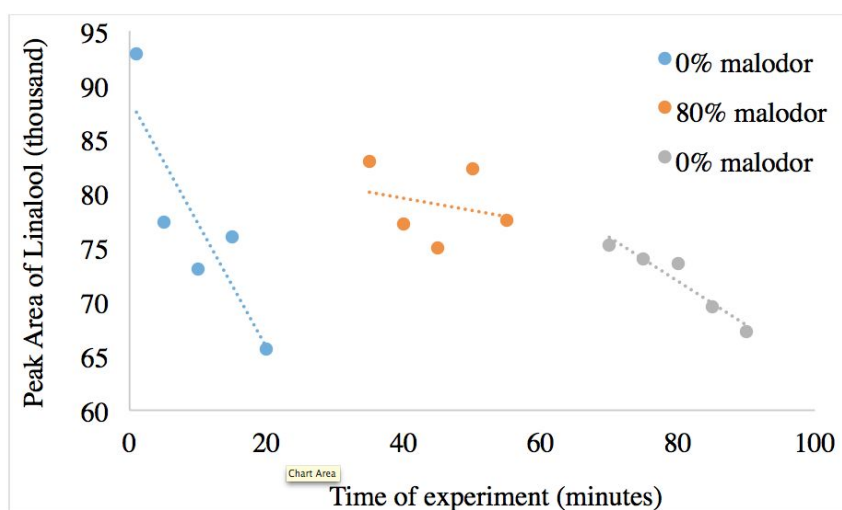


Figure 2: Linalool concentration in vapor stream before, during, and after malodor introduction.

Table 5: Amount of 1-hexanol adsorbed by linalool loaded SilaFresh additive from gas phase, $T=25^{\circ}\text{C}$

Sorbate	Mass adsorbed at $p=p_0$ (mg/g)
1-hexanol vapor	800

The amount of malodor vapor captured increases from 220 mg/g to 800 mg/g when linalool is preloaded in the SilaFresh additive at 35% w/w g linalool/g additive (26% fragrance by total mass).

Summary of Results

- Silafresh additive adsorbs malodor vapors with good capacity.
- SilaFresh additive shows good resistance to adsorbing water vapor.
- Adsorption is reversible.
- Excellent adsorption of malodors when loaded with fragrance.

Recommended Use

SilaFresh additive loaded with fragrance would be an innovative ingredient for powder and roll-on deodorants that employ fragrances. The fragrance delivery is extended and balanced by loading into SilaFresh additive. Fragrance loaded SilaFresh additive shows additional benefit of enhanced adsorption malodors without adversely affecting the fragrance delivery.

The amount of ingredient needed in the final product may vary, but will likely be less than 2% by mass. Fragrance release would extend for at least 24 hr.

Additional Information

Patent Portfolio

ABS Materials has 11 granted patents including composition of matter and applications such as personal care. Several key patents have been filed internationally including EU, Japan, China, Australia, Korea, Canada, Mexico, Brazil, India. The company also has 6 pending patents relevant to personal and home care applications. To date, there has been no limitations on field of use in personal care and home care.

Granted

7,790,830	Swellable sol-gels, methods of making, and use
8,367,793	Swellable materials and methods of use.
8,119,759	Swellable sol-gels, methods of making, and use thereof
8,217,131	Method for extracting a metal particulate from an aqueous solution...
8,563,649	Method of treating a material using a sol-gel derived composition
8,703,895	In-situ method and system for controlling the flow...
8,754,182	Sol-gel derived sorbent material containing a sorbate interactive material...
8,921,504	Method for removing ionic species contained in an aqueous phase...
14/481,077	Method for removing ionic species contained in an aqueous phase...
EP2601127	Method and system for applying force against a solid object...
14/156,326	Sorbent material and method for using the same.

Literature References

Edmiston, P.L.; Swellable, Nanoporous Organosilica for Extended and Triggered Release, Cosmetics and Toiletries: Applied Science, 754-762 (2013).

Contact Information

For additional information regarding SilaFresh additive, please contact info@absmaterials.com.