www.dow.com/en-us

GLOBAL

PERSONAL CARE

INGREDIENTS • FORMULATION • MANUFACTURE

Silicone Elastomer Blend with high natural content

Anne-Marie Vincent, Jean-Luc Garaud, Giada Tonet – Dow Silicones Belgium SRL
Fabienne Bizeray – Dow France S.A.S

Historically, Silicone Elastomer Blends (SEB) have consisted of a crosslinked silicone network swelled in a silicone carrier fluid that is valued by personal care formulators for the sensory, texture, thickening and optical benefits they provide. However, due to their 100% silicone nature, SEB may be difficult to incorporate into formulations with high levels of organic oils. While equivalent blends featuring organic carrier fluids are able to provide enhanced compatibility, this comes at the cost of affecting their sensory profile.

The new DOWSIL™ EL-TIPS Silicone Elastomer Blend technology utilises a novel crosslinking approach that maximises the level of silicone elastomer when combined with an organic carrier fluid. This new SEB features more than 70% of inherently biodegradable C13-15 Alkane, obtained from a renewable source, sugarcane, which is prepared by bio fermentation and not subject to the standards of the Roundtable on Sustainable Palm Oil (RSPO). The use of the new optimised cross-linking technology opens up new possibilities in terms of skin sensory profile, texturising performance, compatibility and product appearance. This makes this technology particularly suited to consumer formulations with high natural content.

Creating naturally derived formulations for today's consumers

The new SEB has been designed to meet consumer behaviours such as desires for home wellness, conscious consumption, self-care and sustainability. Its philosophy translates into four TIPS, Touch, Infusion, Planet and Savvy, that have been exemplified through formulated systems:

Touch delivers multiple pleasant textures, while enabling brands to offer formulations with more than 90% of natural and derived natural ingredients. Touch is a spa ritual at home, consisting of two formulations:

- A gel-to-cream dry oil for the morning to energize your body and soul (93% of natural and derived natural ingredients).
- A melting dry oil for the evening to relax and de-stress (94% natural and derived natural ingredients)

The second TIP is about creating an Infusion

FORMULATION 1: TOUCH GEL-TO-CREAM DRY OIL WITH 93% NATURAL AND DERIVED NATURAL INGREDIENTS.

Phase	Ingredients / INCI	% w/w
A	C13-15 Alkane (and) Dimethicone/Vinyl Dimethicone Crosspolymer	25.0
	C13-15 Alkane	5.0
	Coco-Caprylate/Caprate	14.0
	Prunus Armeniaca (Apricot) Kernel Oil	1.2
	Undecane (and) Tridecane	31.0
	Dicaprylyl Ether	8.0
	CI 26100	0.15
	CI 47000	0.15
B	Glycerin (and) Aqua (and) Sucrose Laurate	12.0
C	Caprylic/Capric Triglyceride (and) Laminaria Ochroleuca Extract	2.0
	Tocopherol	1.0
	Perfume	0.5

FORMULATION 2: TOUCH MELTING DRY OIL WITH 94% NATURAL AND DERIVED NATURAL INGREDIENTS.

Phase	Ingredients / INCI	% w/w
A	C13-15 Alkane (and) Dimethicone/Vinyl Dimethicone Crosspolymer	19.0
	C13-15 Alkane	10.0
	Coco-Caprylate/Caprate	14.0
	Prunus Amygdalus Dulcis (Sweet Almond) Oil	1.5
	Macadamia Ternifolia Seed Oil	1.5
	Undecane (and) Tridecane	28.0
	Dicaprylyl Ether	8.0
B	Hydrogenated Soy Polyglycerides (and) C15-23 Alkane	14.0
C	Caprylic/Capric Triglyceride (and) Laminaria Ochroleuca Extract	2.0
	Tocopherol	1.0
	Perfume	0.8
	CI 26100	0.2

AFTER ABSORPTION

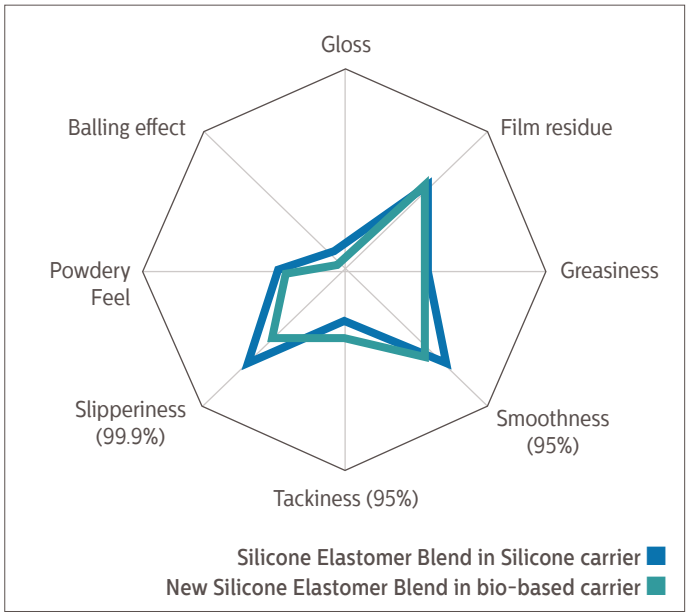

Figure 1: Sensory comparison of traditional SEB in bio-based carrier versus traditional SEB in Silicone carrier.

AFTER ABSORPTION

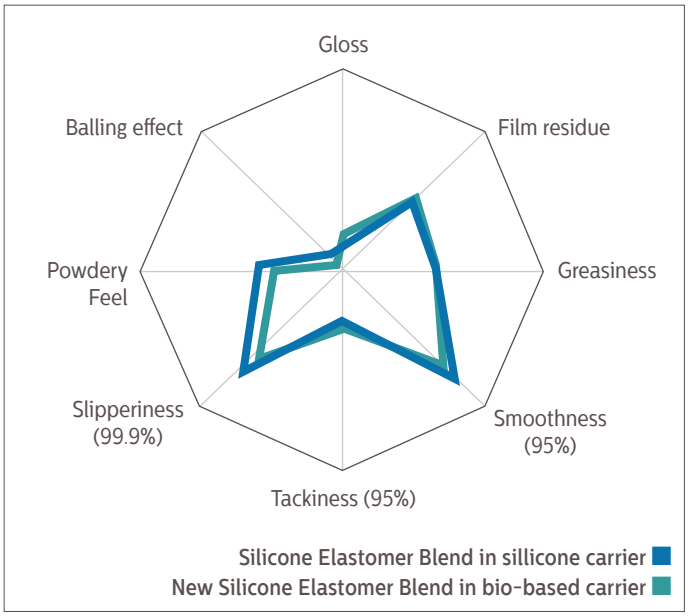

Figure 2: Sensory comparison of New SEB in bio-based carrier versus traditional SEB in Silicone carrier.

experience that stays with the consumer wherever he or she goes. Formulation infusion is a rich fragrance gel that evolves into a silky, light veil while the perfume fully wraps and fuses with the consumer's skin. This is a luxurious and pleasing application, that stays with the consumer for the entire day. Formulation Infusion is a new perfume format, offering an alcohol-free fragrance and a voluminous texture in a non-flammable formulation.

The third TIP, Planet, values people and the environment by formulating products with higher natural content that are more efficient for consumers. Today's consumers are looking to boost their immunity and skin protection by building on their skin care routines and vitamin supplements.

Formulation Planet is a cocktail of cosmetic actives and vitamins that maximises the ingredients in your facial care cream.

FORMULATION 3: INFUSION PERFUMED GEL WITH 82% NATURAL AND DERIVED NATURAL INGREDIENTS.

Phase	Ingredients / INCI	% w/w
A	C13-15 Alkane (and) Dimethicone/Vinyl Dimethicone Crosspolymer	67.4
	Perfume	16.0
	Mica (and) Titanium Dioxide (and) Iron oxides	0.1
	C13- 15 Alkane	16.5

The silicone elastomer matrix helps the delivery of cosmetic actives to the skin, increasing efficiency. This water-in-oil cream delivers a refreshing feel upon application and leaves a smooth after-feel on skin.

Savvy is about eco-consumption, focusing on the essentials and what matters the most for consumers. Formulation Savvy is created from as few ingredients as possible, with simplicity and minimalism in mind. It is a fragrance-free moisturising oil-in-water formulation that provides a smooth, light after-feel leaving the skin with a perception of suppleness.

The elastomer blend could be successfully integrated into the T.I.P.S. formulations thanks to its enhanced compatibility profile, including with renewably sourced carriers, as illustrated below (Table 1).

Silicone sensory feel

Silicone fluids such as Dimethicone are well known for their unique sensory profile. When replacing a silicone fluid with an organic fluid, the sensory performance is typically negatively impacted (Figure 1). When comparing a silicone elastomer blend in a silicone carrier to a blend using a bio-based carrier, sensory parameters such as tackiness,

FORMULATION 4: PLANET WATER-IN-OIL CREAM WITH 95% NATURAL AND DERIVED NATURAL INGREDIENTS.

Phase	Ingredients / INCI	% w/w
A	C13-15 Alkane (and) Dimethicone/Vinyl Dimethicone Crosspolymer	17.0
	C13- 15 Alkane	4.0
	Undecane (and) Tridecane	7.5
	Tri (Polyglyceryl-3/Lauryl) Hydrogenated Trilinoleate	3.0
B	Methoxyhydroxyphenyl Isopropylnitrone	0.1
	1,3-Butylene Glycol	3.0
	Propanediol	2.0
	Glycerin	5.0
C	Water	53.5
	Ascorbic Acid 2-Glucoside	2.0
	Sodium Chloride	1.0
D	Tocopherol	1.0
	Benzyl Alcohol (and) Salicylic Acid (and) Glycerin (and) Sorbic Acid	0.6
	Perfume	0.3

FORMULATION 5: SAVVY OIL-IN-WATER CREAM WITH 94% NATURAL AND DERIVED NATURAL INGREDIENTS

Phase	Ingredients / INCI	% w/w
A	Aqua	60.0
	Caesalpinia Spinosa Gum	0.5
	Propanediol	6.0
	Sorbitan Stearate (and) Sorbityl Laurate	6.0
B	C13-15 Alkane (and) Dimethicone/Vinyl Dimethicone Crosspolymer	19.0
	Coco-Caprylate/Caprate	2.5
	Shorea Stenoptera Seed Butter	5.0
C	Benzyl Alcohol (and) Glyceryl Caprylate (and) Glyceryl Undecylenate	1.0

slipperiness and smoothness are negatively impacted in the bio-based alternative. By developing a new cross-linking technology, the negatively impacted aspects of the organic carrier, especially poor tackiness and smoothness, were overcome (Figure 2). Even when used at high percentage, this new silicone technology can easily achieve greater than 90% naturality without compromising on aesthetics and performance.

Thanks to its optimised cross-linking technology and bio-based carrier selection, the new elastomer blend can provide similar sensory performance as traditional elastomer blends in dimethicone at lower use levels. Figure 3 shows the comparison in O/W formulations using either 6% SEB in C13-15 Alkane carrier or 10% traditional SEB in dimethicone. At a 40% lower use level, no difference before absorption and little difference after absorption was observed.

Superior thickening allows lower use level

Rheology modification, resulting into a specific texture, is a key benefit of SEB that is well perceived and recognised by the consumer. Thanks to its optimised structure and higher content in elastomer, the new SEB in C13-15 Alkane provides better thickening power at similar blend use levels.

The thickening and texturising properties are primarily driven by the level of cross-linked elastomer in the final formulation. When working with traditional silicone carrier-based elastomer, the ability to use derived natural ingredients in the formulation may be limited. The higher elastomer content achieved in the blend allows a lower amount of the blend to be used in the formulation, while maintaining the same thickening performance.

Product appearance

In addition to its compatibility with a broad range of cosmetic ingredients, the new SEB in C13-15 Alkane has a clearer appearance compared to traditional silicone elastomers in silicone carrier fluids. In traditional SEB, the platinum catalyst used for the cross-linking reaction can lead to a slight amber color in the final product, due to a reduction reaction. The new cross-linking chemistry forms a more efficient combination with the platinum catalyst, preventing the platinum reduction and its associated amber colour.

Optical properties

Silicone Elastomer Blends also have the ability to provide a matte finish to skin and a soft focus/optical blurring effect, which helps to mask fine lines and gives skin a smooth and even finish. The blurring effect will depend on the amount of light scattered or reflected from the interface where the cosmetic formulation is applied onto the skin. The higher the blurring effect, the stronger the imperfection-masking ability. Two key parameters are used to determine the optical benefit of a raw material in a cosmetic formulation:

- Total light transmission, translating *in vivo* into natural skin tone appearance.
- Diffused light, translating in vivo into maximum optical skin imperfections masking

To have an optimal optical benefit, the cosmetic raw material evaluated in a standard formulation chassis needs to exhibit a maximum total light transmission (TT > 93%) together with a targeted diffused light transmission (haze value) ~ or > 70.

SEB in C13-15 Alkane demonstrated the same soft focus benefit as measured by the Haze Value compared to the incumbent silicone elastomer blend delivered from a silicone carrier.

BEFORE ABSORPTION

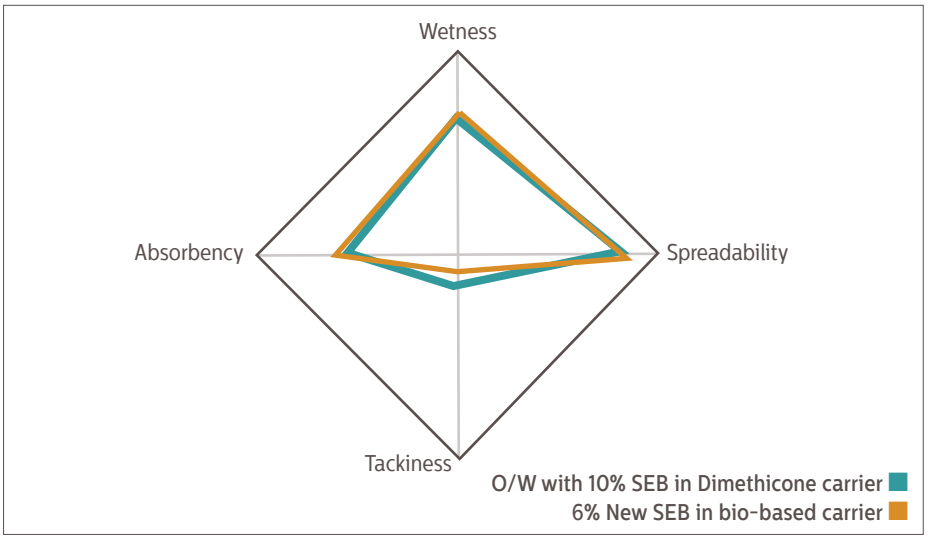

Figure 3: Sensory comparison in O/W, 6% New SEB in bio-based carrier vs 10% traditional SEB in dimethicone (before absorption).

TABLE 1: NEW SEB IN BIO-BASED CARRIER COMPATIBILITY PROFILE.

Ratio Optimized SEB: ingredient	Ratio 1:9	Ratio 5:5	Ratio 9:1
Water	NC	NC	NC
Ethanol	NC	NC	C
Hydrocarbons			
Isododecane	C	C	C
Isohexadecane	H	C	C
Mineral Oil	NC	NC	C
Silicones			
Cyclopentasiloxane	C	C	C
Dimethicone (5 cSt)	C	C	C
Dimethicone (100 cSt)	C	C	C
Caprylyl Methicone	C	C	C
Phenyltrimethicone	H	C	C
Oils			
Sunflower oil	NC	NC	H
Castor oil	NC	NC	NC
Esters			
C12-15 Alkyl benzoate	NC	NC	C
Caprylic/Capric Triglyceride	NC	NC	C
Renewable sourced carrier			
C13- 15 Alkane	C	C	C
Undecane (and) Tridecane	C	C	C
Sunscreen			
Ethyl Hexyl Salicylate	NC	NC	C

Liquid | pourable viscous liquid | Gel

C= Compatible & clear SC= Slightly compatible H= Compatible and hazy NC= Not compatible

Conclusion

DOWSIL™ EL-TIPS Silicone Elastomer Blend features a new cross-linking technology and a high level of inherently biodegradable C13-15 Alkane sourced from a renewable sugarcane carrier. With enhanced compatibility with natural ingredients, sensory performance that is close to that of 100% silicone elastomer blends, formulation texturising and optical properties potential, this unique combination opens new doors to cosmetic products with both superior feel and a high content of natural and derived natural ingredients (>90%). PC

Delivering superior sensory experience with cosmetic products having a high naturality content

Formulation advantages:

- High-solids silicone elastomer to maximize weight efficiency in formulations
- Highly compatible with organic derivatives
- Compatible with a variety of cosmetic ingredients
- Suitable for formulations with high natural content

Consumer advantages:

- Enables multiple textures and sensory experiences
- Luxurious feel for all skin types
- Rich smooth after-feel
- Blurs skin imperfections
- Moisturizing and suppleness perception of the skin
- Safe for people, safe for the planet