# Simulgreen™ 18-2: a New Green Based O/W Emulsifying Structure for Concentrated Performances

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## Abstract

Simulgreen™ 18-2 is a new, oil-in-water emulsifying structure able to concentrate performance: with environmentally-friendly structure design, versatile emulsifying power and unprecedented sensory profile, suitable for both women and men.

Manufactured using renewable ingredients of plant origin and according to a process meeting green chemistry principles, Simulgreen™'s original chemical structure is behind its new application properties (INCI name: Hydroxystearyl Alcohol and Hydroxystearyl Glucoside). Usually used at between 1 and 3% Simulgreen™ 18-2 easily emulsifies all types of oil: esters, mineral oils, silicones and vegetable oils over a broad pH range, from 3 to 10. From 3%, it spontaneously produces cream textures without having to add waxy additives, supported by the formation of an elastic network of lamellar phases in the continuous aqueous phase.

Another benefit of Simulgreen™ 18-2 is its improved resistance with respect to electrolyte-rich stress-inducing active ingredients that usually decreases viscosity and strongly affects emulsion stability with natural emulsifiers. Simulgreen™ 18-2 enables the keeping of cream textures where active ingredients are present, without using waxy additives, thus providing an interesting alternative to ethoxylated emulsifying structures (creams are for instance easily obtained with 3% of Simulgreen™ 18-2 and 4% of Magnesium Ascorbyl phosphate at pH=7.2 or 4% of Pyrolidone Carboxylate or 4% of Sodium Glycolate expressed as active substance at pH= 4.5 and 6.5).

The sensory properties of Simulgreen™ 18-2 play hide and seek: light and easy to spread, the cream is rapidly absorbed for an immediate feeling of bare skin, quickly followed by a gradually revealed softness. The lightness and rapidity of absorption in the upper layers of the skin prevents unpleasant soaping phenomena, too often encountered with natural emulsions, especially when vegetable oils are used at a high dose in combination with natural stabilising gums.

Simulgreen™ 18-2 also provides to the end-user significant, continuous moisturisation of the upper layers of the skin, up to 8 hours after application of the emulsion since the lamellar phases structure within the continuous aqueous phase plays the role of water reservoir (demonstrated by *in vivo* corneometric measurement on a panel of 20 volunteers in comparison with an untreated area).

## Introduction

### Why a New Green Based Emulsifier?

Despite the latest progresses with green based ingredients and all the formulation skills to design efficient and environmental friendly emulsions, there is still a demand for improvement.

A recent worldwide investigation presented in February 2011 by data monitor in a US congress actually showed a contrasting opinion: if more than half of the consumers (52%) think that cosmetic products formulated with natural ingredients are good for their health, only "37% of them feel that health and beauty products formulated with natural ingredients are equally effective as non-natural alternatives" [(1)]. The opinions shared in certain formulator web communities confirmed the need for improvement: for instance, an investigation made in November 2010 on a proprietary specialist website posed the question "what element should be improved in priority looking at natural or organic formulation?" This highlighted that indeed formulators are looking firstly, for better effectiveness (29% of the respondents) and a better texture (23% of the respondents globally but almost 40% in Europe). It can be assumed that there exists a relationship between these two needs because the immediate effectiveness of the formulation is often perceived by the consumer through the texture of the emulsion.

In response to the challenge, Simulgreen™ 18-2 was designed to address key performances and no longer choose between efficiency and aesthetics. A faultless 'green' design, strong and versatile emulsifying properties, an elegant sensory profile and visible benefits for the consumer form the Simulgreen™ 18-2 footprint.

## A New Structure Designed to Respect the Environment

Starting from renewable ingredients, the manufacturing process of Simulgreen™ 18-2 complies with the green chemistry principles (no use of solvents or preservatives) and guaranties its safe use and biodegradability. The original character of the molecule is brought by the diol structure on the lipophilic part (coming from ricinus seeds source – Figure 1). This diol structure actually increases the hydrophilic character and generates new application properties.

Simulgreen™ 18-2 INCI name: Hydroxystearyl Alcohol & Hydroxystearyl Glucoside

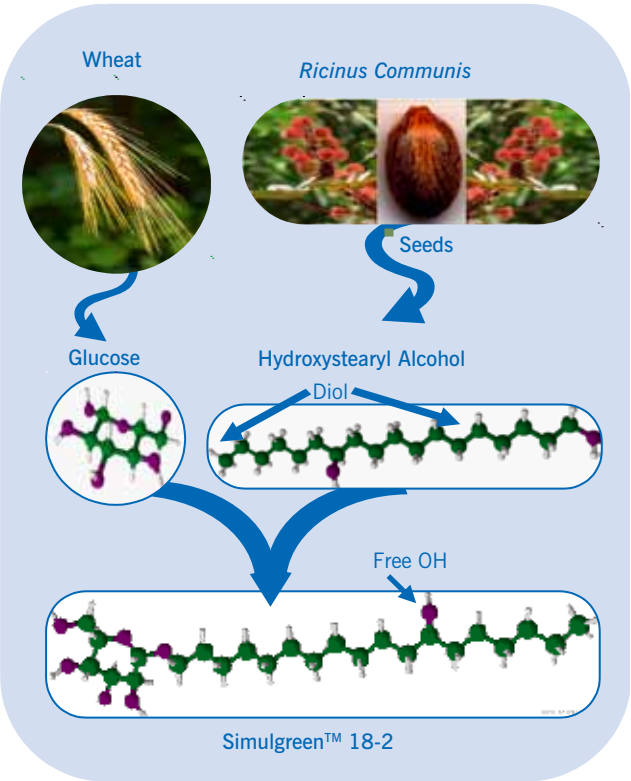


Figure 1. Simulgreen™ 18-2 Structure

## Performances to Meet Formulator Challenges

### Strong and Versatile Emulsifying Properties

Simulgreen™ 18-2 is efficient between 1 and 3% over a broad pH range (from 3 to 10) with all types of oils: esters, mineral oils, silicones and vegetable oils. Cream textures are spontaneously produced from 3% without having to add waxy additives. Figure 2 features an example of the emulsions obtained in a very simple formula, containing 3% Simulgreen™ 18-2, 20% oil and 0.5% stabilising polymer Simulgel™ SMS88 (Sodium

| | | Viscosity Brookfield LV (mPa.s) | Stability Room Temperature 45°C |
|---|---|---|---|
| Esters | Caprylic/Capric Triglyceride | ≅ 46,500 | Stable 3 Months |
| | C12-15 Alkyl Benzoate | ≅ 18,000 | |
| | Coco-Caprylate/ Caprate | ≅ 41,500 | |
| | Isononyl Isononanoate | ≅ 71,500 | |
| Mineral Oil | Paraffin Oil | ≅ 41,000 | |
| Vegetable Oils | Hazelnut Oil | ≅ 89,000 | |
| | *Prunus Amygdalus* Dulcis (Sweet Almond) Oil | ≅ 59,000 | |
| | *Helianthus Annuus* (Sunflower) Seed Oil | ≅ 77,000 | |
| | Vegetable Squalane | ≅ 48,500 | |
| Silicone Oils | Cyclopentasiloxane | ≅ 52,000 | |
| | Dimethicone | ≅ 47,500 | |

Figure 2. Emulsifying Power

Acrylate and Acryloyldimethyl Taurate/Dimethylacrylamide Crosspolymer and Isohexadecane and Polysorbate 60).

For more natural emulsions, Simulgreen™ 18-2 is effective with vegetable oils from 2%, depending on their nature and in combination with a natural stabilising polymer such as Solagum™ AX (Acacia Senegal Gum and Xanthan Gum).

The strong emulsifying properties of Simulgreen™ 18-2 are supported by the formation of an elastic structured network of lamellar phases in the continuous aqueous phase which traps oil droplets as a net. Figure 3 demonstrates by rheology oscillation

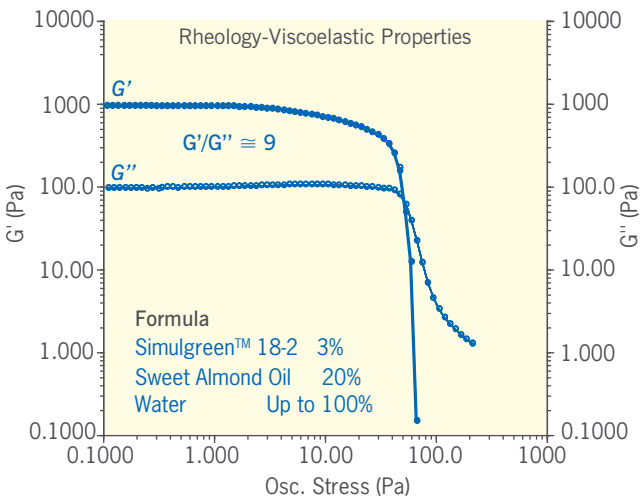


Figure 3. Elastic Network Induce by Lamellar Phase Organisation (G'≅ Elastic Character >>> G"≅ Viscous Character)

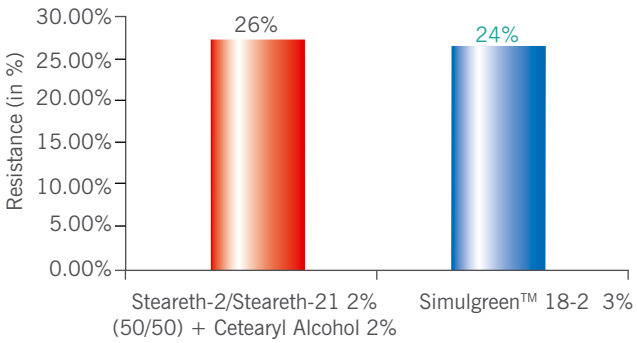


Figure 4. Compared Resistance to NaCl 2%
Viscosity resistance with stress inducing actives
Viscosity of the emulsion with active/ viscosity of the control without active x 100 (Day7)
Viscosity measured by Brookfield LV (Day 7)

experiment the High intrinsic elasticity brought by Simulgreen™ 18-2 alone (without any additive or polymer) linked with a dense organisation in the external phase of the emulsion.

### Improved Resistance to Electrolytes and Stress-Inducing Active Ingredients

Contrary to ethoxylated emulsifying structures, natural emulsifiers are generally very sensitive to electrolyte-rich active ingredients which reduce viscosity and greatly affect emulsion stability. Simulgreen™ 18-2 offers improved viscosity resistance and makes it possible to conserve cream textures without using waxy additives.

When NaCl is used as a model electrolyte, Simulgreen™ 18-2 provides a resistance similar to a benchmark ethoxylated emulsifying system combined with a fatty alcohol (See results in Figure 4 obtained with the same standard formula containing 20% of Caprylic/Capric Triglyceride, 0.1% of Xanthan gum and 1% of Sepiplus™ 400: Polyacrylate-13 and Polyisobutene and Polysorbate-20. Salt was added last in the emulsion at around 40°C as generally recommended for actives).

Figure 5 confirms the electrolyte resistance of Simulgreen™ 18-2 with various stress-inducing active ingredients formulated in an acid or neutral pH in the same standard emulsion; all these aforementioned emulsions have a cream texture.

## Benefits for a Better Consumer Satisfaction

### A Unique Sensory Profile

The sensory properties of Simulgreen™ 18-2 evaluated in a simple emulsion containing 3% Simulgreen™, 20% Coco-Caprylate/Caprate and 0.5% Solagum™ AX play hide and seek. It begins with an invisible presence (hide), extra-light contact and quick absorption leave a nude skin sensation followed by a progressively unveiled softness (seek) (see Figure 6 on page 4). This light unprecedented sensory profile is suitable for both women and men. An example of a simple formula for men's skin care is shown in Figure 7 on page 4.

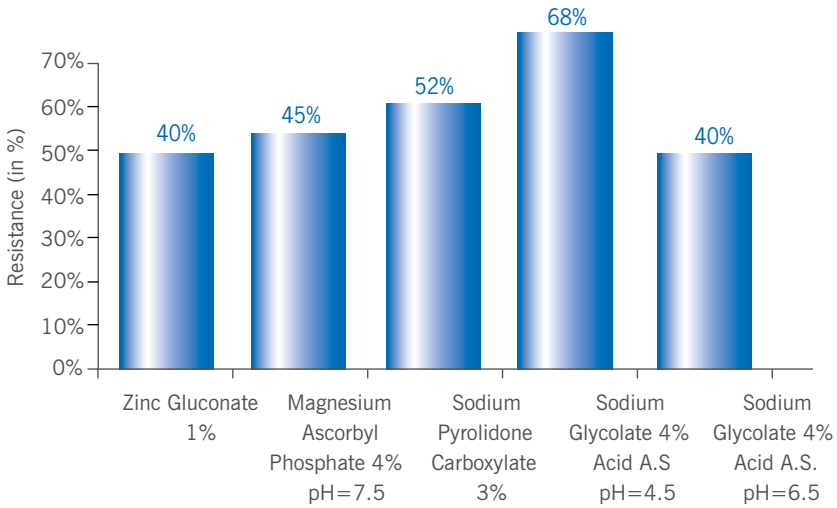


Figure 5. Resistance to Stress-inducing Active Ingredients
Viscosity resistance with stress inducing actives
Viscosity of the emulsion with active/ viscosity of the control without active x 100 (Day7)
Viscosity measured by Brookfield LV (Day 7)

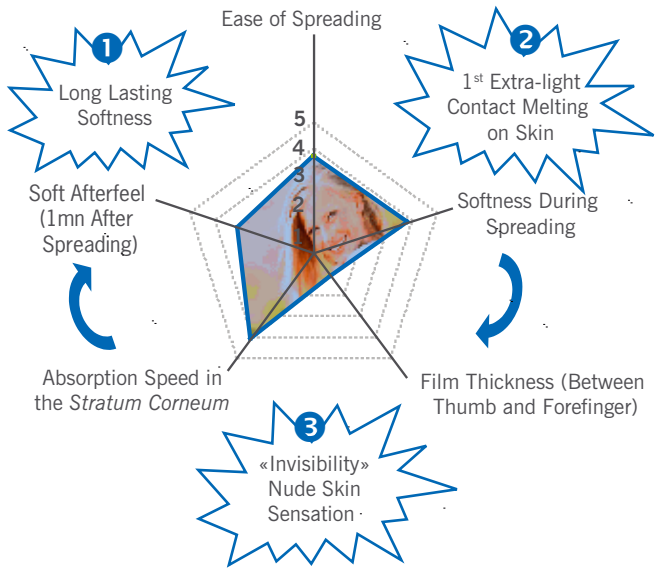


Figure 6. Simulgreen™ 18-2 Sensory Profile

| **Natural Men's Skin Care** (Ref EU07198)<br>**White Cream – pH≅ 5** | |
|---|---|
| Vegetable Squalane | 4.00% |
| *Helianthus Annus* (Sunflower) Seed Oil | 4.00% |
| Coco Caprylate/Caprate (Lanol™ 2681) | 2.00% |
| DL Alpha Tocopherol | 0.10% |
| Acacia Senegal Gum & Xanthan Gum (Solagum™ AX) | 1.00% |
| Simulgreen™ 18-2 | 3.00% |
| Aqua/Water | Up to 100% |
| Zinc Gluconate (Givobio™ GZn) | 1.00% |
| Aqua/Water | 10.00% |
| Benzyl Alcohol & Dehydroacetic Acid | 0.60% |
| Parfum/Fragrance | 0.10% |

Figure 7. Simple Illustrative Formula

## Texture Improvement of "Green" Formulas: no Soaping Effect in Natural Emulsions

Formulation of environmentally-friendly emulsions containing only natural ingredients often induce an unpleasant soaping effect during spreading, especially when containing a high dose of vegetable oils, notably combined with natural stabilising gums and fatty alcohol as consistency agents. The invisible presence of Simulgreen™ with its typical quick absorption in the upper layers of the skin prevents this whitening phenomenon.

A large laboratory study measuring the soaping effect with a standard spreading protocol leads to the definition of four behaviours according to the time for the appearance of whitening and the whitening intensity. Following these rules, Figure 8 demonstrates the effectiveness of Simulgreen™ 18-2 compared to existing emulsifiers using a standard natural emulsion designed to maximise the soaping effect (content: 4% of emulsifier, 10% of Coco-Caprylate/Caprate, 10% of Sweet Almond Oil, 0.5% of Xanthan gum and natural preservatives for a final pH adjusted to 5.5). In such a difficult case, only Simulgreen™ 18-2 fully avoids the soaping effect after 30 seconds of spreading. To keep a light texture and optimum spreading, it is recommended for replacing the usual emulsifying system (emulsifier + fatty alcohol) by Simulgreen™ 18-2.

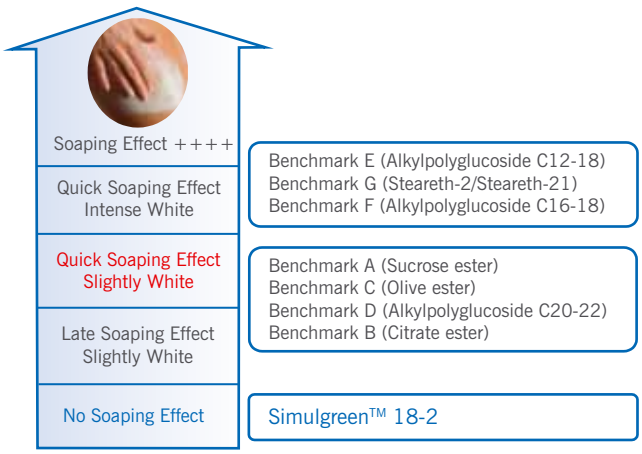


Figure 8. Compared Soaping Effect

## Effectiveness Contribution: Continuous Moisturising Properties, up to 8 Hours after Application Fully Perceived by the Users

Beyond the stabilising properties, another benefit of the lamellar phase network formed within the external aqueous phase of Simulgreen™'s emulsions is its role of the water reservoir. An *in vivo* corneometric study on a panel of 20 volunteers demonstrated the continuous moisturising effect of the upper layers of the skin provided by a very simple emulsion containing 3% Simulgreen™ 18-2, 20% Caprylic/Capric Triglyceride and 0.5% Solagum™ AX (See Figure 9 – results are expressed as increased % of moisturisation compared to the untreated area after a single application on the leg).

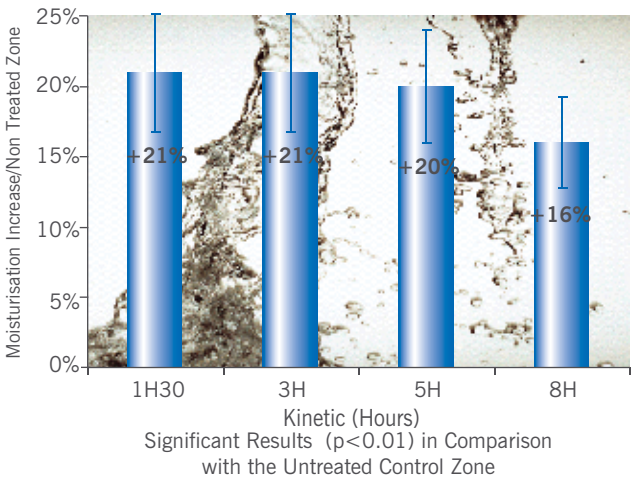


Figure 9. Moisturising Effect After a Single Application

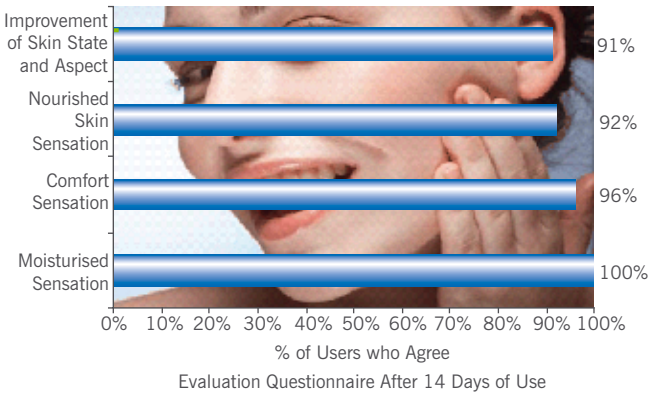


Figure 10. Users Feed-back After 14 Days of Use

Moreover, the evaluation questionnaire after fourteen days of use of this formula confirmed the product efficacy perceived by the users: all the users confirmed a moisturised sensation and more than 90% a comfort and nourished skin sensation as well as an improvement of skin state and aspect (See Figure 10).

## Conclusion

Simulgreen™ 18-2 is a new, oil-in-water emulsifier which combines both:

- Technical performances to make the formulator's everyday life easier by providing:
  - A structure designed to respect the environment
  - Versatile and powerful emulsifying properties
  - Easy formulation of natural creams without having to add fatty alcohol
  - Excellent compatibility with active ingredients
- As well as visible benefits for the consumer such as:
  - An improved texture of natural creams
  - Rapid absorption (no soaping effect)
  - An unprecedented sensory profile
  - A real contribution to the emulsion efficacy giving us the hope to renew the consumer's image of natural-based emulsions.

## References

1. Beauty Industry West meeting Data Monitor – February 8, 2011 (US)

## Authors' Biographies

Alicia Roso has worked for Seppic's R&D team since 1986. She is a chemical engineer and has worked for twenty years in the Cosmetic Application Laboratory, firstly as laboratory technician then as laboratory manager. She joined the excipient marketing team in 2006 firstly as Polymer Product Manager, then as Emulsifier and Texturising Agents Product Manager. She was named as Air Liquid International Expert for Cosmetic Formulation in 2010.

Florence Clemenceau joined Seppic in 2005. She is a chemical engineer and has worked for 16 years in the cosmetic industry, including 10 years as a laboratory manager in skin care. She is now in charge of the Emulsifiers and Texturing Agent team within the Cosmetic Application Laboratory.

Dr Jérôme Guilbot graduated from the Chemical Engineering School of Rennes. He obtained his Ph.D. in 1999 at the University of Rennes. He has been working for Seppic R&D since 2002 and is responsible for the Sugar and Protein team in the Organic Synthesis Department. He particularly develops the syntheses of new excipients or actives for the cosmetic area using APGs or Lipoaminoacid technologies. Between 2004 and 2010, he was also involved in the assessment of the ecological properties of Seppic's products.

Dr Sebastien Kerverdo received his Ph.D. in organic chemistry from Nice University in 2002 and has 8 years experience in the cosmetic industry. He is presently Sustainable Chemistry Coordinator and is in charge of implementing greener and safer manufacturing processes for vegetable-based emulsifiers and actives. He is also involved in the sourcing of new feedstock for the development of new sustainable materials for cosmetics.