



ELEVATING NATURAL OILS IN HAIR CARE REPAIR WITH **OLEOFLEX™ FG-100**

A study on leveraging the nourishing power of natural oils in hair cuticle repair and overall protection

Demand for cosmetic and toiletry products with higher natural and naturally-derived ingredient content continues to grow steadily as consumers become more environmentally conscientious. Formulators must often find a balance between using higher amounts of environmentally responsible ingredients while still maintaining important performance parameters like skin sensory, stability, long wear, and biochemistry benefits.

To meet this challenge, OleoFlex™ was developed in an effort to increase the usage of natural oils by boosting their functionality through a new type of delivery system. It is a patented hybrid material comprised of oxidatively-stable

natural oils and an advanced synthetic polymer, combined using an environmentally friendly, proprietary process without any chemical reactions.



OleoFlex™ FG-100

It structures the oils by creating a thermally reversible micro-sponge polymer network that enmeshes the oil molecules, creating a soft, cushioned viscoelastic gel.



Polymer network enmeshes natural oils, creating a film that bonds the oils to hair follicles.



When OleoFlex™ is heated above the gel-to-liquid transition temperature (40-60 °C) under normal cosmetic manufacturing conditions, this 3-D micro-sponge structure loosens up and eventually dissolves, resulting in a flowable liquid not unlike normal vegetable oil.

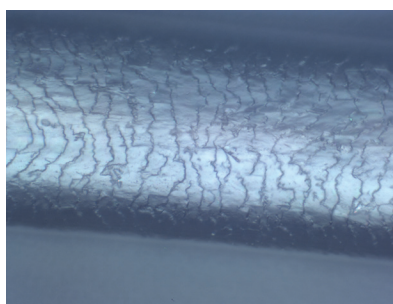
When it cools down to room temperature, it restructures back into a solid gel state, indicating that the entire process is thermo-reversible.

There are actually two types of OleoFlex™ in the marketplace today. The EG (Elastic Gel) series contains a more three-dimensional polymer structure, resulting in an elastomer-type gel.

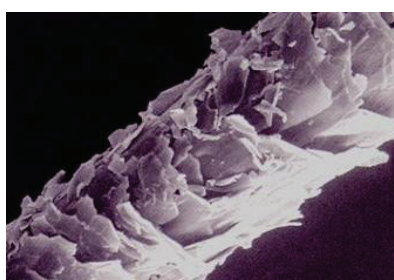
The focus of our study is on the second type, the FG (Flowing Gel), which has much more of a thickened, honey-like consistency.

Hair Repair Study Parameters

We wanted to examine the implications of using OleoFlex™ FG-100 in hair treatment products, specifically in the area of cuticle repair due to heat damage, chemical damage from harsh treatment procedures, excessive washing, and combing.



Healthy, undamaged hair with CLOSED cuticles



An extreme case of damaged hair due to physical force, with OPEN cuticles

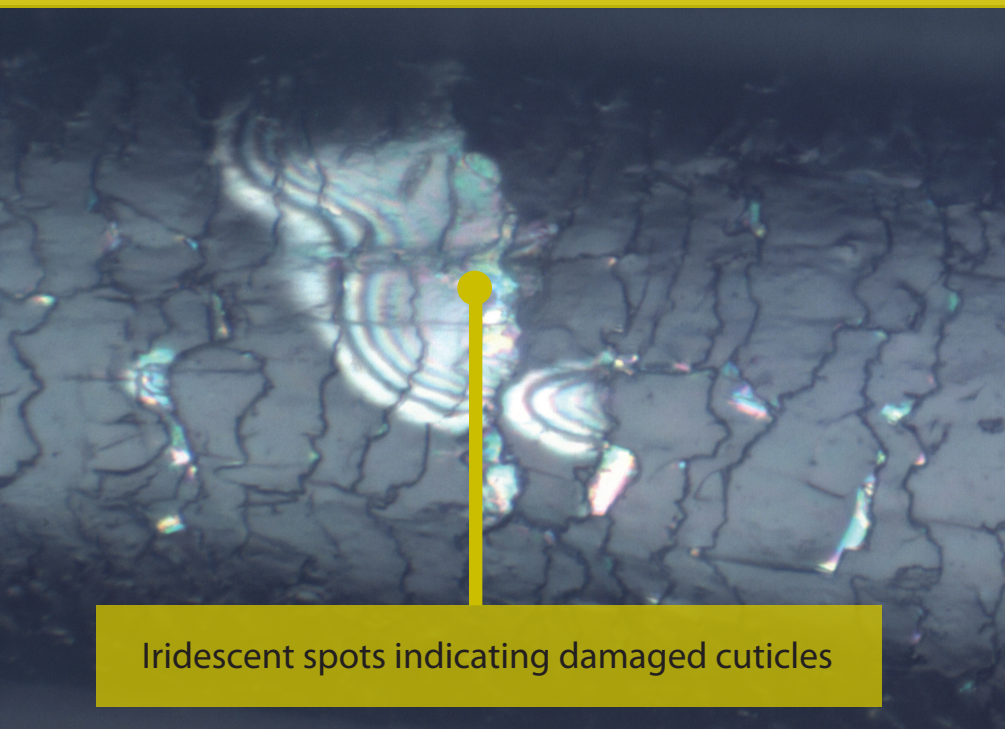
Take a look at the photos to the left. Healthy hair has cuticles that are lying flat - the cuticles are essentially sealed down with naturally-produced lipids (otherwise known as "sebum"). Damaged hair, on the other hand, exhibit frayed, open cuticles, where the natural lipids have been stripped away due to environmental damage.

When observed under an optical microscope, these damaged cuticles appear as iridescent spots. These are essentially "bubbles" that form underneath raised, damaged cuticles.

We hypothesized that OleoFlex™ FG-100 should have demonstrable benefits in formulations centered on hair repair and treatment. The hybrid polymer network is incredibly hydrophobic, so the bonding action between the natural oils and the hair follicles should be very resistant to rinse-off while extending the restorative effects of the oils themselves.

In order to validate these hair repair benefits, we correlated the reparative benefit of OleoFlex FG-100™ with two specific observations:

- Fewer lifted or damaged cuticles, as indicated by the intensity of the iridescent light spots
- The visual appearance of the hair tress



Iridescent spots indicating damaged cuticles



Frizzy hair damaged from bleaching

A Summary of the OleoFlex FG-100™ Hair Study Protocol

Hair Preparation Process:

Virgin hair tresses were cleaned by washing once with a 1% SLES solution. To simulate damage, they were immersed in a solution containing 2.3% H₂O₂ and 1.3% ammonia, and then blow dried. This process was repeated 5 times.

Damaged hair tresses were treated with either an anhydrous serum or a lotion/cream. In order to study the long term protective effects, tresses were subjected to a washing process. This involved an application of 0.4 grams of shampoo which was worked in for 20 seconds, then a rinse under warm tap for 30 seconds, and then blow dried.

Evaluation Protocol:

Hair tresses were evaluated using the following parameters:

- Gloss/Shine
- Frizz
- Texture
- Sensory

Hair tresses were observed under an optical microscope at 1250X magnification under incident light and halogen lamp. Observed the state of the hair cuticles and other surface characteristics. Iridescent color spots were highlighted by quickly immersing hair in isopropyl alcohol, then air dried. Images on multiple focal planes combined to increase the field of view.

TREATED HAIR CARE COMPARISON RESULTS

In this comparison, the damaged hair tresses were treated with a hair serum formulation, as detailed on the right.

A natural oil-based one was created as a control, while two other serums used the FG-100 and an FG-100/EG-200 combination as a replacement.

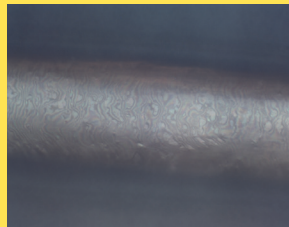
	Natural Oil	FG-100	FG-100 + EG-200	Competitor A
Isododecane	79.0%	79.0%	79.0%	-
Cyclopentasiloxane	-	-	-	79.0%
Argan Oil	7.5%	5.0%	7.5%	16.0%
Sunflower Oil	12.5%	-	-	-
OleoFlex™ EG 200	-	-	5.0%	-
OleoFlex™ FG 100	-	15%	7.5%	-
Hydrogenated Castor Oil/ Sebacic Acid Copolymer	-	-	-	4.0%
Polyglyceryl-3 Oleate	1.0%	1.0%	1.0%	1.0%

Finally, a silicone-based serum (Competitor A) was created featuring one of the top hair repair ingredients on the market today.

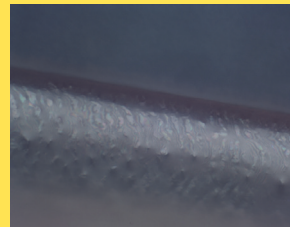
DAMAGED HAIR TRESSES, AFTER SERUM TREATMENT



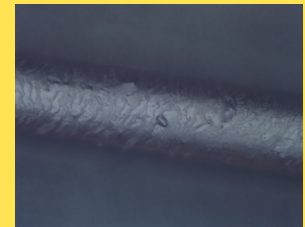
Natural Oils (Control)



OleoFlex™ FG-100

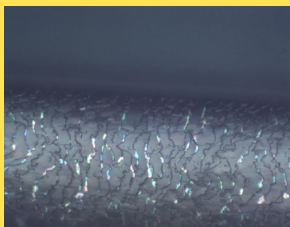


FG-100 + EG-200

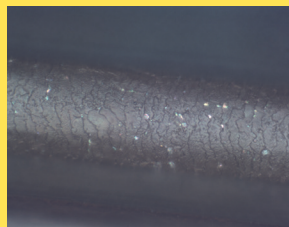


Competitor A

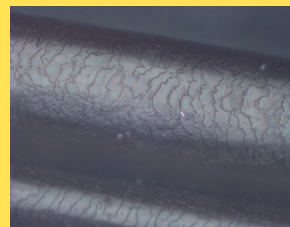
Treated with Isopropyl Alcohol to highlight raised cuticles



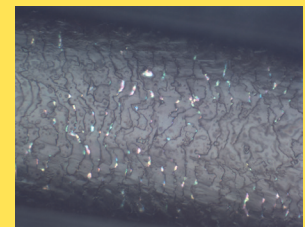
Natural Oils (Control)



OleoFlex™ FG-100



FG-100 + EG-200



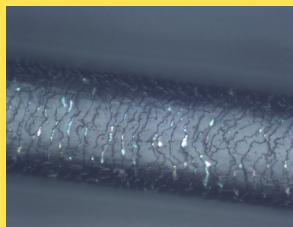
Competitor A

Based on the size and number of iridescent spots on each hair tress, we can conclude that the most restorative hair serum results came from the **FG-100 + EG-200 combination**. **The FG-100 serum and Competitor A's serum had relatively equal performance**, while the control serum remained the most damaged out of all four serums.

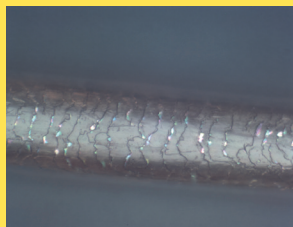
TREATED HAIR AFTER SHAMPOO WASH COMPARISON RESULTS

In this comparison, the treated hair tresses from the previous experiment were then subjected to a single shampoo wash, followed by four more shampoo washes to depict rinse-off resistance and extended nourishment over time.

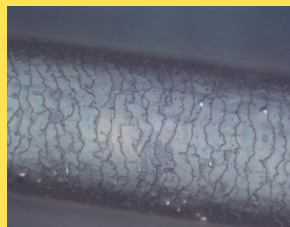
DAMAGED HAIR TRESSES, AFTER 1 WASH



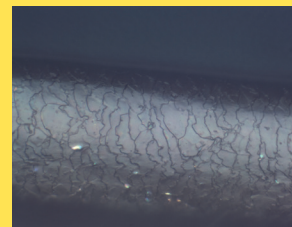
Natural Oils (Control)



OleoFlex™ FG-100

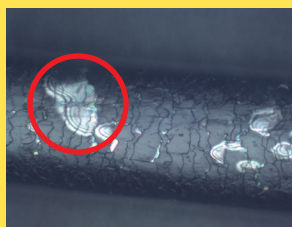


FG-100 + EG-200

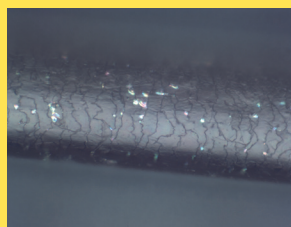


Competitor A

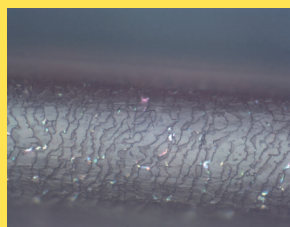
DAMAGED HAIR TRESSES, AFTER 5 WASHES



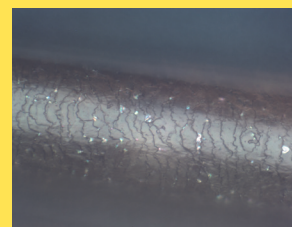
Natural Oils (Control)



OleoFlex™ FG-100



FG-100 + EG-200



Competitor A

Based on the size and number of iridescent spots on each hair tress, we can conclude that the **FG 100 + EG 200 combination and Competitor A's serum were equally restorative, followed by the FG 100 serum.** Note the high level of damage done to the control sample compared to the tresses treated by OleoFlex.

VISUAL COMPARISON OF TREATED HAIR TRESSES AFTER SHAMPOO WASH

Natural Oils (Control)

OleoFlex™ FG-100

FG-100 + EG-200

Competitor A



Post-Treatment After 1 wash



Post-Treatment After 1 wash



Post-Treatment After 1 wash



Post-Treatment After 1 wash

Note the remarkable difference in shine, frizziness and hair entanglement post-wash between the control sample and the OleoFlex™-treated hair tresses. The OleoFlex™ tresses also compare very favorably to Competitor A's silicone-treated hair tress.

CONCLUSIONS AND OTHER OBSERVATIONS

It's clear that OleoFlex™ FG-100 has a strong, functional effect in extending the benefits of natural oil in hair care protection and repair, as there is a demonstrable difference between the control samples and the ones treated with the OleoFlex.

What's more, the OleoFlex system is very comparable in performance with silicone-based repair systems, and in some ways even exceeding them, which is an exciting development for hair care formulations that emphasize natural oil components.

CONCLUSIONS

OleoFlex™ FG-100 dramatically enhances and extends the benefits of natural oils in hair care formulations.

OleoFlex™ FG-100 smoothes and restores the damaged hair cuticles back to a healthy state with strong shine.

It also protects and reduces hair damage from shampooing, combing, and styling.

OleoFlex™ FG -00 is a very capable replacement for silicone-free formulations, as it can either match or outperform silicone-based repair formulas with the added benefit of increasing natural content.

FORMULATION GUIDELINES

The standard usage rate for OleoFlex™ FG-100 is between 1 to 10%, depending on the intended application.

The type of non-volatile oil used in the system is the most significant determining factor in the overall efficacy of the hair repair effect.

The usage of volatiles (whether it's an oil-type or simply water) is also important because it helps in the delivery and penetration into lifted cuticles.

Intensive treatment type formulations should consider using a combination of FG-100 and the EG-200 products in order to maximize the bonding effect on the hair. Incorporating a larger percentage of non-volatiles also helps in this regard.

For light, daily treatment formulations, just the FG-100 will be sufficient. The overall dosage of non-volatiles should also be decreased, while supplemented with light oils.

OleoFlex™ FG-100 is also very effective and works well in combination with other hair treatment actives like quaternium compounds, cationic polymers, amino acids, and proteins.

APPLICATIONS

- Intensive hair repair products (either anhydrous or emulsions) applied after hair chemical treatments. This can include products that focus on hair and shine restoration, curl definition, anti-frizz, friction reduction, and detangling.
- Hair protection and restoration from combing damage, over-styling, and shampoo exposure.
- FG-100 and natural oil combinations in chemical treatment products (perm, straightening, coloring, etc) can help restore smoothness and shine without interfering with intended functionality.
- Hair conditioner - boosts softness and smoothness, while greatly increasing ease-of-combing.
- Hair styling - increases moisturization and water retention while creating a more sleek sensory.

STARTER FORMULATIONS

ENHANCED ARGAN OIL HAIR REPAIR SERUM

#	INCI Name, (Trade Name)	A	B
1	Isododecane	79%	79%
2	Argan oil	7.5%	5%
3	OleoFlex™ FG100	7.5%	15%
4	OleoFlex™ EG200	5.0%	-
5	Polyglyceryl-3 Oleate	1.0%	1.0%

Features

A sprayable clear-yellow tinted low viscosity liquid

Procedures

1. Add all ingredients to a beaker.
2. If using EG 200, the batch must be heated to incorporate; FG 100 will incorporate into the batch at room temperature.
3. Mix with propeller at 300-500 RPMs, until homogeneous.

Formulation Concepts

- OleoFlex™ EG 200-containing formulations (Formulation A) provide deeper repairing and conditioning while FG100 (Formulation B) is ideal for daily applications.
- The non-volatile components are the most critical part. It forms a thin film across the hair as the Isododecane evaporates. The benefits and properties of this film can be controlled by selecting (a) a combination of OleoFlex™ EG 200 and FG 100 with different ratio, and (b) % of OleoFlex™ in the non-volatile oil. A quick way to judge its property – Mix the items 2 - 5 into a homogeneous solution, cool down to RT, and feel its physical film property with finger tips or spatula.
- Polyglyceryl-3 Oleate is present to reduce surface tension and promote even spreading in the presence of water on damp hair.

DEEP TREATMENT INTENSIVE HAIR REPAIR MASK

#	INCI Name, (Trade Name)	%
A/1	Water	77.05
2	Hydroxyethyl Cellulose (Natrosol 250 HHR)	0.5
3	Glycerin	3.0
4	EDTA	0.02
B/5	Behentrimonium Chloride (Genamin BTLF)	1.8
6	Cetearyl Alcohol	3.0
7	Cetyl Ester Wax	0.5
8	Ceteareth-20	0.8
C/9	OleoFlex™ FG 100	6.0
10	OleoFlex™ EG 200	2.0
11	Propylene Glycol Dibenzoate (Lexfeel Shine)	2.5
12	Argan Oil	0.5
13	Isododecane	2.0
D/14	Preservative, perfume	q.s.
15	Citric acid to pH 5	q.s.

Features

- Pale white, glossy cream emulsion.
- Brookfield Viscosity 5 rpm/SP #3 = 30700 cP
- pH = 5.0

Procedures

1. Mix Phase A to a clear solution.
2. Heat it to 70-75C, add Phase B to A one at a time, and mix until dissolved.
3. Mix Phase C in a separate beaker.
4. Add Phase C into A/B while mixing with a Silverson homogenizer at 3000 -4000 rpm, 70-75C.
5. Cool down to 40-50C; add the lost water, preservatives, perfume, and pH adjusters.

Formulation Concepts

- The complex is made of a blend of OleoFlex™ EG 200 and FG 100, Argan oil, and Propylene Glycol Dibenzoate (hair shining agent) to deliver the optimum benefits of cuticle smoothing, the highly touted natural nourishment of argan oil, and healthy shine.
- The volatile isododecane is a carrier to help the delivery and the spreading of this complex into the damaged hair.