Hair Mask, A Way to Improve Production Sustainability while Reaching the Same Performance and High Level of Hair Caring

HC_144

Elodie Cuq Arnaud[1*], Cécile Taillebois[1], Alicia Roso[1]
[1]Seppic Research and Innovation, 50 boulevard national, 92257 La Garenne Colombes, France
+33 (0)5 63 72 64 15, elodie.cuqarnaud@airliquide.com

Introduction

When thinking about formulation sustainability, ingredients naturality often takes center stage, as a focal point for communication with end consumers. However, hair care conditioner, associated with large production volume and hot processed formulas justifies paying attention to their environmental impact.

The aim of this work was to investigate the possibility of reaching a cold processable consistent hair mask base, using a combination of a liquid thickening-conditioning material and biobased ingredients.

The efficacy of the cold-processed formula was challenged *ex vivo* compared to classic hot-processed hair mask.

Materials & Methods

FORMULATION OF A HAIR CARE MASK WITH COLD PROCESS

To develop a hair care mask with expected characteristics (viscosity, stability and efficacy), biobased ingredients and a thickening liquid cationic polymer were used.

The liquid selected cationic polymer was an *Acrylamidopropyltrimonium Chloride / Acrylates Copolymer and Isohexadecane and Coceth-7* obtained by a zero waste inverse emulsion polymerization process without any additional solvent.

EFFICACY TESTS

❶ Wet and dry combing

Mechanical measurement after a single rinsed off application on double-bleached damaged caucasian tresses (EMIC DL-500 test equipment; Kosmoscience company) followed by 24h drying time at 55 ± 5% relative humidity and 22 ± 2 °C.

Evaluation of 3 groups of tresses:

Untreated tresses	5 tresses treated with 0.5mL/tresse of the cold-processed hair mask	5 tresses treated with 0.5mL/tresse of the hot-processed standard hair mask

The reduction of combing energy was calculated *versus* the untreated group (5 replicates; ANOVA & Dunnett's post-test analysis for comparison with untreated group; Student's t-test, bimodal & unpaired for formulations comparison; 95% confidence interval).

The combing force of the cold-processed formula was compared to a market reference *(hot-processed containing inter alia Cetearyl Alcohol, Stearamidopropyl Dimethylamine, Ceteareth-20, Hydroxypropyl Guar Hydroxypropyltrimonium Chloride, Polyquaternium-10)*.

❷ Hair wettability[1] and porosity

Evaluation using contact angle on 3 groups of tresses (Software ImageJ-1-47v). A drop of water was deposited on the hair surface and the angle was measured as well as its time of absorption:

5 untreated double-bleached tresses	Virgin hair tresses	5 double-bleached tresses treated with the cold-processed hair mask

After the leave on application of the products, the tresses were dried in a standardized environment at 55 ± 5 % relative humidity and 22 ± 2 °C, for 24 hours before **contact angle and time of absorption measurements** (5 replicates; ANOVA & Dunnett's post-test analysis for comparison with untreated group; 95% confidence interval).

❸ Hair surface observations[2]

SEM-FEG observations (Zeiss Supra55VP; triplicate) were done by Novitom company to investigate film-forming properties of the thickening-conditioning polymer on virgin brazilian hair (leave-on application).

The **observation** was made on 3 samples:

Hair treated with the cold-processed formula without the liquid conditioning polymer (placebo)	Hair treated with the cold-processed hair mask	Hair treated with the cold-processed hair mask after flat ironing (200°C) 3 times during 5s

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References: [1] Bouillon C, Wilkinson J (2008). *Hair structure, Function, and Physical Properties,* The Science of Hair Care, T&F Informa Health care, second edition, p47.

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Results & Discussions

FORMULATION OF A HAIR CARE MASK WITH COLD PROCESS

Cream-gel cold-processed conditioning mask is obtained by simply blending the oil phase with the liquid cationic polymer, and mixing for about 10 minutes the water phase with the oil phase.

Ingredients (INCI name)*	% w/w
• Aqua	• Up to 100%
• C15-19 Alkane	• 3.00%
• Acrylamidopropyltrimonium Chloride / Acrylates Copolymer and Isohexadecane and Coceth-7 *(Cationic liquid polymer)*	• 3.00% (1.2% A.M.)
• Glycerin	• 2.00%
• Argania Spinosa Kernel Oil	• 2.00%
• Antioxidant and preservative	• as required
• Caesalpinia Spinosa Gum	• 0.30%
• pH	• 4-5

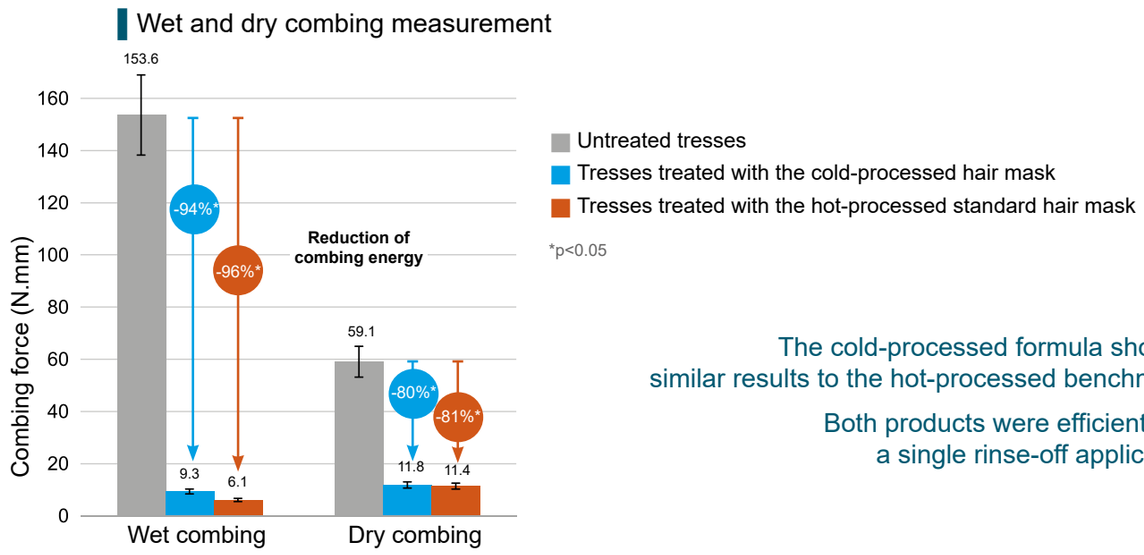
Appearance: Compact, white, shiny
Stability: Stable after 3 months at RT
Viscosity: ~170 000 mPa.s

*__96.6% of natural origin ingredients__ according to ISO 16128 and calculated __biodegradability of 98.3%__ (Internal calculation based on the amount of water or readily biodegradable ingredients present in the product; data provided from OECD 301 tests, QSAR calculations, products SDS and literature).

The cold processed mask with the liquid cationic polymer exhibits high viscosity and good stability

EFFICACY TESTS

❶ Wet and dry combing



The cold-processed formula showed similar results to the hot-processed benchmark.

Both products were efficient with a single rinse-off application

❷ Hair wettability and porosity

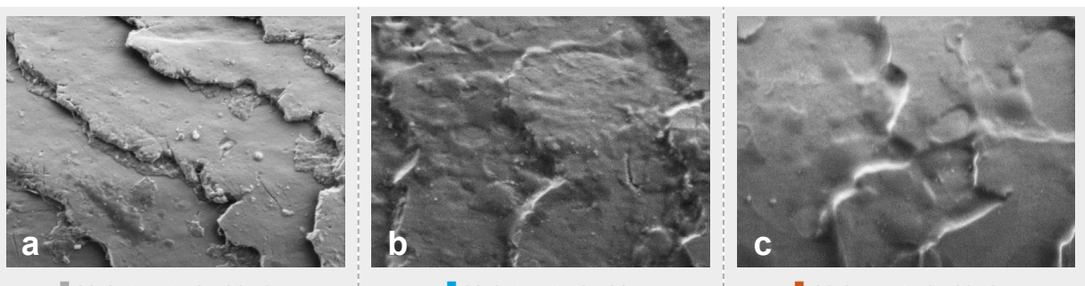
Contact angle: 75.3°
Absorption time: 6.8s

Contact angle: 88.5°
Absorption time: 17.6s

Significant increase in the time of absorption and contact angle value (+18%) *versus* the untreated bleached tresses.

➔A single leave-on application of the mask helped to partly restore the typical hydrophobicity of healthy hair

❸ Hair surface observations



Hair treated with the cold-processed placebo (without the liquid conditioning polymer)

Hair treated with the cold-processed hair mask

Hair treated with the cold-processed hair mask after flat ironing (200°C) 3 times during 5s

Visualisation of the film formed by the conditioning liquid polymer on picture b and c *versus* a.

The film is still present after the straightening process, and is not impacted by the heating procedure (picture c)

Conclusion

This study demonstrated the interest of the tested liquid thickening-conditioning polymer to design efficient and simplified high consistency cold-processed hair masks.

Stable formulas were developed with high viscosity and good stability.

Significant effects on different types of hair have been demonstrated after a single application, rinsed or left on the hair.

These results confirmed the interest in working with a liquid cationic polymer to obtain efficient cold-processed formulas, with a high percentage of naturality and biodegradability, and improving manufacturing process sustainability.