



**HOC**  
FOMBLIN® HC  
*Classic*



Solvay  
Solexis



# The first

## The first "organic fluorine" for cosmetics

Historically, perfluoropolyethers are the first fluorinated polymers proposed for cosmetics<sup>1</sup>, and still the most important.

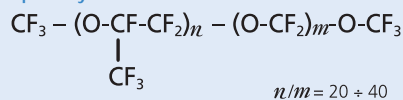
Fomblin® HC Classic perfluoropolyethers are odorless, colorless, non-greasy, transparent, liquid polymers. Their chemical structure was widely investigated<sup>2</sup>. The bridges of oxygen atoms and the high fluorine content (nearly 70%) allow apparently incompatible properties to be compatible.

Fomblin® HC Classic perfluoropolyethers are:

- Hydrophobic, lipophobic and homophobic (they repel themselves)
- Hydrophobic and vapor permeable

### Chemical structure, names and main registrations

#### A Proprietary Chemical Structure:



#### Trade Name:

Fomblin® HC (HC stands for "Health Care")

#### Range:

Fomblin® HC04 (MW = 1500): a silky feeling emollient  
Fomblin® HC/25 (MW = 3200): a more lubricious emollient  
Fomblin® HC/R (MW = 6250): a more persistent emollient

#### INCI Name:

Polyperfluoromethylisopropyl Ether  
(formerly Perfluoropolymethylisopropyl Ether)

#### IUPAC Name:

Trifluoromethyl-poly[oxy-2-trifluoromethyl-1,1,2-trifluoroethylene]-poly[oxy-difluoromethylene]-trifluoromethyl ether

#### Other Chemical Names:

Perfluoropolyether, or perfluorinated polyether, or polyoxyperfluoroalkane or poly (perfluoropropylene oxide - perfluoromethylene oxide)

#### Abbreviation:

PFPE

#### CAS Name:

1-Propene, 1,1,2,3,3,3-hexafluoro-, oxidized and polymerized

#### CAS Number:

69991-67-9

#### EINECS Number:

not applicable since HC/04, HC/25, HC/R are polymers

#### ENCS Name (Japan):

Perfluorocopolyalkylene(propylene and methylene)] polyether

#### ENCS Number:

(7)-2095 ENCS: Existing and New Chemical Substances)

#### CLS Name (Japan):

Perfluoropolyether

#### CLS Code Numbers:

42 (Standard Code), 523159 (Ingredient Code; CLS: Comprehensive Licensing Standard of Cosmetics by Category, 1994)

- Film forming, without clogging the pores of the skin
- Easily formulated in emulsions, in spite of their insolubility in all cosmetic materials.

Besides a safe toxicological profile, Fomblin® HC Classic perfluoropolyethers show remarkable cosmetic characteristics: absence of comedogenic activity, aesthetics, and the capability to impart a "velvet effect" to the finished products.

Other more general properties are:

- Excellent chemical and thermal stability and solvent resistance
- Biological inertness
- No flammability
- Low surface tension
- Low pour point
- High solubility of respiratory gases (oxygen, carbon dioxide).

# Performances

## Performances in formulation

Fomblin® HC Classic perfluoropolyethers perform as <sup>3,4</sup> :

- Skin protectants
- Film formers
- Skin feel improvers
- Moisture barriers
- Emollients
- Water and oil repellents
- Hair conditioners

depending on its content, on the grade chosen and on the characteristics of the preparation itself. Besides, Fomblin® HC Classic perfluoropolyethers work as technological auxiliaries and processing aids:

- Emulsion and dispersion stabilizers
- Lubricants
- Antiadhesives
- Wetting agents
- Binder and anticracking agents

Fomblin® HC Classic: typical properties (measures at 20°C)

Property	HC/04	HC/25	HC/R	Method
Molecular Weight	1500	3200	6250	PF 29/12
Viscosity (cSt)	40	250	1300	ASTM D445
Pour Point (°C)	-62	-35	-25	ASTM D97
Vapor Pressure (mmHg)	10 <sup>-3</sup>	10 <sup>-5</sup>	10 <sup>-7</sup>	PF 29/2
<b>Interfacial Tension vs Water</b>				
(dyne/cm)	55	55	55	ASTM D971
Surface Tension (dyne/cm)	21	22	24	ASTM D1331
Refractive Index	1.293	1.299	1.302	ASTM D1747
Density (g/ml)	1.87	1.90	1.92	ASTM D891
<b>Neutralization Number</b>				
(mgKOH/g)	0.01	0.01	0.01	PF 29/48
<b>Solubility:</b>				
• water, alcohols, glycols,	I	I	I	
• ketones, chlorinated solvents,	I	I	I	
• aromatic solvents,	I	I	I	
• mineral oil, alkyl esters,	I	I	I	
• triglycerides, silicone oils	I	I	I	
• fluorinated solvents	S	S	S	
Key: I = Insoluble (<10 ppm) S = Soluble (>5% w/w)				

NB: Typical property value should not be used as commercial specifications. For assistance and commercial specifications, please contact Solvay Solexis SpA/Personal Care Products.

# Protection

A protective agent

The results of clinical investigations on creams containing Fomblin® HC Classic perfluoropolyethers highlighted the potential of fluorine chemistry in the protection of the skin and paved the way for further developments (including chemically modified perfluoropolyethers). Fomblin® HC/R was widely investigated as the active ingredient of protective and barrier products<sup>5,6</sup>.

In a preliminary study<sup>7</sup>, 25 workers occupationally exposed to metal powders, paints, detergents and industrial oils, and having severe chronic irritant dermatitis of the hands, showed good resolution of symptoms over a 3 month period of applications.

In a second study<sup>8</sup>, regarding 22 female volunteers with chronic irritant dermatitis, marked solution of symptoms was monitored, after 40 days of applications, by clinical and instrumental evaluation.

In a third study<sup>9</sup>, 40 patients, suffering from chronic non-allergic dermatitis of the hands, were divided in two groups. Over 30 days, the regular use of a 4% Fomblin® HC/R cream caused complete resolution of symptoms in 16/20 patients, while the use of the base cream caused complete resolution of symptoms only in 3/20 patients.

Finally, another clinical study<sup>10</sup> demonstrated the protective effects of Fomblin® HC/R against facial irritation caused by medical treatments with vapors containing hydrogen sulfide (Tabiano thermal water).

## Application guide

Fomblin HC Classic	HC/04	HC/25	HC/R
<b>Facial Cosmetics</b>			
Lotions/milks	*	*	
Creams	*	*	*
<b>Hand and Body Care</b>			
Body care lotions	*		
Hand care lotions		*	
Barrier creams/pastes		*	*
Protective foams		*	*
<b>Cleansing Products</b>			
Lotions/milks	*	*	
Soap/syndet bars	*	*	
<b>Shaving Products</b>			
Preshave creams/lotions	*	*	
Shaving creams/gels	*	*	
<b>Hair Care</b>			
Shampoos	*		
Conditioners	*	*	
<b>Decorative Cosmetics</b>			
Emulsions	*	*	
Powders	*		



# Formulation

## Formulating with Fomblin® HC Classic

Fomblin® HC Classic perfluoropolyethers can be incorporated into almost any cosmetic technical form – only monophasic (aqueous or oily) systems are a challenge.

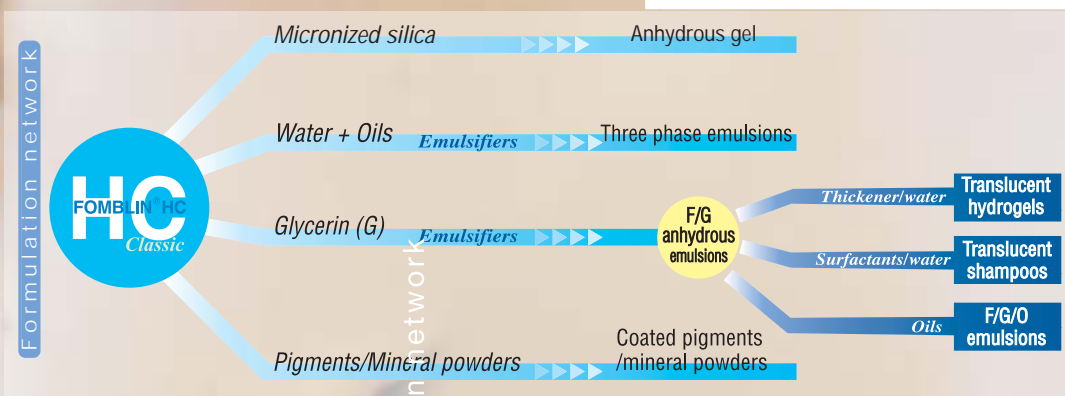
Besides insolubility, the main factors to be taken into account are the viscosity and the content of oils, fats, surfactants and powders.

In the case of emulsions, the use of Fomblin® HC Classic perfluoropolyethers does not have major implications in the processing techniques, provided that these ingredients are well dispersed by vigorous stirring either in the oily or in the aqueous phase before emulsification, and that the emulsion is continuously stirred, while being cooled down to room temperature. Being insoluble, Fomblin® HC Classic perfluoropolyethers build up a third phase that helps to stabilize the system. As a preliminary indication, we suggest to use a Fomblin® HC Classic perfluoropolyether at a concentration in the 0.05-3.0% range – at 0.05-0.1% to improve the stability and the general properties of an emulsion; at 0.2-1.0%, to obtain moisturizing effects; and at 1.0-3.0%, to have protective and barrier properties.

The discovery that Fomblin® HC Classic perfluoropolyethers form extremely fine and stable dispersions in glycerin<sup>11,12,13</sup> represents a major step in simplifying their incorporation into

creams and lotions; in obtaining more stable monophasic translucent gels and shampoos; and in the preparation of multiple emulsions. Highly stable emulsions are obtained by addition of Fomblin® HC Classic

perfluoropolyethers to concentrated glycerin (or other polyols) containing a small quantity of an emulsifier. While vigorous mixing is necessary to reduce the particle size of the dispersed phase, it is sufficient to operate at room temperature and with low concentrations of an emulsifier (0.1-0.5%), preferably an ionic emulsifier.



## TOXICOLOGICAL AND ECOTOXICOLOGICAL TESTS

Test	Grade	Institute	Year	Dose	Results
Acute oral toxicity, rats	HC/25	RBM	1989	15g/kg	LD <sub>50</sub> >15g/kg
Acute intraperitoneal toxicity, rats	HC/25	HRC	1989	5g/kg	LD <sub>50</sub> >5g/kg
Acute dermal toxicity, rats	HC/25	RBM	1989	5g/kg	LD <sub>50</sub> >5g/kg
28 day oral toxicity, rats	HC/25	HRC/IGD	1990	1g/kg/day	No effects
Primary dermal irritation, rabbits	HC/25	RBM	1989	0.5 ml	Non-irritating
14 day repeated dose dermal irritation, rabbits	HC/25	RBM	1990	0.5ml/site/day	No effects
Acute eye irritation, rabbits	HC/25	RBM	1989	0,1 ml	Non-irritating
Delayed contact hypersensitivity, Guinea pigs	HC/04	LSR	1988	-	Non-sensitizing
Delayed contact hypersensitivity, Guinea pigs	HC/25	LSR	1988	-	Non-sensitizing
Delayed contact hypersensitivity, Guinea pigs	HC/R	LSR	1988	-	Non-sensitizing
Contact photosensitivity, Guinea pigs	HC/25	LSR	1989	-	Non-sensitizing
Contact photosensitivity, Guinea pigs	HC/R	LSR	1989	-	Non-sensitizing
Human repeated insult patch test	Y25*	IRI	1983	-	Non-sensitizing
Irritation and sensitization, in humans	HC/25	JHRI	1988	-	Non-irritating Non-sensitizing
Comedogenicity, in rabbit ear, (one dose/day for 2 weeks)	HC/25	RBM	1990	1ml/site	Non-comedogenic
Bacterial mutation assay (Ames test)	HC/25	HRC	1990	5,000 µg/plate	Negative
Acute toxicity, in trouts	HC/04	IRI	1994	Saturated water	No effects
Acute toxicity, in daphnia	HC/04	IRI	1994	Saturated water	No effects
Cell reproduction inhibition to <i>Pseudomonas putida</i>	HC/04	IRI	1994	Saturated water	No effects

### Key:

- RBM Istituto di Ricerche Biomediche "Antoine Marxer" RBM SpA, Italy
- HRC Huntingdon Research Center Ltd, England
- IGD Istituto Guido Donegani, Italy
- LSR Life Science Research Ltd, England
- IRI Inveresk Research International, Scotland
- JNRI Japanese Hair Research Institute, Japan

(\*) Y25 is a technical grade

Perfluoropolyethers have been produced for more than 30 years with no adverse effects reported in workers at the production plant.

To support the widespread use of Fomblin® HC Classic perfluoropolyethers in barrier creams and other cosmetic products, a program of safety testing was developed. This was designed to permit adequate safety evaluation of new chemical entities. Fomblin® HC/25 was selected for testing, being the grade with the highest versatility, due to a medium molecular weight (MW: 3200). A special attention was given to the detection of any sensitizing or photosensitizing potential activity. Considering that any biological activity could be expected to increase with decreasing molecular weight, additional toxicological tests were carried out on Fomblin® HC/01, a much lower molecular weight perfluoropolyether (MW 650) - technical documentation is available.

All informative material on the toxicity tests have been reviewed and published<sup>14,15,16</sup>.

Ecotoxicity tests were carried out on Fomblin HC/04, being the lowest molecular weight of the HC Classic range. According to the German Water Hazard Scheme set up in 1976 by the Commission for the Evaluation of the Water Endangering Substance (KBWS), Fomblin® HC perfluoropolyethers can be classified as "low hazard to waters", similarly to very common cosmetic ingredients, such as glycerin.

## Non-animal origin

The raw materials used in the production of perfluoropolyethers are a mineral (fluorspar) and methane.



# Bibliography

1. Bader S., Brunetta F., Pantini G., "Perfluoropolyethers: a new class of products for cosmetic applications", 14th IFSCC Congress, Barcelona, September 16-19, 1986
2. Pianca M., Del Fanti N., Barchiesi E., Marchionni G., "Characterization of Perfluoropolyethers", Chemistry today, 13, 29-46, January/February 1995
3. Pantini G., Sekine S., "Perfluorinated polyethers: a new class of compounds for cosmetic applications" (Japanese), Fragrance Journal, 124-129, April 1989
4. Rigano L., Savonelli S., Bencini P.L., "Use and properties of perfluoropoly-methylisopropyl ethers in skin and hair cleaning: system stabilization and interference with sebum redistribution on skin and hair", Int. J. cosmet. Sci., 11, 259-282, 1989
5. Pantini G., Bencini P.L., "Striving for the perfect barrier cream" Drug Cosmet. Ind., 29-32, January 1989
6. Pantini G., Ingoglia R., Sekine S., Kurata Y., "Perfluoropolyethers: a class of perfluorinated liquid polymers for the prevention and treatment of irritant dermatitis" (Japanese), Fragrance Journal, 88-92, July 1996
7. Pantini G., Forestieri R., Brunetta F., Bencini P.L., "Treatment of irritant contact dermatitis in workmen with perfluoropolymethylisopropyl ether", Int. J. cosmet. Sci., 273-279, December 1990
8. Bencini P.L., Lodi A., Chiarelli G., Crosti C., Pantini G., "Creams for treatment of chronic irritant dermatitis", Drug Cosmet. Ind., 28-32 February 1990
9. Crosti C., Bencini P.L., Brunetta F., Pantini G., "Perfluoropolyethers (Fomblin HC) for treatment of chronic irritating dermatitis of the hand: a controlled study" SOFW Journal, 16, 1020-1023, 1992
10. Pasquariello G., Bencini P.L., Pantini G., "The protective effect of a perfluoropolyether against skin irritation caused by aqueous vapours containing hydrogen sulphide", Hospital Management, 14-17, February 1992
11. Brunetta F., Pantini G., "Multiple emulsions comprising a perfluoropolyether (Fomblin HC)", SOFW Journal, 11, 1993
12. Pantini G., Brunetta F., Guidolin V., "Perfluoropolyethers (Fomblin HC): status and new developments", Cosmet. Toiletries, 71-80, October 1991
13. Brunetta F., Guidolin V., Pantini G., "Emulsioni anidre di perfluoropolieteri" (Italian), Cosmet. Toiletries, 19-27, March-April 1992
14. Malinverno G., Pantini G., Bootman J., "Safety evaluation of perfluoropolyethers, liquid polymers used in barrier creams and other skin care products", Food and chemical Toxicology, 34, 639-650, 1996
15. Malinverno G., Ingoglia R., Pantini G., Paglialonga S., "Profilo tossicologico dei perfluoropolieteri" Cosmet. Toiletries Ed. It., n. 1/98, 39-51, 1998
16. Malinverno G., Ingoglia R., Pantini G., Paglialonga S., "Polyperfluoromethylisopropyl Ether" Cosmet. Toiletries, 53-62, January 1999

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FOMBLIN<sup>®</sup> HC

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